15th International Conference on Environmental Science and Technology

Proceedings

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UNIVERSITY OF THE AEGEAN

Volume of Abstracts

31st August - 2nd September 2017
Rhodes, Greece

Editor: D. F. Lekkas

UNIVERSITY OF THE AEGEAN

15th INTERNATIONAL CONFERENCE

ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY

CEST2017

VOLUME OF ABSTRACTS

EDITOR: D.F. LEKKAS

RHODES, GREECE
31 AUGUST – 2 SEPTEMBER 2017

Global Network for Environmental Science and Technology
(Global-NEST)
University of the Aegean

Proceedings of the International Conference on Environmental Science and Technology

ISSN 1106-5516

Proceedings of the 15th International Conference on Environmental Science and Technology
31 August – 2 September 2017, Athens, Greece

ISBN 978-960-7475-53-4

Editor: D.F. Lekkas

Editing co-ordinator: Eleftheria Klontza
Editing: Kalliopi Vrentzou
Films – Montage - Printing: Diagramma

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PART A - ORAL PRESENTATIONS

SESSION 1 – OPENING

Thursday 31 August 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Enabling science to deliver change[1]

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Abstract

Delivering change through science to address the many environmental problems we face, cannot happen in a vacuum and without public support. However, we live in an age when it seems that citizens increasingly question experts' advice and reject science as an authoritative source of knowledge. But is this a disbelief in science or is it an erosion of trust in 'experts' and to how science is applied? Considering the complexity of environmental problems, there appears to be a pressing need for people to not simply accept solutions, but to understand such problems and even get involved in defining them. Recent calls for the traditional neutral, disinterested and objective expert to evolve into a good communicator have delivered short lived benefits and contributed to the decline of public trust in the infallibility and neutrality of scientific expertise. Instead, *epistemic trustworthiness* -the integration of expertise, integrity and benevolence- is what inspires public trust more. People want explanations before accepting decisions. They need to be involved and engaged, and this process must be fair, inclusive and transparent, taking place through fruitful public debate. The drive to a society which is more scientifically literate, aware of the many interdependencies that define the problems we face, and able to cope with the strengths and limitations of the available science, might be a real prerequisite to enabling science to deliver change.

Keywords: Climate change, science, public-policy, public engagement

Paper ID: CEST2017_01007

[1] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

New Impacts on Drinking Water and Non-Target Identification of New Disinfection By-Products[2]

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Abstract

Drinking water around the world is experiencing increased impacts from anthropogenic activities. These include impacts of treated wastewater, where potentially hazardous contaminants are not completely removed and enter our source waters; impacts of droughts where natural bromide and iodide, as well as wastewater contaminants are concentrated in our rivers; and new impacts of energy extraction, where hydraulic fracturing activities are introducing fracking chemicals and natural brines into our source waters. Besides the parent chemical contaminants that can enter drinking water, disinfection by-products (DBPs) can be formed from these contaminants. Moreover, it is often the case where non-hazardous chemicals become potentially hazardous once they react with disinfectants in drinking water treatment. This presentation will discuss the state-of-the-science regarding these impacts, as well as new non-target mass spectrometry approaches to identify these unknown DBPs and transformation products.

Paper ID: CEST2017_01434

[2] Invited speech

SESSION 2 – WATER AND WASTEWATER TREATMENT (1)

Thursday 31 August 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Leachate treatment using a novel sustainable fixed bed based method

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Abstract

Toxic and environmentally damaging leachate is a product of municipal solid waste disposal in landfill systems. Currently, 51% of landfill leachate (LFL) produced in Irish landfill sites is discharged directly into sewer mains with 48% being treated in increasingly overloaded regional wastewater treatment plants. These discharge and treatment options are inadequate, costly and pose risks for both public and environmental health. Unlike other EU countries onsite treatment of leachate in Ireland is uncommon (<1%), but could represent a viable and sustainable alternative to current practices. The current study has shown that low cost adsorption material, such as oyster shells and pumice, are capable of reducing the concentration of ammonia, phosphate and nitrate from these waste streams. In addition, microbial isolates from leachate have demonstrated the ability to reduce toxic compounds, such as ammonia and phosphate. This research aims to combine both, adsorption and bioremediation into single treatment process using fixed bed systems. This treatment should reduce LFL to within acceptable limits set by the EPA (Ireland) for the discharge of leachate into receiving bodies. This treatment option will also be low-cost and have the ability to be implemented onsite in Irish landfills.

Keywords: Landfill leachate, Novel Treatment, Wastewater, Bioremediation, Adsorption

Paper ID: CEST2017_00242

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Strategies for sustainable wastewater treatment based on energy recovery and emerging compounds control

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Abstract

Wastewater treatment contributes significantly to protect human health and ecological safety. With sustainable development of wastewater treatment, recovery of resources and energy from wastewater has been the focus for conventional contaminants, while removal and control of ecological toxicity is the focus for emerging compounds. Under anaerobic conditions, especially with enhancement of direct interspecies electron transfer, methanogenesis and/or nitrous oxide production could be achieved separately or simultaneously, and removal of some types of emerging compounds could be enhanced. During nitritation, both nitrogen and emerging compounds removal could be achieved simultaneously. Therefore, a new wastewater treatment concept based on recovery of energy and control of emerging compounds was proposed, including anaerobic treatment technology by incorporating directly electron transfer enhancement and nitritation-based nitrogen removal. The proposed strategy provided a new technology for advancing the sustainable development of wastewater treatment through recovery of energy and control of emerging compounds.

Keywords: Wastewater treatment; Energy recovery; Emerging compounds; Anaerobic treatment; Nitritation

Paper ID: CEST2017_00274

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Improving the removal of phosphate in secondary effluent of domestic wastewater treatment plant

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Abstract

World widely, the excess loads of phosphorus (P) is one of the most common chemical contamination in freshwater bodies (e.g. lakes, rivers). It is one of major causes of eutrophication. In the UK, 80% of 98 surveyed rivers were found to exceed the accepted standard of healthy rivers' P concentration, e.g. 0.1 mg/L. Effluents from wastewater treatment plant (WWTP) are considered to contribute up to 60–80% of the P in rivers due to discharge of treated effluents containing residual P concentrations of 1–2 mg/L. The discharge level of P from WWTPs in many countries is going to be strictly limited to 0.1 mg/L or even less due to the growing concern over eutrophication. Hence, the alternative technologies are sought to enhance the P removal efficiency from WWTPs. In this study, Ca and Mg incorporated layered double hydroxide (LDH) adsorbents were synthesized and assessed for phosphate removal from both P spiked synthetic solution and real effluent sample of WWTP. The results demonstrated that the effluent from WWTP's secondary treatment process with P concentration of 1.4–5.6 mg/L can be treated by both types of LDH to meet future stringent discharge limit at the level of 0.1 mg/L.

Keywords: Phosphate removal, Wastewater treatment plant, Layered double hydroxide, Adsorption

Paper ID: CEST2017_00328

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Dairy processing sludge feedstock-based biochars for the removal of phosphorus in discharge effluents

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Abstract

Globally, the removal of phosphorus (P) in discharge effluents from industrial wastewater treatment is crucial to comply with discharge limits and to control eutrophication. The traditional practice involves the use of costly chemical coagulants to achieve required effluent quality. An alternative option is to utilize selected biochars derived from the pyrolysis of different dairy processing sludge feedstocks to capture P by replacing chemical use and thereby creating a circular economy. Sludge samples used to create biochar were of two types: a) bio-chemically treated mixed sludge and b) lime treated De-Areated Fat (DAF) sludge. Herein, biochar was added to synthetic and dairy wastewater and the overall efficay of different biochars to remove P was determined along with biochar dosage, contact time, pH effect and P concentration levels. Results showed variable P removal across biochar type and composition. The biochars from mixed sludge showed 85−98% of P removal at dose between 10−50 g/L, whereas, those from DAF sludge removed >99% at 3 g/L. The P level was significantly reduced to <0.1 mg/L from dairy wastewater sample using DAF biochars. Water extractable P was found to be a factor that can be used to pre-screen biochar media for P attenuation capacity.

Keywords: Dairy processing sludge, Biochar, Phosphorus removal, Wastewater treatment

Paper ID: CEST2017_00360

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Degradation COD in sewage by active oxygen species

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Abstract

In conventional depth sewage treatment processes, COD concentration can only be decreased from 1064 mg/L ~ 1280 mg/L to 100 mg/L ~ 150 mg/L, which can not meet the requirement of COD concentration (≤50 mg/L) in the sewage reuse criterion. Therefore, the paper describes that active oxygen species (O_2^+, O_3) produced by strong ionization dielectric barrier discharge were injected into the sewage to quickly and non-selectively degrade COD into CO_2 and H_2O. The COD concentration after conventional depth sewage treatment can be degraded from 132 mg/L to 28.2 mg/L using active oxygen species within 3 min plasma reaction time. The COD concentration of 28.2 mg/L can meet the sewage reuse criterion. Compared with conventional sewage treatment methods, the present method has lower initial investment, operating costs, and simple processes.

Keywords: Degradation COD; Strong ionization discharge; Active oxygen species; ·OH radicals; COD concentration

Paper ID: CEST2017_01311

SESSION 3 – EMERGING POLLUTANTS (1)

Thursday 31 August 2017 - morning

Tackling micropollutants in the environment by benign design – an important building block of sustainable chemistry and the protection of water resources

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Abstract

Protection of water resources is sustainable development goal #6 of the United Nations. Several thousand chemicals including biocides, pharmaceuticals, personal care products, pesticides, surfactants and others as well as micro plastics are introduced into the aquatic environment - most of them as an unwanted side effect of proper use. (Advanced) effluent treatment can remove some to some extend from effluents. In case of heavy rain events most of the wastewater circumvents treatment plants and is directly introduced into the aquatic environment. Increasingly leaking of wastewater into ground water is observed due to damaged piping. In many countries proper effluent treatment is not available. Compounds present in effluents or in the aquatic environment are often not completely mineralized by biological, oxidative or reductive treatment or by natural processes. Instead often unwanted products of incomplete mineralization and undetermined chemical structure, fate, and toxicity are generated. Such transformation products may be even more toxic than their respective parent compounds. Research has demonstrated the presence of these micropollutants in the aquatic environment all over the world. Furthermore, testing and risk assessment is becoming more and more complex, expensive, and time consuming.
Therefore, molecules of the future that can end up in the environment at the end of their life have to be designed for rapid and complete mineralization after their introduction into the environment whilst keeping the properties and functionality needed for their application. Integrating methods and tools from the fields of environmental chemistry, environmental microbiology, analytical chemistry, computational chemistry, and sustainable chemistry allows for this. It will fundamentally contribute to the solution of one of mankind's most pressuring problems worldwide by reducing the introduction of organic water pollutants into the aquatic system and will contribute extensively to the SDGs. The conceptual approach as well as some successful examples will be presented.

Paper ID: CEST2017_01435

[3] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Identification of micropollutants in sewage treatment facilities discharges by using suspect screening strategies based on regulatory databases

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Abstract

Discharges from sewage treatment facilities are a major pathway of organic micropollutants to the aquatic environment. However, the existing target analysis methodologies only allow the detection of a very small fraction of the substances present in wastewater samples. The application of suspect screening, with a suspected screening list based on prior information but with no reference standards, greatly increases the list of substances that can be identified. In the present study a suspect list was built based on the hypothesis that regulatory databases can assist in the prioritization of potentially relevant substances. Therefore, we used the Swedish Chemical Agency database to prioritize substances present in wastewater effluents and surface water by using different criteria including (i) the occurrence on the market, (ii) the consumed tonnage, and (iii) the use pattern. The final list contained ~200 organic micropollutants (with a high ratio of industrial chemicals) and was used to identify the prioritized substances in wastewater.

Keywords: Micropollutants, Suspect screening, Regulatory databases.

Paper ID: CEST2017_00218

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters

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Abstract

Various workflows have been published for the workout of datasets for the Non-Target screening of water samples for TOrCs. The main aim is to provide a better and more complete view of the organic content in different water bodies, as well as identify new compounds of interest.This study was realized by analyzing river water samples with the established RPLC-HILIC-ToF/MS system and by using the STOFF-IDENT compound database. Its main aim is to demonstrate and discuss an efficient strategy for the non-target screening of aqueous environments, as a mean to facilitate the process of identification of very polar compounds. The samples were prepared using polarity extended SPE and analysed by the established RPLC-HILIC-ToF/MS system. The analysis data were then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine polar compounds, of which six have not been reported previously in water surface samples.

Keywords: Polar TOrCs, HILIC, RPLC-HILIC-ToF.MS, Non-Target Screening, STOFF-IDENT

Paper ID: CEST2017_00473

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of saxitoxins in spirulina supplements and cyanobacterial mass using SPE and HILIC-LC-MS/MS.

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Abstract

Cyanobacteria (green-blue algae) can release hazardous secondary metabolites, called cyanotoxins, with a variety of chemical structures and modes of toxicity. Among them, saxitoxins are neurotoxins, mostly known for causing food poisoning when eating shellfish seafood. Saxitoxin analysis from shellfish has been thoroughly investigated. However, analysis of saxitoxins from spirulina supplements, derived from blue-green algae, is understudied, despite the fact that spirulina is used as part of the human diet and could lead to an increased risk for the consumer due to contamination from cyanotoxins. In this study, an analytical method has been developed using Liquid Chromatography tandem Mass Spectrometry (LC-MS/MS) for the analysis of saxitoxins from spirulina supplements and cyanobacterial mass. Target saxitoxins were Saxitoxin, decarbamoylsaxitoxin, Neosaxitoxin, Gonyautoxin 2&3, decarbamoylgonyautoxin 2&3. Separation was achieved using a HILIC chromatographic column with a gradient elution program of acetonitrile and water, both containing ammonium formate 2mM and formic acid 3.6mM. Identification was achieved using MS/MS in positive ESI mode. Extraction of saxitoxins was achieved with acetic acid in acetonitrile/water 50:50 with recoveries 30-40% due to matrix suppression. Solid Phase Extraction (SPE) with different cartridges (C18, Carbon Graphitized) did not improve the obtained recoveries. Nevertheless, column clogging was decreased, as column pressure remained in a steady value. Limits of detection (LODs) were 0.14-0.23μg g^{-1} (dry weight) and mean relative standard deviation (%RSD) was 15-20%.

Keywords: Saxitoxins, Spirulina, Extraction, SPE, HILIC-MS/MS

Paper ID: CEST2017_00534

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of multi-class cyanotoxins in fish tissue. Application to fish from Greek lakes

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Abstract

The analysis of cyanotoxins in aquatic organisms, particularly in fish tissue, has lately received increasing interest, due to public health and environmental concerns. This study presents novel, efficient and sensitive analytical methods for the simultaneous determination of multi-class cyanotoxins i.e Cylindrospermopsin (CYN), Anatoxin-a (ANA-a) and 12 Microcystins (MCs), in freshwater fish. Prior to LC-MS/MS analysis, several combinations of extraction solvents at different pH were tested, for the efficient extraction of selected cyanotoxins from fish tissue (muscle and liver). Various treatment techniques were employed in order to release the fraction of MCs that is conjugated to proteins. Protein precipitation and hexane washing of lipids were also tested along with different SPE materials, in order to further eliminate matrix interferences. Evaluation of LC-DAD and LC-MS/MS chromatograms, using identical chromatographic conditions, revealed the co-elution of several matrix components with the targeted compounds, which induced increased matrix suppression, decreased sensitivity and overall efficiency of the method. Optimized pretreatment procedures are proposed, presenting drastic elimination of matrix effects and optimum extraction and recovery for each cyanotoxin group. The developed analytical methods were validated and subsequently used for the evaluation of the diversity, abundance and accumulation of cyanotoxins in fish samples from various Greek lakes.

Keywords: cyanotoxins, LC-MS/MS, fish tissues, matrix effect

Paper ID: CEST2017_00547

SESSION 4 – ENERGY TECHNOLOGIES AND SUSTAINABILITY (1)

Thursday 31 August 2017 – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Determination of biodiesel properties from residual feedstock

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Abstract

The current work examined how biodiesel produced by frying oils affects the physicochemical properties of its mixtures with conventional diesel heating oil. Through the characterization of biodiesel blends and heating oil, the purpose is to promote the optimum mixture; the one that will continue to meet the requirements of the existing legislation for heating oil, while positively contributes in reducing the production of pollutants. The percentage of biodiesel added to a conventional diesel fuel helps to reduce pollutants produced during combustion. The examined biodiesel is considered the corrupted product that produced at a factory in Cyprus, which is deemed unsuitable for export, because it does not meet the legal requirements. Using specific volumes of these mixtures, cetane index after distillation, oxidation stability, and cold filter plugging point, were determined in order to investigate the effect of the mixtures. Taking everything into consideration, an efficient potential utilization of a residual domestic product is proposed. Furthermore, the pollutants that accumulate on the urban atmospheres during the winter months, due to increased heating needs of homes and other public or private buildings, will be significantly reduced.

Keywords: biodiesel; heating oil; blends; legal requirements; pollutants

Paper ID: CEST2017_00552

Synthesis of Mesoporous Silica-Alumina from Lapindo Mud Using Gelatin from Catfish Bone as a Template: Effect of Extracting Temperature on Yield and Characteristic of Gelatin as well as Mesoporous Silica-Alumina

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Abstract

Mesoporous silica-alumina was synthesized from silica and alumina extracted from Lapindo mud with gelatin from catfish bone as a template. The bone was refluxed in demineralized water at 60, 70, 80 and 90 ℃ to extract the gelatin. Gelatin was analyzed by FTIR and SDS-PAGE. The alumina was separated from the mud by reflux method using HCl solution and the silica was separated form mud by reflux method using NaOH solution. The purity of silica and alumina were determined by XRF. The mesoporous silica-alumina was synthesized using SiO_2 and Al_2O_3 from Lapindo mud and the catfish gelatin as a template under hydrothermal method at 100 ℃ for 24 h and calcined at 500 ℃ for 5 h and characterized by TEM and N_2 adsorption-desorption. The yield of extracted gelatin at 60, 70, 80 and 90 ℃ was 4.79%, 6.09%, 8.13% and 12.24.%, respectively. The purity of silica and alumina extracted from Lapindo mud were 100% and 89.69%. The synthesized silica-alumina showed mesoporous characters and had pore diameter of 105.14 Å, pore volume of 0.1974 cc/g and BET surface area of 75.105 m^2/g.

Keywords: Gelatin, Catfish bone, Mesoporous silica-alumina, Lapindo mud

Paper ID: CEST2017_00741

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation of burning and reutilization parameters of different crop production by-products

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Abstract

Nowadays covering the permanently increasing energy demand is a serious challenge of the energy management. In the Central and Eastern European Region it is necessary to integrate energy sources into practical applications that do not need the reorganisation the infrastructural systems. In our work, the determination and assessment of the Higher Heating Value (HHV) released from burning some secondary products of crop and bioenergy production were done. Analytical examination of the ash remained after the burning of three by-products (bagasse, oil cakes, fermented sludge of biogas production) of biomass energy production were done in order to reveal its agricultural utilization possibilities regarding its nutrient content. Significant differences were found in the HHV of the investigated by-products of crop production. The least significant difference (p=0.05) of the calorimetric heats among the by-products of crop production was 86.51 KJ kg^{-1}, while 120.80 KJ kg^{-1} was among the by-products of bioenergy production. In the case of the nutrient contents significant differences (p=0.05) were found. According to the high nutrient contents found in the ash remained after the burning of the by-products of bioenergy production it can be suitable to increase the nutrient stocks of the soil.

Keywords: bioenergy, higher heating value, crop production, byproduct, ash

Paper ID: CEST2017_00529

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A Current-Voltage Model for Hydrogen Production by Electrolysis of Steam Using Solid Oxide Electrolysis Cell (SOEC)

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Abstract

A current-voltage model for solid oxide electrolysis cell (SOEC) was developed and validated. The cell voltage and overpotentials were simulated and compared to an existing model and a published experimental data. A good agreement was obtained between current model, the existing model and that of the experimental data with respect to cell voltage, cell overpotentials and individual overpotentials. Analysis on the current model generated values revealed a significant 71.37% contribution of ohmic overpotential to the cell overpotential over the combined electrode (concentration and activation) overpotentials of 28.65%. This means that the influence of the electrolyte in the cell overpotential is 2.5 times greater than the influence of the electrodes, as predicted by the current model, implying that the structure and characteristics of the electrolyte in solid oxide electrolysis cells (SOECs) has direct bearing on hydrogen generation. At 1273 K, the limiting density of the cathode was predicted by the current model at 100,000 Am^{-2} which was verified and supported by Ni et al. and the experimental data of Momma et al. The current model in general was found to be consistent in predicting parametric values for high temperature steam electrolysis using solid oxide electrolysis cells (SOECs).

Keywords: hydrogen production, water electrolysis, HTE, solid oxide electrolysis cell, SOEC model

Paper ID: CEST2017_00491

LCA of alternative biochar production technologies

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Abstract

This paper investigates the environmental performance of biochar produced using different technologies including: traditional earth kiln; metal ring kiln, Missouri kiln and Missouri with gas recycling. The analysis has been produced using Life Cycle Analysis (LCA) and includes extensive inventory of direct gas emissions during the carbonization stage. The normalized analysis evidence that the impact categories most severely affected are photochemical oxidant formation, human toxicity and climate change. In the case of climate change, impact values ranged between 2773 and 4714 kg CO_2/ton, with lower emissions produced by advanced carbonization technologies due to higher product yields, improved thermal efficiency (which results in reduced combustion of primary products) and elimination of volatile pollutants in the gas condenser and post-combustor. Single point indicator analysis evidences a 33-40 % reduction in environmental impact when using advanced processing methods compared to traditional charcoal production.

Keywords: Biochar, pyrolysis, biomass, LCA

Paper ID: CEST2017_00937

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of the conventional wind farms on environment

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Abstract

Regarding high demand of energy, lack of traditional energy resources and also pollution associated with fossil fuels, there is a significant tendency toward renewable energies like wind and solar energy. Wind energy has shown the benefits as relatively low cost and simple required technology. But the belief that wind energy has no weak points is completely wrong. This renewable energy may badly affect environment and ecosystem and also human's life. There are some problems when using wind turbines to harvest this kind of energy. Among them death of wildlife, producing some bothering mechanical and aerodynamical noises and also visual impacts are the most commons. In this paper the environmental impacts of the conventional wind turbines and related farms are studied and aggregated. The results indicate that there should be an attempt toward modifying the traditional wind farms and also to generate new wind technologies in which these problems are considered to be solved.

Keywords: Environment, Energy, Wind.

Paper ID: CEST2017_00653

SESSION 5 – ECOLOGY AND ECOSYSTEM MANAGEMENT (1)

Thursday 31 August 2017 – morning

Precision conservation of *Olea europaea* with thermal imaging techniques

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Abstract

Olive tree (*Olea europea*) groves are not only typical Mediterranean ecosystems but also traditional agricultural systems supporting a significant range of ecosystem services. Over the last decades, olive tree conservation has become a priority for EU agro-environmental policy, focusing on agricultural landscape, olive-oil quality and local agro-economics. Precision agriculture, i.e. a set of analysis techniques combining multi-sensor systems, is used mainly in increasing productivity, though it can sufficiently support conservation strategies, resulting in a new research field called precision conservation. In this research, ground thermal imaging was used to study the olive trees' health and productivity. Approximately 70 trees were selected and photographed in two different field areas on Lesvos Island, Greece. Environmental parameters, cultivation practices, structural characteristics and productivity of these trees were recorded. The infrared-thermal (IRT) images of each tree were analyzed, and linear regression analysis was performed to detect key variables of the dataset. Results showed that both healthy and under stress olive trees could be detected through thermal imaging, a technique that facilitates conservation practices concerning olive groves. Significant correlation between productivity and thermography was partially detected. For better productivity estimation, future research will focus on analytical production traceability and temporal cultivation practices.

Keywords: ground remote sensing, olive tree, environmental stress, agricultural production

Paper ID: CEST2017_00902

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Trend analysis of different vegetation cover types using FPAR and Surface Reflectance: A case study of Western Ghats, India

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Abstract

Use of remote sensing data is an obligatory alternative to study biodiversity loss in this fast changing world. The Moderate Resolution Imaging Spectroradiometer (MODIS) instrument (Terra) time series data (2000 to 2015) for surface reflectance and fraction of photosynthetically active radiation (FPAR) were acquired in this study, considering the diverse landscape of Western Ghats, India as the study site. The spatial pattern of surface reflectance and FPAR was observed to be varying inversely. The Mann-Kendall trend analysis (2000-2015) was performed separately for surface reflectance and FPAR on 24 different vegetation types. Based on Sen's slope the trend was evaluated as positive and negative. In case of FPAR the positive trends observed for artificial managed vegetation while natural vegetation types were depleting along the period 2000-2015, except for *Acacia sp.*, and the remaining vegetation types shown negative trends for surface reflectance. Overall, the threat to naturally occurring vegetation types marked significantly with negative trend compared to manage vegetation types having some economic values. Although, managed systems were also found sensitive to changing climate and are under significant risk. The study suggested exploring this concept with more intense data and field observations to reduce the risk to plant diversity.

Keywords: FPAR, remote sensing, spatial pattern, time series, Western Ghats

Paper ID: CEST2017_00968

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biomarkers and kits for early and rapid testing – current knowledge and gaps

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Abstract

The use and development of biomarkers is related to the establishment of hidden toxic effect on molecular, sub-cellular, cellular and tissue level. The development of new biomarkers is very important for successful early diagnosis of toxic effects on the macro-biological systems. The effects on these levels often come from complex impact and are hard to spot until the onset of extinction of the population or degradation of the community. Developing of a novel biomarker is time consuming and in most cases very expensive, but very perspective issue. The other contemporary tool for rapid assessment of toxicity is the biomarker assay kits. They are very often used due to their ease of operation and representativeness of obtained results. The discussed information about early and rapid ecotoxicological testing was obtained by Review Publication screener software using published developments for recent five years. The frequency and characteristics of biomarkers and kits used in the recent studies are examined and statistically processed. The main advantages, disadvantages and trends in developments are outlined.

Keywords: ecotoxicology, biomarker, kit, advantages, gaps

Paper ID: CEST2017_01195

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Silviculture treatments for reducing fire's potential severity in urban forests, N. Greece

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Abstract

Urban forest fires constitute a natural disaster presenting many particularities and specific difficulties. Such difficulties include the high number of people visiting urban forests as well as some specific forests characteristics which include the flammable species involved and the high levels of accumulated combustible biomass. The main purpose of the current research is to quantify the optimum combination of silvicultural treatments in order to efficiently reduce forest fire potential severity and contribute to their successful suppression by firefighting crews under field conditions. In order to simulate the basic fire environment of urban forests, two main experimental plots were established and several tree and topographical characteristics were estimated. Additionally, the NEXUS wildfire system was used to simulate forest fire potential behavior before and after the adoption of the silvicultural treatments that altered critical characteristics of the forest fire environment. The results clearly showed that specific silvicultural prescriptions altered the type of forest fire spreading potential, revealing the overall efficiency of preventing actions during forest management.

Keywords: urban forests, silvicultural treatments, NEXUS, simulation, fire

Paper ID: CEST2017_01317

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biodiversity monitoring tool in LafargeHolcim quarries: An application in Greece

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Abstract

While extraction of raw materials can have a significant impact on biodiversity, proper management of our quarries can reduce, reverse and even generate positive impacts for biodiversity. LafargeHolcim aims for a positive change in biodiversity by 2030, as part of its sustainable development strategy, the 2030 Plan. The Biodiversity Indicator and Reporting System (BIRS), developed by an independent panel of experts in collaboration with IUCN will be used to demonstrate a positive change by assessing the evolution of the condition of a site from year to year (i.e. taking size and quality of each habitat into account). This Indicators System does not measure the absolute value of biodiversity, but shows the relative changes over time. By 2020, LafargeHolcim has committed to assess the condition of its habitat for all its extraction sites using BIRS. That is, LafargeHolcim's approach encompasses its entire portfolio of extraction operations, both existing and new.
BIRS takes into account the area of every habitat type found on a site, the ecological condition of these habitats, including enhancements and threats and the uniqueness and ecological importance of each habitat in the regional context.
Lafarge Greece has 9 aggregate quarries and 9 cement quarries. The company has started the implementation of BIRS by identifying the different habitats present in the quarries (for example: forest, woodland and shrubland, bare rock). The assessment of the different habitats will be carried out within the next 2 years. Through the BIRS assessment, the operations will gain a better understanding of the conditions of its habitats, minimize their impacts, and also better manage their rehabilitation programs, and thus conserve and enhance local biodiversity.

Paper ID: CEST2017_01440

SESSION 6 – ENVIRONMENTAL ODOUR, MONITORING AND CONTROL (1)

Thursday 31 August 2017 – morning

Recent advances in biotechnologies for a cost-effective abatement and valorization of greenhouse gases: moving towards GHG biorefineries

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Abstract

CH_4 and N_2O emissions represent 20 % of the anthropogenic greenhouse gas (GHG) emissions, and their share is expected to increase in this 21st century based on the steady increase in human population. Based on the recent COP 21 Paris agreement to limit the increase in global average temperatures to 2 ºC above pre-industrial levels, the European Union has committed to reducing its GHG emissions by 40% by 2030 and 60% by 2040 (compared to 1990 levels). Apart from the current actions oriented to reduce CO_2 emissions from fossil fuel combustion, additional measurements such as an active CH_4 and N_2O abatement must be considered in order to achieve these target emission cuts. Despite the increasing environmental relevance of CH_4 and N_2O, minimum attention has been paid to date to these greenhouse gas emissions from a legislation and abatement viewpoint worldwide. This has limited the development of cost-efficient and environmentally friendly end-of-pipe treatment technologies. Physical/chemical treatment methods for CH_4 abatement such as incineration, and for pre-concentration like activated carbon adsorption, are either inefficient or costly at the low concentrations (1-5%) typically found in emissions from waste treatment activities, coal mining or animal farming. On the other hand, conventional NO_x treatment technologies such as selective catalytic reduction, selective non-catalytic reduction, adsorption or scrubbing present prohibitive operating costs (and large environmental impacts) when treating large volumes of air containing low concentrations of NO_x (as a result of their intensive use of energy and chemical). In this context, biotechnologies could become, if properly tailored, a low-cost and environmentally friendly treatment alternative to physical/chemical methods for the abatement of CH_4 and N_2O emissions. Biotechnologies, which are based on the biocatalytic action of specialized microorganisms, have been consistently proven as robust and efficient methods for the treatment of industrial volatile organic compounds (VOCs) and malodours, exhibiting lower operating costs and environmental impacts than their physical/chemical counterparts. These biological technologies are based on the biodegradation of these GHG pollutants by specific microbial communities, which transform them into less harmful products such as CO_2, N_2 or H_2O. Unfortunately, conventional bioreactors such as biofilters, biotrickling filters or bioscrubbers are limited by the mass transfer of these GHGs from the gas to the liquid phase as a result of their high henry law constant. Under optimal operating conditions, GHG-laden emissions can be also used by microorganisms as raw materials to synthesize high added value products such as biopolymers, exopolysaccharides, vitamins or ectoine. The valorization of these waste gases through their bioconversion into commodities with a high market value will turn their abatement into a sustainable and profitable process. This keynote will critically review the recent advances in high-mass transfer bioreactors applied to CH_4 and N_2O removal, and the potential biological valorization of these GHGs as added value products.

Paper ID: CEST2017_01437

[4] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effectiveness of polyethylene bottles as containers for 1-butanol odour intensity reference solutions

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Abstract

Odours discharged from various human activities may cause severe damage to residents. For appropriate evaluation of environmental odours, it is necessary to develop a reliable odour measurement scale. Odour intensity, a kind of main sensory odour characterization parameters, reflects people's perception of odours and contributes to effective odour management. In the past study, Japanese conventional six-point odour intensity scale was reconsidered and a new series of six dilution steps of 1-butanol prepared in Erlenmeyer flasks and explanatory labels were proposed. In this study, polyethylene (PE) bottles were selected as containers for 1-butanol odour intensity reference solutions for convenience in on-site handling. Effectiveness of PE bottles were inspected based on comparative odour intensity measurements using Erlenmeyer flasks and PE bottles. Applicability of PE bottles for odour intensity measurement of hydrogen sulfide was also investigated. The results suggested that PE bottles could be substituted for Erlenmeyer flasks as containers for 1-butanol reference solutions, especially in the middle intensity level. Although odour intensity evaluation of hydrogen sulfide was accompanied by greater variation, mean odour intensities were relatively discriminable. In conclusion, the effectiveness of PE bottles as containers for 1-butanol odour intensity reference solutions was suggested.

Keywords: environmental odour, odour intensity, 1-butanol, polyethylene bottle, reference solution

Paper ID: CEST2017_00406

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Occurrence of 2,4,6-Trichloroanisole in anaerobically stabilised dewatered biosolids emission

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Abstract

Odours from biosolids emission are a complicated matrix. Still a little is known about chemical composition of odours from biosolids. Apart from well-known odorants such as sulphur compounds and ammonia participation of other volatile organic compounds (VOCs) in overall odour may be non neglectable. Especially if this chemicals have low odour threshold, exists in low concentrations and their analytical identification is not trival. In this work occurrence of 2,4,6-Trichloroanisole (TCA) into biosolids emission was measure using GC-MS/O system. Thirty six anaerobically stabilised dewatered biosolids samples from wastewater treatment plant were stored over a 35 days under ambient conditions. Emissions from samples were collected onto Tenax TA sorbent tubes using a U.S. EPA flux hood method on days 1, 3, 7, 10, 14, 21 and 35. Odour intensities classified on a scale of 1 to 4 and character were specified by three ODP operators. TCA was identified in all biosolids cake emission. Intensities levels of TCA do not shown any increasing or decreasing trend as the biosolids were aged. However the intensities of TCA as samples were stored varied.

Keywords: biosolids, 2,4,6-trichloroanisole TCA, odour, GC-MS/ODP

Paper ID: CEST2017_00413

Indoor air quality and thermal comfort in a typical Mediterranean primary school with a green roof system

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Abstract

This paper presents experimental results from a typical school building in Athens equipped with a green roof system (GRS). The GRS covers 1/3 of the school's total area, while the rest is used for reference purposes. Environmental monitoring took place in six classrooms located under the concrete reference roof and the green roof sectors as well as in the immediate external environment during warm and cold periods of the year. Measurements of CO_2, VOCs, PM1, PM2.5, PM10, ambient temperature (T) and relative humidity (RH) were performed. Preliminary results highlight that during summer, the green roof reduces T in a classroom on the top floor by about 2.8 ^{0}C while RH is increased by 5.9 %, in comparison with respective classrooms under concrete roof. Amid winter, a reverse behavior occurs. Concentrations of PM1, PM2.5, PM10, CO_2 and VOCs levels were found to be elevated during class hours with average values of 0.85 μg m^{-3}, 3.11 μg m^{-3}, 22.68 μg m^{-3}, 589 ppm and 7.69 ppm respectively. The examination of the indoor/outdoor ratio of air pollutants, demonstrated that the outdoor meteorology affects only PM1 and PM2.5, as PM10 and VOCs are strongly affected by internal emitting sources and the activities of pupils.

Keywords: indoor air quality, thermal comfort, school building microenvironment, green roof, air pollutants

Paper ID: CEST2017_00452

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Abatement of odour emissions by advanced oxidation

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Abstract

The growing expectations of the population in the urban areas with respect to air quality and the increasingly stringent regulations regarding air pollution have resulted in the need to minimize and conveniently treat the waste gas from different emission sources. The emissions from a large variety of plants, including waste and wastewater treatment plants, derive mainly from the degradation of organic matter. These emissions are composed of a complex of substances emitted at low concentrations from diffusive sources. These characteristics make complex their treatment on economically efficient conditions. The design and management of environmental engineering and industrial plants, therefore, require the implementation of focused processes for the control of the target compounds. The present study shows the applicability of an UV-Ozone lab-scale system for odours and VOCs removal. An artificial gaseous stream contaminated by toluene, at different incoming concentrations, was treated evaluating the abatement efficiencies in terms of odours and total VOCs as a function of power and contact time. The residue ozone concentrations was determined in order to optimize the set-up conditions. The results were discussed with the aim of evaluating the feasibility of the investigated solution for the advanced treatment of the waste gas from environmental facilities.

Keywords: VOCs, odours, AOPs, UV, Ozone

Paper ID: CEST2017_00860

Electronic nose performance optimization for continuous odour monitoring in ambient air

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Abstract

Industrial plants with odour emissions affect the quality of air and are often cause of public complaints by the people living surrounding the plant. For this reason, the control of odour represent a key issue. The starting point for an effective odour control it's their objective quantification. The electronic nose represent the odour measurement technique with probably the greatest potential, but currently there is not a universally recognized procedure of their application for the continuous monitoring of environmental odours.
The aim of this paper is to present and describe a novel procedure to training electronic noses in order to maximize their capability of operating a qualitative classification and estimating the odour concentration of ambient air. This novel approach will reduce the uncertainty and increase the reliability of the continuous odour measures.
The research is carried out through a real case study application in a big liquid waste treatment plant (LWTP). The seedOA system, patented by the SEED group of the University of Salerno, was used as e.nose device. The characterization of the odour concentrations from the different treatment units and the identification of the principal odour sources is discussed.

Keywords: air quality, dynamic olfactometry, liquid waste treatment plant, multisensory array system, public complaints.

Paper ID: CEST2017_00700

SESSION 7 – AGROFORESTRY AND THE ENVIRONMENT (1)

Thursday 31 August 2017 – morning

Full and deficit irrigation of "Mountain Tea" plant, at low altitude (first growing season)

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Abstract

The aim of this research is to study the effects of full and deficit irrigation regarding to the growing, productive and qualitative characteristics of "Mountain Tea" plant (Sideritis raeseri). The surface drip irrigation system was used. The research took place during 2015 at the experimental field of the University of Thessaly, in Velestino, Magnisia, Central Greece. It was used a fully randomized compete block design with two treatments in three replications. The amount of supplied water was 50% and 100% of the water needs according to the daily evapotranspiration (ETc) using the method of Penman-Monteith FAO 56. The plant height, the fresh and dry biomass production were measured and the crop's qualitative features were analyzed. The results shown that "Mountain Tea" can be cultivated at low altitude using irrigation. Moreover there are no statistically significant differences ($P<0.05$) of the growing and productive characteristics between full and deficit irrigation treatments. As for the studied qualitative properties, the results showed that the deficit treatment surpass compared to the full one. Thus, deficit irrigation is at least as productive as the full one, having the same effects on tea quality while an important amount of water can be saved as well.

Keywords: Mountain Tea, Surface Drip Irrigation, Deficit Irrigation, Water Saving, Low Altitude.

Paper ID: CEST2017_00097

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Environmental assessment of organic protection products towards an agro-sustainable fruit sector

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Abstract

The increase of production rate in the fruit sector brings a new challenge in terms of the sustainability of the agricultural sector. Apart from the social and economic perspective, it leads to identify the environmental challenges across the value chain. In this vein, farmers consider that the plant protection products are key factor to avoid fruit and vegetable losses, estimated at 78% and 54%, respectively. However, the environment and human health can be greatly affected because of their toxicity. An option to reduce this impact is the transition towards agro-sustainable production by using organic products, so that ensuring sustainable agricultural systems. Based on the fact that organic and sustainable are not equivalent concepts, this study is focused in one on these three pillars that hold the sustainable model, namely, the environmental assessment of the application of new organic plant protection and fertilizer products in conventional cherry farming. To do that, the Life Cycle Assessment methodology has been used. First results reveal that a more ecological cultivation does not always show better environmental performance in all indicators and it is very dependent on the functional unit chosen.

Keywords: LCA, fruit sector, organic products, agro-sustainable

Paper ID: CEST2017_00327

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Public perception on measures needed for the ecological restoration of Grecian juniper silvopastoral woodlands

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Abstract

The purpose of the study was to explore the views of social groups operating around the silvopastoral woodlands of the EU priority habitat type *9562 *Grecian Juniper Woods* and the formulation of measures that will contribute to the ecological restoration of the habitat type. The first phase (February 2014) was conducted with questionnaires addressed to social groups in the region. The Principal Component Analysis showed that the main factors forming the perception of social groups are (a) the advantages and benefits of the habitat type (15.79%), (b) threats (14.91%), (c) interdisciplinary complementarity of livestock management and Forestry (9.24%), (d) cost effectiveness (8.61%), (e) present condition (8.57%), and (f) direct degradation of wood-standing capital (7.48%). The second phase (June 2016) included a simulation exercise on the institutional environment of a LIFE+ project activities and held within a summer school. It was found similarity in the factors which determine the attitude of the two groups (society, institutional groups) with emphasis on the economic benefits and the interdisciplinary complementarity of livestock management and forestry.

Keywords: *Juniperus excelsa*, *Juniperus foetidissima*, restoration, conservation, role playing

Paper ID: CEST2017_00628

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of lime and sewage sludge fertilisation on flora biodiversity in a silvopastoral system under *Pinus radiata D.* Don

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Abstract

In the silvopastoral systems, the liming and the fertilisation are usually carried out to increase the productivity but these techniques can also modify the flora biodiversity of the understory. The aim of this study was to evaluate the effect of liming and the application of two doses of sewage sludge (50 and 100 kg total N ha^{-1}) on the flora biodiversity in a silvopastoral system established in an area reforested with *Pinus radiata* D. Don in Galicia (NW Spain). The results of this experiment showed that the improvement of the soil fertility caused by the liming and the fertilisation with sewage sludge decreased the proportion of shrubs in the understory, which have a positive impact on the reducing fire risk.

Keywords: agroforestry, afforestation, herbaceous, shrubs, fire risk

Paper ID: CEST2017_00670

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evolution of soil organic matter in *Eucalyptus nitens* Maiden silvopastoral systems fertilised with different types of sewage sludge

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Abstract

The silvopasture has been recognized as a possible greenhouse gas mitigation strategy under the Kyoto Protocol due to the potential for carbon storage in multiple plant species and in the soil. Soil organic matter (SOM) represents the most important pool of carbon storage in terrestrial ecosystems and can be modify among other factor by the fertilisation. The objective of this experiment was to evaluate during five years the evolution of SOM in a silvopastoral system established with *Eucalyptus nitens* Maiden in Galicia (NW Spain) and fertilised with sewage sludge that has been stabilised using anaerobic digestion, composting, and pelletisation. The results showed that the SOM gradually decreased from the second year of the study probably due to the fertilisation and the ploughing of the soil but also due to a negative effect of the trees on the biological activity in the soil. Therefore, the afforestation with *Eucalyptus* not served its task to soil carbon sequestration compared with other tree species established in silvopastoral systems in the same area and it is necessary to continue our study to properly evaluate the effect of *Eucalyptus* on the SOM.

Keywords: agroforestry, afforestation, sowing, climate change, carbon sequestration

Paper ID: CEST2017_00672

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Land cover changes in a valonia oak silvopastoral system in W. Greece – ecological and sociological implications

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Abstract

Silvopastoral systems integrate the complexity of forestry and forage-livestock management in an economically and ecologically sustainable way. However these systems have undergone intensive pressure in the past decades caused by changes in land-uses and in the local socioeconomic priorities that suppressed traditional practices such as livestock grazing. These changes have respectively caused land cover spatiotemporal diversifications and their effects were investigated in a traditional oak silvopastoral system at western Greece under the framework of this study. The temporal land-cover changes were analyzed using aerial orthophotographs for a distinctive time period, from the year 1945 to the years 2007 - 2009. Land-cover was digitized with the use of ArcGis software for the above mentioned time period. Based on the analysis of produced maps, land cover changes are mainly attributed to the human intervention related to land cultivation and livestock grazing.

Keywords: Silvopastoral systems, Spatiotemporal landcover changes, Geographic Information Systems, Land use human behavior changes, Quercus ithaburensis subsp. Macrolepis.

Paper ID: CEST2017_00686

SESSION 8 – WATER AND WASTEWATER TREATMENT (1)

Thursday 31 August 2017 –afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Thermal, alkali and thermo-alkali pretreatments applied on monospecific microalgal biomass to improve anaerobic biogas production

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Abstract

In last years microalgae biomass has been used for several scopes. One of them is to investigate their use as energy products. In this work microalgae were studied for anaerobic digestion use, but, to do so with a positive cost/revenue ratio, the cell walls must be efficiently removed before that the anaerobic digestion process takes place. This is the only way to make available the organic matter for the microbial activity and consequently enhance quantity and quality of produced biogas. In this study were used *Scendesmus obliquus* strain treated with thermal, alkali and alkali-thermal pre-treatments. Samples of microalgae biomass were collected and subjected to a first pre-treatments test at 120 °C (autoclave) for one hour and half. The second test was performed with an alkali pre-treatments using NaOH with a dosage range from 4 to 20% of the selected TS matrix (2, 5, 10% by weight). The last test was conducted using a hybrid pre-treatment (alkali – thermal), with the same dosage of NaOH and thermal exposition described above. Both tests with the use of NaOH showed a better efficiency in releasing intracellular organic matter and breaking polymeric bridges. Then biogas potential tests were performed under batch mesophilic conditions after each pre-treatment to evaluate possible enhancement in biogas production and quality.

Keywords: Microalgae, Scenedesmus obliquus, Anaerobic Digestion, alkali pre-treatments, thermal pre-treatments, thermos-alkali pretreatments, renewable energy production

Paper ID: CEST2017_00385

Attached growth anoxic-aerobic system treatment of domestic wastewater

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Abstract

An integrated water quality management system involves both treatment of wastewater and appropriate reuse of the effluent. Treated wastewater from commercial establishments such as hotels, high-rise residential or office buildings and shopping malls are potential source of non-potable water for use as landscape watering and toilet flushing. This study aimed to determine the performance of a full-scale aerobic activated sludge system and a bench-scale attached growth anoxic-aerobic growth wastewater treatment system (WWTS), which operated at shorter HRT and higher organic loading rate (OLR) than the present full-scale system. The effect of HRT on the bench-scale performance was also determined. Furthermore, this study assessed the effluent water quality for possible reuse. In the full-scale WWTS, at 2.06 ± 0.18 days HRT and 0.396 ± 0.123 kg COD/m^3/d OLR, the COD, BOD, FOG and TSS removal efficiency values were 97.2 ± 2.3%, 95.3±2.0%, 91.6±15.0% and 85.96±13.4%, respectively. In the bench-scale attached growth anaerobic-aerobic WWTS, the BOD, COD, FOG and TSS removal efficiency were 97.9±2.3%, 93.6±5.9%, 87.8±22.9% and 71.4±18.5%, respectively, at 6.35 h HRT and 2.42±0.40 kg COD/m3/d OLR. The efficiencies were better at longer HRT and lower OLR. At 12.70 h HRT and 1.50 ± 0.30 kg COD/m3/d OLR, the BOD, COD, FOG and TSS removal efficiencies were 98.1 ± 2.4%, 94.7 ± 4.6%, 95.0 ± 5.1% and 91.4 ± 2.4, respectively. The effluent of the bench-scale WWTS after an additional tertiary treatment could be used for landscape watering and flushing toilet.

Keywords: aerobic; anoxic; attached growth; reuse; wastewater

Paper ID: CEST2017_00389

Degradation of Iopamidol, a Commercial X-ray Contrast Chemical and Micropollutant, with ZVA and ZVI-activated, Common Oxidants: Investigation of Acute Toxicity and Anaerobic Inhibition

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Abstract

The effect of nano-sized zero-valent aluminum (ZVA) and iron (ZVI) activation of hydrogen peroxide (HP) and persulfate (PS) oxidants on the treatment of aqueous iopamidol (IOPA, 2 mg/L), an iodinated organic X-ray contrast chemical and micropollutant, on acute toxicity and anaerobic digestion inhibition was examined. For this purpose, two different toxicity bioassays were conducted with *V. fischeri-P.subcapitata* and cumulative biogas production was monitored in batch anaerobic tests. The application of "activated" HP (1.00 mM) and PS (0.50 mM) treatment under acidic conditions (pH=3) resulted in complete IOPA removal. Acute toxicity results indicated that the untreated IOPA sample caused an inhibitory effect of 5% and 74% towards *V. fischeri* and *P. subcapitata*, respectively. The HP/ZVI- and PS/ZVA-treated IOPA samples exhibited toxic effects on *P. subcapitata*; the relative inhibition increased to 97% and 93% after 120 min HP/ZVI and PS/ZVA treatments, respectively. The freshwater microalgae *P. subcapitata* appeared to be more sensitive to IOPA and its degradation products than the photobacterium *V. fischeri*. Anaerobic digestion results indicated no meaningful change not only in the digestion performance but also in cumulative biogas production in the presence of untreated IOPA (2 mg/L) and HP/ZVI or PS/ZVA treated IOPA samples.

Keywords: Iopamidol (IOPA); zero-valent aluminum (ZVA) and iron (ZVI); persulfate (PS) and hydrogen peroxide (HP); acute toxicity; cumulative biogas production.

Paper ID: CEST2017_00393

Chromium recovery by membranes for process reuse in the tannery industry

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Abstract

Leather tanning is a wide common industry all over the world. In leather processing, water is one of the most important medium, almost 40-45 L water kg-1 raw-hide or skin is used by tanneries for processing finished leathers. The composition of tannery wastewater presents considerable dissimilarities in the concentration range of pollutants both of inorganic (chlorides, with concentration ranging from several hundred to over 10,000 mg L-1 Cl–; sulphate (VI), ammonium ions and sulphide ions, exhibiting concentration that ranges from tens to several hundred mg L-1) and organic (the COD value is usually several thousand mg L-1 O2). Throughout the years, many conventional processes have been carried out to treat wastewater from tannery industry: unfortunately, in this case, biological treatment methods give rise to an excessive production of sludge, whereas physical and chemical methods are too expensive in terms of energy and reagent costs. In this work, a membrane process based on NF membrane modules was adopted to treat the tannery feedstock after primary conventional treatment. In a first step, the determination of all boundary flux parameters, in order to inhibit severe fouling formation during operation, were performed. After this, experimental work was carried out to validate the approach. The target of water purification was reached, that is the legal discharge to municipal sewer system in Italy of 90% of the initial wastewater stream volume. This allows having an immediate cost saving of 21%. Moreover, the developed process leads to a second benefit, that is the production of 5% of the initial volume as a highly chromium-rich concentrate at no cost suitable to tannery process recycle and reuse. In this case, cost saving rates exceeds 40%. At the end, scale-up of the investigated process will be discussed from technical and economic point of view.

Keywords: chromium, tannery wastewater, reuse, recovery

Paper ID: CEST2017_00401

About the limits of microfiltration for the purification of wastewaters

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Abstract

In the past, microfiltration was widely used as a pretreatment step for wastewater stream purification purposes. Experiences performed during the last years shows that microfiltration fails to maintain its performances for longer period of times. Many case studies demonstrate that the adoption of microfiltration leads to the failure of the overall process; the severe fouling of the microfiltration membranes leads to high operating costs with the consequence to make the treatment of the wastewater economically unfeasible. The boundary flux concept is a profitable tool to analyze fouling issues in membrane processes. The boundary flux value separates an operating region characterized by reversible fouling formation from irreversible one. Boundary flux values are not content, but function of time, as calculated by the sub-boundary fouling rate value. The knowledge of both parameters may fully describe the membrane performances in sub-boundary operating regimes. Many times, for wastewater purification purposes, ultrafiltration membranes appear to be suits better to the needs, even they exhibit lower permeate fluxes compared to microfiltration. Key to this choice is that ultrafiltration appears to resist better to fouling issues, with a limited reduction of the performances as a function of time. In other words, it appears that ultrafiltration exhibit higher boundary flux values and lower sub-boundary fouling rates. In this work, after a brief introduction to the boundary flux concept, for many different wastewater streams (more than 20, produced by the most relevant industries in food, agriculture, manufacture, pharmaceutics), the boundary flux and sub-boundary fouling rate values of different microfiltration and ultrafiltration membranes will be discussed and compared. The possibility to successfully use microfiltration as a pretreatment step strongly depends on the feedstock characteristics and, in detail, on the particle size of the suspended matter. In most cases, microfiltration demonstrates to be technically unsuitable for pretreatment purposes of many wastewater streams; as a consequence, the adoption of microfiltration pushes operators to exceed boundary flux conditions, therefore triggering severe fouling, that leads to economic unfeasibility of the process in long terms.

Keywords: membranes, fouling, boundary flux, wastewater treatment, microfiltration

Paper ID: CEST2017_00402

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biological anaerobic–aerobic treatment of dairy wastewater in Poland

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Abstract

In 2014, farms across the EU-28 produced approximately 164.8 million tones of milk, of which 159.6 million tones (or 96.8%) were cows' milk. Cows' milk production on farms was the highest in Bretagne (France), Southern and Eastern Ireland and Lombardia (Italy) and Masovia (Poland) (8,3%). Milk processing produces wastewater. In Poland 1 m^3 of processed milk accounts for 3.2 m^3 of wastewater. In 2013 the production of dairy products in Poland generated 26.5 hm^3 of sewage: 14.7 hm^3 of which was treated (9.3 hm^3 biologically and 5.4 hm^3 with increased nutrient removal). The dairy wastewater is primarily generated from the cleaning and washing operations. Its main contaminants are: high BOD and COD concentrations, and it contains fats, nutrients, lactose, as well as detergents and sanitizing agents. Biological treatment is the basic method used for wastewater from food processing. Dairy wastewater in Poland is treated using aerobic biological methods: circulated pond, activated sludge process, sequencing batch reactor, Moving Bed Biofilm Reactor and anaerobic reactors. The two steps anaerobic-aerobic reactors are used in two cases in Poland.

Keywords: wastewater, dairy, biological treatment, anaerobic reactor, aerobic reactor

Paper ID: CEST2017_01134

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Recovery of noble metals from industrial process waters by the use of functional textiles

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Abstract

The recycling and recovery of high-prized noble metals such as platinum, gold, palladium and silver or rare and strategic metals like indium, gallium, and rare earth metals from scrap metals and wastewaters will be from steadily increasing importance within the next years. Therefore, the focus has to be set on the detection of potentially usable secondary resources and the development of inexpensive and energy-saving processes to separate and recover the metals selectively (urban mining). Beside electronic scrap industrial process and wastewaters represent a considerable source for noble metals. Recently, we have successfully developed an innovative metal-adsorbing textile filter material based on polyvinylamine-coated polyester fibers. The surface modification of the fibrous material is easy to realize with common methods in textile finishing yielding a durable, high-performing and even cheap adsorbent for water-dissolved metal ions. We present results on the general textile finishing procedure and the pH-depending adsorption of noble metal ions. The feasibility of the overall process is demonstrated on palladium containing process waters obtained from a German producer of curcuit boards. Moreover, the same innovative adsorber material is useful for the decontamination of chromate-polluted ground waters and soils. Our latest investigations focus their use in the selective recovery of rare earth metals from large-scale FCC catalyst production for the petroleum refining industry.

Keywords: textile, polyelectrolyte, metal recovery, urban mining, textile mining

Paper ID: CEST2017_00092

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Pig slurry treatment by a combined Helophytes-Biodiscs system

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Abstract

Pig slurry was treated in a pilot wastewater treatment plant composed of a rotobioreactor based on rotating microalgae-biofilm discs, and a helophytes floating filter. Slurry in this work included cleaning water and its main characteristics were: 8,400-5,500 mg $O_2 \cdot L^{-1}$ COD, 1,575-800 mg $O_2 \cdot L^{-1}$ BOD_5 and 2,275-1,799 mg$\cdot L^{-1}$ total nitrogen. Prior to the experiment, the rotobioreactor was conditioned adding pig slurry for 15 days in order to adapt the microorganisms biofilm to that substrate; at the end of the conditioning period, COD was 3,200 mg $O_2 \cdot L^{-1}$. The experiment was carried out for 10 days, adding 200 L pig slurry$\cdot day^{-1}$ to the rotobioreactor. The mixture in the reactor (diluted pig slurry) flowed by plug-flow to the helophytes floating filter to continue the depuration process. After 10-day treatment, the daily average reduction achieved was 88.3% COD, 97.6% BOD_5, 78.5% phosphorous and 85.6% total nitrogen. From the results it was estimated that a load of 1 $m^3 \cdot day^{-1}$ pig slurry would require about 1,008 m^2 discs area in the reactor and 54 m^2 of helophytes floating filter.

Keywords: Bioreactor, Biofilm, Helophytes, Phytodepuration, Pig slurry.

Paper ID: CEST2017_00490

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ozonation of washing concentrates from an ultrafiltration pilot plant treating the secondary effluent of a WWTP

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Abstract

This work studies the result of treating, by ozone, washing concentrates of an ultrafiltration plant, which processes the secondary effluent (biological) of a WWTP. The study is presented as a first stage towards the establishment of an integrated process UF-ozonization. Two types of concentrates and two ozonation intensities: 24.4 and 6.4 mg /L of O3 in gas we studied in this work. The results reveal that an initial increase of total organic carbon is given since oxidizable part of total suspended solids dissolve more quickly than it oxidizes. Once this part has been dissolved completely, the total organic carbon begins to decrease, within the global mineralization process, following a two-series-reaction scheme. Ozonation at low concentrations of ozone improves the efficiency of the process in terms of mineralization. It seems to be associated with a change in the overall degradation scheme (TSS solution followed by mineralization). The effluent turbidity increased in all cases analyzed, following clearly an order-zero kinetic in the cases when the ozone concentration is high. The pH is initially set around 9, first suffering a fall not more than 0.8 in none of the cases. The loss of aromaticity was observed around 51.8% as maximum.

Keywords: ozonation, WWTP, ultrafiltration, total Organic Carbon, turbidity

Paper ID: CEST2017_00539

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geology and engineering processes as determinants in the quality of mining-influenced waters in Philippine copper porphyry mines

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Abstract

The impacts of geology and engineering processes on the quality of mining influenced waters (MIW) in Philippine copper porphyry mines were studied. Acid mine drainage-metal leaching (AMD-ML) is a common phenomenon in pyrite-rich copper porphyry deposits and said factors determine to a large extent the acidity or alkalinity of the final effluent waters discharged by an active or defunct mine to the environment. After characterization using micromineralogy, pyrite concentrates and mine tailings were leached in the laboratory (accelerated weathering) by bubbling by air to determine the main factors that affect its degradation and the subsequent formation of acidic waters. As observed in the leaching runs, interfering ions, like those of copper, act as buffers and delay the leaching out of heavy metals; similarly, various minerals dissolve, and specific ions precipitate, at various pH levels. Process lime, used in the recovery of copper from the porphyry deposits, provides a very important source of neutralizing capacity. The same behavior was observed in waters that have percolated from surrounding limestone and other alkaline rocks that find their way inside the mine. Precipitates were also characterized to determine the fate of leached-out metals after the acidification and neutralization processes.

Keywords: accelerated weathering, acid mine drainage, copper porphyry, micromineralogy, mining-influenced water

Paper ID: CEST2017_00610

SESSION 9 – EMERGING POLLUTANTS (2)

Thursday 31 August 2017 –afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Accurate mass screening of pharmaceuticals in water and sediment by UHPLC-ORBITRAP mass spectrometry

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Abstract

The extended use of pharmaceuticals is a potential contamination source of surface water, groundwater, sea water and soils. Pharmaceuticals are among the most prescribed pharmaceutically active substances throughout the world. Their presence and persistence in environmental matrices and the toxicity posed by them as well, according to the first studies carried out, indicate that environmental monitoring programs are crucial to assess the fate of such substances ending up to the environment. The present study focuses on the determination at trace levels of psychiatric drugs in environmental matrices (water, sediment) taking at the same time advantage of the innovative hybrid technology and versatility of the high resolution-accurate mass LTQ Orbitrap MS platform.

Keywords: pharmaceuticals, waters, sediments, LC-LTQ-Orbitrap MS

Paper ID: CEST2017_00604

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Computational prediction, rationalization and experimental validation of PCR primers for the detection of antibiotic resistance genes in wastewater treatment plants

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Abstract

Wastewater treatment plants (WWTPs) are point sources of various emerging pollutants, including antibiotics and antibiotic-resistance genes (ARGs). These reservoirs promote formation of antimicrobial resistance due to natural selection of the multidrug-resistant bacteria and horizontal gene transfer of ARGs. Therefore, there is a great need to effectively monitor the spread, diversity and fate of ARGs in WWTPs. One of the possibilities for such screening is PCR typing. However, efficient and diverse sets of primers specific to various ARGs are needed. In literature, there are plethora of such primers, however their usefulness in environmental studies varies significantly. In this study a dedicated bioinformatic *in silico* PCR (e-PCR) tool was created to validate and calculate various primers specificity and efficacy. Over 300 primer pairs specific to diverse ARGs families were validated against the Comprehensive Antibiotic Resistance Database (CARD) and Antibiotic Resistance Genes Database (ARDB) and various WWTPs metagenomes, which enables calculating primers overall rating and preparation of the database of PCR primers most useful in ARGs environmental screening. Finally, selected primer pairs were used in experimental PCR testing survey to check the presence of the ARGs in waste samples (collected on subsequent stages of the wastewater treatment process) from the Oswiecim WWTP (Poland).

Keywords: Wastewater treatment plant, antimicrobial resistance, antibiotic resistance genes, PCR typing

Paper ID: CEST2017_00765

Use of passive sampling devices for monitoring emerging contaminant metaldehyde

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Abstract

Metaldehyde is the active ingredient in 80% of slug pellets used globally. Metaldehyde is not phytotoxic and is used by arable farmers to protect crops such as cereals, oilseed rape, and potatoes and has been identified as an emerging contaminant by NORMAN. High mobility and extensive use allow metaldehyde to enter surface waters where it has been detected above the EU Drinking Water Directive limit of 0.1 µg/L. Water quality monitoring programs rely on the collection of infrequent (2-4 weeks) high volume spot/grab water sampling. This is expensive and time-consuming and can miss sporadic inputs having serious implications for water quality management. We have developed a new variant of the Chemcatcher® (an easy to use, low-cost passive sampling device) for a suite of polar pesticides including metaldehyde which utilises a hydrophilic/lipophilic balance sorbent (Horizon Atlantic HLB-L) as the receiving disk. Initial trials for the metaldehyde Chemcatcher® were undertaken at three catchment sites along the river Thames, where previous spot sample data shows drastic fluctuations in metaldehyde concentrations over time. Spot sample concentrations were measured at concentrations of 71- 309 ngL^{-1} during the two week deployment interval, with the Chemcatcher® demonstrating a TWA concentration 159 ng L^{-1} (with good agreement to the mean concentration of spot samples). It was therefore determined that the Metaldehyde Chemcatcher® can provide accurate reporting and act as a supplement for metaldehyde monitoring programmes.

Keywords: Metaldehyde, Chemcatcher® passive sampler, Surface water, Calibration, In Situ sampling rate

Paper ID: CEST2017_00783

Determination of 48 pesticides in water by using DI-SPME coupled to GC/MS

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Abstract

This paper discusses the optimization and validation of a complete and simple method for the simultaneous determination of 48 pesticides in water by combining direct immersion solid-phase micro-extraction (DI-SPME) and gas chromatography- ion trap tandem mass spectrometry (GC-ITMS/MS). For the extraction, the different SPME parameters were tested and optimized. As a result, the polyacrilate fiber (PA 85µm) was selected in direct immersion mode; the extraction temperature was set to 60ºC with an extraction time of 45 min and a stirring speed of 250 rpm; the thermal desorption time of the fiber in the injector port was fixed to 10 min, at 275 ºC. Concerning the analysis, MS/MS parameters were optimized and figures of merit were compared. Later, the method was validated and showed good linearity in the concentration ranging from 0.05 to 100 ng mL^{-1}. The reproducibility of measurements expressed as relative standard deviation (% RSD) was found to be satisfactory. Furthermore, the detection limits obtained were in the low or sub ppt levels. Finally, the proposed DI-SPME-GC-ITMS/MS method was tested successfully for water samples collected along the watershed of Abou Ali River (North Lebanon).

Keywords: Pesticides, GC-ITMS/MS, DI-SPME, Abou Ali River

Paper ID: CEST2017_00885

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of veterinary antibiotics in dairy environments by Liquid Chromatography – Mass Spectrometry

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Abstract

Veterinary antibiotics are widely used for disease treatment, protection and to promote animal's growth. The emerging concern regarding the diffusion of antibiotic resistant microorganisms (AMR) is directly linked to the use of antibiotics in animal husbandry as they act as co-selective drivers for AMR development and spread. Therefore, a new analytical method for the detection of pharmaceuticals at trace levels to be able to study their occurrence, behaviour and fate in complex environmental matrices (including milk, wastewater slurry and soil) has been developed. Several extraction techniques were tested in solid matrices for analytes under study such as ultrasound assisted extraction (UAE) and microwave assisted extraction (MAE), using different buffers and additives. Clean-up and pre-concentration of the extracts were performed by means of solid-phase extraction (SPE), using different cartridges (e.g. SAX-HLB) and methanol as eluting solvent. Antibiotic residues were also extracted from milk samples using acetonitrile previous to SPE purification or ultrafiltration. Recoveries were generally about 75% for most compounds, decreasing for those antibiotics having the highest instability (e.g. B-lactams). Identification and quantification of antibiotics were performed by liquid chromatography-mass spectrometry (LC-MS). Finally, the protocol proposed was validated by analysing the concentration of target compounds in samples collected from a dairy farm.

Keywords: Veterinary antibiotics, AMR, extraction methods, dairy environment, LC-MS

Paper ID: CEST2017_00889

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Screening of pesticides used in marine aquacultures with the aid of LC-High resolution orbitrap MS

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Abstract

A wide range of chemicals are used in aquaculture, including antibiotics, pesticides, hormones, anesthetics, various pigments, minerals, and vitamins. The concerns about the use of chemicals center on both their potential effects on human health and on natural ecosystems. These compounds may accumulate in aquacultured fish through contaminated feed ingredients while also; certain biocides (e.g. Irgarol) are applied directly to the water in aquaculture ponds to control weeds and algae. It is, therefore, needed to collect data on these chemicals for a better knowledge of its fate in natural waters and for the risk assessment. The aim of this work was to develop an efficient method on the basis of solid phase extraction (SPE) technique for the determination of antifouling compounds and pesticides such as Irgarol 1051, Azamethiphos, and Deltamethrin in aquaculture sea water samples. Sea water collected from Epirus region (North-Western Greece), was used to validate an analytical method. Analysis was carried out with ultra-high performance liquid chromatography (UHPLC) high-resolution Orbitrap mass spectrometry.

Paper ID: CEST2017_00605

Simultaneous determination of Paraquat and Atrazine in water samples with a White Light Reflectance Spectroscopy biosensor

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Abstract

An optical immunosensor based on White Light Reflectance Spectroscopy for the simultaneous determination of the herbicides atrazine and paraquat in drinking water samples is demonstrated. The biosensor allows for the label-free real-time monitoring of biomolecular interaction taking place onto a SiO_2/Si chip by monitoring the shift in the reflected interference spectrum during the reaction. Dual-analyte determination is accomplished by functionalizing spatially distinct areas of the chip with protein conjugates of the two herbicides and scanning the surface with an optical reflection probe. A competitive immunoassay format was adopted, followed by reaction with secondary antibodies for signal enhancement. The sensor was highly sensitive with detection limits of 50 and 100 pg/ml for paraquat and atrazine, respectively. The assay duration was 12 min. Recovery values ranging from 88 to 112% were determined for the two pesticides in spiked drinking water samples. In addition, the sensor could be regenerated and re-used at least 12 times without significant effect on the assay characteristics. Its excellent analytical performance and short analysis time combined with the small sensor size should be helpful for fast on-site determinations of these analytes.

Keywords: paraquat, atrazine, white light reflectance spectrometry, label-free biosensor, drinking water

Paper ID: CEST2017_00893

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Detecting emerging pollutants in environmental compartment by Ultra High Performance Liquid Chromatography - Time of Flight Mass Spectrometry

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Abstract

Pharmaceuticals, illicit drugs, personal care products and pesticides, among others, are emerging pollutants widely distributed in water. In this work, the occurrence of these pollutants in waste and surface waters as well as in fish (*Anguila anguila*) has been study. A screening of these kind of compounds, in order to detect all the compounds present in these matrices, was carried out with a Ultra High Performance Liquid Chromatograph coupled to a Time of Flight Mass Spectrometry (UHPLC-QToF MS/MS) and compared with a library of more than 1200 compounds. More than 200 compounds in the effluents were identified at low concentrations. Less compounds were detected in water of the Albufera Lake, 90 emerging pollutants Two extraction methods, for biota samples were compared, the QuEChERS (one of the most used methods) and other developed in the laboratory based in a McIlvaine-EDTA buffer extraction. Resulting better peak areas in the McIlvaine-EDTA buffer method than QuEChERS and detecting some compounds that do not appear with the last method (55 compounds were detected with the McIlvaine extraction and 35 with QuEChERS).

Keywords: Emerging pollutants, WWTP, effluents, lake, water, fish, UHPLC, qToF

Paper ID: CEST2017_00996

Liquid Chromatography-Mass Spectrometry-based Metabolomics and Lipidomics reveal toxicological mechanisms of Bisphenol F in breast cancer xenografts

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Abstract

Bisphenol F (BPF) is a major alternative to bisphenol (BPA) and has been widely used. Although BPA exposure is known to generate various toxic effects, toxicity of BPF remains under-explored. A comprehensive method involving mass spectrometry (MS)-based global lipidomics and metabolomics, and matrix-assisted laser desorption/ionization-mass spectrometry (MALDI)-imaging MS (IMS) was used to study the toxic effects of BPF and the underlying mechanisms on breast cancer xenografts. Our results demonstrated that BPF exposure disturbed the metabolome and lipidome of kidney and liver without morphological alterations. BPF exposure induced the reprogramming of the glutathione (GSH) biosynthesis and glycolytic metabolism by activating glycine, serine, cysteine, glutamine, lactate and pyruvate although. It also perturbed the biosynthesis and degradation of glycerophospholipids (GPs) and glycerolipids (GLs), resulting in abnormality of membrane homeostasis and cellular functions. Moreover, the spatial distribution and profile of metabolites changed across the renal cortex and medulla regions after the BPF treatment. Levels of phosphatidylethanolamines (PE) and triacylglycerols (TAG) increased in renal medulla and pelvis, while the levels of phosphatidylcholines (PC) and phosphatidylinositols (PI) increased in renal cortex and pelvis. These observations offer a deeper understanding of the critical role of metabolites and lipid reprogramming in BPF-induced biological effects.

Keywords: Bisphenol F, Metabolomics, LC-MS/MS, MALDI-IMS, Breast cancer xenografts.

Paper ID: CEST2017_01059

Prioritization of organic compounds for suspect screening in (drinking) water and biota

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Abstract

Suspect and non-target screening are powerful tools for identification of organic compounds using high resolution mass spectrometry (HRMS). However, there is a lack of smart suspect screening lists for the identification of organic compounds which are persistent, have high mobility in the environment and are potentially bioaccumulative and toxic. In this study, we created a prioritization strategy for top candidates among ~32,000 compounds including pesticides, pharmaceuticals, flame retardants and many other chemicals based on their physiochemical characteristics (e.g. log K_{ow}, log K_{oc}), predicted environmental fate characteristics (e.g. biodegradability, bioconcentration factor), human toxicity, emission sources and emission quantity for (drinking) water and biota. For charged compounds (18% of the list), a log *D* value was estimated based on the log K_{ow} at *pH* 7 to account for different behavior of charged compounds in the environment. Three lines of specialization were developed, one for water and two for biota (LC- and GC-HRMS, respectively). For biota, the driving factor for achieving a high score was high mobility towards biota and bioaccumulation potential, whereas for water, the mobility in the aquatic environment and human toxicity was of most significant importance. Typically, halogenated compounds ended up in the "(drinking) water-" (26,4%) and "biota-GC-HRMS" (19,4%) suspect lists due to their high bioaccumulation factor. In summary, we present three suspect screening lists developed for anthropogenic compounds that may end up in water and biota providing new opportunities to screen for environmentally relevant compounds by HRMS.

Keywords: Suspect screening; prioritization of compounds; physiochemical properties; environmental fate; emerging pollutants

Paper ID: CEST2017_01072

SESSION 10 – ENERGY TECHNOLOGIES AND SUSTAINABILITY (2)

Thursday 31 August 2017 –afternoon

Sustainability of China's electricity system; proposal for a structured analysis

San Miguel G.[1], Ornia J.[1], Alvarez S.[1], Gutiérrez F.[1], Corona B.[1], Wang C.[2], Lu X.[2], Song Q.[3], Yao Q.[3], Xu W.[3], Lechón Y.[4], De La Rúa C.[4], Caldés N.[4] and Del Río P.[5]

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Abstract

A methodological framework has been designed to analyze the sustainability of China's electricity sector in the wake of the 13th Development Plan for the Electricity Sector (2016-2020). The proposal is based on ISO 14040 but also incorporates some features from the "new LCA" approach described in the CALCAS project. Discussion is provided about its practical implementation, including definition of objectives through sustainability questions and sub-questions, definition of scope, definition of scenarios, functional unit, selection of sustainability issues and indicators, suitability of analysis tools, availability of inventory dataand aggregation methods to facilitate decision making.

Keywords: Sustainability, renewables, China, electricity, LCA, LCSA

Paper ID: CEST2017_00939

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Thermodynamic study of residual biomass gasification with air and steam

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Abstract

This paper presents the results obtained from modeling the gasification process of residual biomass, based on the non-stoichiometric Gibbs-free-energy minimization method. The RAND algorithm (Li, 2002) was used for the calculation of thermodynamic equilibrium and implemented in a computational tool. 44 chemical species were taken into account, 42 of them in the gas phase and two more in the solid phase (carbon and sulfur). The model offers good results for the conditions tested and allowed the selection of air, steam, or a combination of those, as gasification agent. The results obtained for a fixed biomass composition and operating conditions of 740°C and 1 bar with variation of the gasification medium composition were analyzed. It was possible to determine the maximum theoretical yield and other process thermodynamic limitations. An analysis of the deviations presented between experimental results reported in literature and those obtained from the equilibrium model was also carried out. The model implemented in this work is a useful tool for the analysis of the gasification process. The detailed assessment of the influence of temperature and composition of the biomass on gasification is being currently performed.

Keywords: RAND algorithm, residual biomass, gasification, equilibrium model, gasification agent

Paper ID: CEST2017_01010

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Educational Renewable Energy Screw Wheel Technologies for Pico Hydropower Generation and Sustainability

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Abstract

Various laboratory-scale inclined axis Screw Wheel Technological Systems simulating pico hydroelectric generation and sustainability have been constructed in ASPETE, under the supervision of the Austrian B.O.K.U. University and used in the educational curriculum of Renewable Energy and Sustainability Programme at the M.Sc. in "Management Technologies of Waters, Soft Energy Systems and Environmental Mechanics (M.T.W.- S.E.S.E.M.)". The mainlines of the small screw turbine systems construction, simulating pico hydropower generation and the measurement procedures are described. The small hydraulic screw turbine is simple to make and use inexpensive components, most of which can be found in standard science laboratories. From the "M.T.W. - S.E.S.E.M." M.Sc. courses experimental results, the small-scale screw turbine was found to have good hydrodynamic performances for small water flow rates. The educational renewable energy screw wheel technological system simulating pico hydroelectric generation demonstrates the principles of hydropower and sustainability and is well suited for education in hydraulic renewable energy and sustainability.

Keywords: Renewable Energy Technologies, Small Hydropower, Screw Turbine, Environmental and Renewable Energy Education, Sustainability

Paper ID: CEST2017_01146

Development of Hybrid Vehicle for ground service handling operations

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Abstract

The objective of this work is to develop a hybrid power pack which both improves fuel efficiency and reduces the emission of ultra-fine particles at the same time. The power pack consists of a fuel cell and a battery and it operates on methanol-water mixture. The power pack represents a cost effective solution, while the hybrid vehicle has a number of advantages compared to an internal combustion engine (ICE) diesel powered vehicles: no particle emissions; possible indoor usage in hangars; fuel efficiency and fossil free transportation. Particle emissions from diesel ICE utility vehicles at the airport handling area (luggage, passenger in/out, fueling and service) represent serious health hazards. Especially the emission of ultra-fine particles represents a significant problem for the working environment at airports.
The advantage of this concept is that the size of the individual components can be reduced (as compared to a non-hybrid system), while improving the overall energy efficiency by using the most efficient hybridization for a given power requirement (5 kW). The fuel cell technology is based on High Temperature PEM fuel cells (HTPEMFCs) from Danish Power Systems Company. The battery pack, battery management system (BMS) and on-board charger are being developed by Lithium Balance Company.

Keywords: Hybrid vehicle; PEM Fuel Cell; MeOH reformer; hybrid power pack, biofuel.

Paper ID: CEST2017_01254

Estimating the productive potentials of energy crops with the impact of multi-scenarios of land use and water resources in China—in the case of sweet sorghum

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Abstract

Bioenergy plays an important role in supplying energy and reducing CO_2 emission, and energy crops will account for an important proportion of bioenergy in the future for it is the most promising new potentials in bioenergy supply system. Meanwhile, the growth of energy crops will be affected by available land, water resources and other natural environmental factors such as rainfall, temperature, soil texture, terrain and so on. Due to limited area of cultivated land and food security concerns, the future of energy crops in China will focus on the non-grain energy crops (e.g. sweet sorghum), which has not been planted large-scale in China. Based on multiple scenarios such as maximum planting area, ecological security, food security, marginal land, our research combined land-use model, ArcGIS and supply-demand situation of water together to quantify the potential and suitable spatial distribution of sweet sorghum in China. The results show that the potentials of sweet sorghum will be 2.74-20.97Gtce (tons of coal equivalent) and the suitable area is 8.56~65.54x$10^7$$hm^2$.Taking water into consideration, the values will be 0.26~15.90Gtce and 0.82~49.60x$10^7$$hm^2$ respectively. It can supply the demand of bioenergy before 2030 in China. Water will be an important limitation to the application of energy crops in the northwest of China.

Keywords: Energy crops, sweet sorghum, land use, water sustainability, China

Paper ID: CEST2017_01322

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Exergy and environmental based comparison of hydrogen production from natural gas, carbon and nuclear energy

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Abstract

Hydrogen is an important energy carrier which could play a very significant role in the reduction of emissions of greenhouse gases. The route by which hydrogen is produced is the determining factor for its environmental performance. Hydrogen can be produced through methane reforming, coal gasification or through the electrolysis of water with the use of electricity. However, as these processes involve environmental and energy security concerns, it is of great importance to assess their environmental and energy performance. In this study, the environmental and exergy performance of auto thermal reforming of natural gas, coal gasification and thermochemical water-splitting are evaluated. It is noted that in the thermochemical water-splitting, decomposition reactions take place to produce H2, according to the method of sulphur-iodine. The increased temperature requirements are covered by a nuclear reactor H2-MIR. The calculations reveal that the exergy efficiency of CO2 sequestration reaches 70.3%; whereas the exergy efficiency of carbon gasification process to comes up to 35.8%.

Keywords: Exergy Analysis; LCA: Hydrogen production; Carbon Sequestration; Nuclear energy

Paper ID: CEST2017_00509

Dehydration of Tungsten Oxide Hole Extraction Layers via Microwave Annealing for Efficiency and Lifetime Enhancement in Organic Solar Cells

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Abstract

A significant contribution to the efficiency and lifetime enhancement of organic solar cells is due to the successful engineering of the metal contact/organic interface by introducing appropriate interlayers. In the current work we show that a short microwave post-annealing treatment in air of an under-stoichiometric tungsten oxide (WO_x) hole extraction layer significantly enhanced the performance and lifetime of an organic solar cell based on the poly(3-hexylthiophene):[6,6]-phenylC70butyric acid methyl ester (P3HT:$PC_{70}BM$) blend. The enhanced performance is mainly driven by the increased work function of the anode, the reduced series and increased shunt resistances and also the higher charge generation efficiency, the reduced recombination losses and the improved hole transport towards the anode contact. In addition, the lifetime of the devices with the microwave annealed WO_x interlayers was also significantly improved compared to those with the as-deposited WO_x and, especially, to those with the PEDOT-PSS interlayer. The above were attributed to the effective dehydration which was also followed by the weak structural transformation and crystallization of the WO_x layer during microwave annealing, as revealed by the x-ray and infrared measurements.

Keywords: microwave exposure, dehydration, tungsten oxide, organic solar cell *Chemistry C*, 117, 18013.

Paper ID: CEST2017_00695

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Wave Energy Exploitation in the North Aegean Sea: Spatial Planning of Potential Wave Power Stations

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Abstract

During the last decades there has been an increasing interest in renewable energy sources applications especially for covering the electricity needs of non-interconnected islands. Among the emerging renewables, wave energy has the potential to make significant contribution towards a sustainable future. Greece is located in the eastern Mediterranean region while hundred of Greek islands are located inside the Aegean Archipelago. Taking into consideration the vast energy potential available in sea as well as the fact that coastal areas can much benefit from the implementation of such energy solutions, the current study emphasizes on sea sites close to non-interconnected to the mainland grid islands, which are depended on fossil fuels and more precisely on oil imports. This research describes a geo-spatial Multiple-Criteria Decision Analysis, based on the Geographic Information Systems technology, for the identification of the candidate locations to deploy a potential Wave Energy Farm in the North Aegean Sea, an area offshore the Greek mainland East coast. For this purpose, several factors are taken into account; restrictions such as protected areas, military exercise areas etc. and weighted factors such as distance to power grid, wave height etc. Based on the results of this survey, future prospects of wave energy and the possible implementation of innovative marine technologies could be supported, providing the remote island communities of the Aegean Sea with clean electrical energy at a reasonable cost.

Keywords: Significant wave height, Wave power, Wave energy potential, Marine technologies, Electrical Energy

Paper ID: CEST2017_01016

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Performance Evaluation of Dates Palm Ash (DPA) Modified Bitumen for Sustainable Pavement Construction

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Abstract

The purpose of this research is to investigate the suitability of using Dates Palm Ash (DPA) as binder modification. This study is probably the first attempt to investigate the possible use of Dates Palm Ash (DPA) in bitumen modification. The controlled bitumen of PG 64-10 was used as base binder and DPA of 4, 8 and 12 % by weight of bitumen were used in this study. The rheological tests using Dynamic Shear Rheometer (DSR) and Bending Beam Rheometer (BBR) were conducted on un-aged binders. The experimental results showed an improved performance of Dates Palm Ash-Modified Binder (DPA-MB) in terms of resistance against rutting at various temperatures. Finally, it can be concluded that it is feasible to use DPA as bitumen modifier and it will contribute in reducing environmental problems by recycling Dates Palm waste for sustainable pavement construction.

Keywords: Rheology,Temperature,rutting,DatesPalmAsh

Paper ID: CEST2017_00607

SESSION 11 – USE OF MICROWAVE COMMUNICATION LINKS AS NEAR-GROUND WEATHER SENSORS

Thursday 31 August 2017 –afternoon

Capitalizing on Cellular Technology – opportunities and challenges for Environmental Monitoring

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Abstract

The use of existing measurements from a commercial wireless communication system as virtual sensors for environmental monitoring has gained attention in the last decade. In particular, measurements of the received signal level (RSL) in the backhaul communication microwave network (CMN) of cellular systems are considered as opportunistic sensors for precipitation monitoring. Research results have demonstrated the use of the suggested technique for estimating and mapping of rain, as well as of monitoring other-than- rain phenomena. However, further advancement toward implementation and integration in e.g., meteorological systems and models, are heavily dependent on multidisciplinary collaborations: Communication and networks engineers are needed to enable access to the existing measurements; Signal processing experts can utilize the diverse data for improving the accuracy and the tempo-spatial resolution of the estimates; Atmospheric scientists are responsible for the physical modeling; Hydrologists, meteorologists and others can contribute to the end uses; Economists can indicate on the potential benefits; etc. etc.In this paper I will review recent results and open challenges, demonstrating the benefit to the public-good from utilizing the opportunistic-sensing approach, and as an IoT application

Keywords: Environmental monitoring, commercial microwave links, rainfall estimation

Paper ID: CEST2017_00240

[5] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Microwave-links in cellular backhaul networks: statistical studying and modeling

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Abstract

While the effect of rainfall and other environmental phenomena on a link budget in microwave wireless communication has been well studied for networks design, it has usually been done for each link separately. Recently, attenuation in multiple microwave links is used for rainfall mapping in specific areas, so rain-induced attenuation fields can be constructed. The novel algorithms which relate attenuation and rain-fields are useful for both weather monitoring and networks design. As the topology of microwave links network is region-dependent, general theory can only be developed statistically. In this paper we study the statistical nature of Cellular Microwave Networks and lay the groundwork for such model based on empirical results.

Keywords: Microwave links, rainfall mapping, rain-field estimation, network statistics

Paper ID: CEST2017_00282

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Vertical Precipitation Estimation Using Microwave Links in conjunction with Weather Radar

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Abstract

Precipitation measurements taken at a specific height, e.g., by weather radar, may not represent the precipitation amount that actually reaches the ground because of a Virga phenomenon, which particularly happens when the air below the cloud base is dry, and continues until humidity increases. In this paper we suggest a method of combining data from several weather radar beams and from a near ground Commercial Microwave Links (CMLs) in order to create a vertical profile of the rain-rate measurements. We propose an estimation method and demonstrate it on real-data measurements in the dead-sea area, and verify the validity of the estimation near ground by comparing the results with Rain Gauges' (RGs) actual measurements. The suggested method provides the best correlation results, with a correlation of up to 0.9615, when correlated with real measurements of RGs.

Keywords: Precipitation Estimation, Commercial Microwave links, Virga

Paper ID: CEST2017_00374

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Empirical Study of the Quantization Bias Effects in Commercial Microwave Links Min/Max Attenuation Measurements for Rain Monitoring

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Abstract

The potential of commercial microwave links to be used as sensors for rain monitoring depends heavily on the availability of the links attenuation measurements. The cellular operators which provide the majority of these measurements usually make use of the standard Network Management Systems (NMS), which log only a quantized version of the minimum and the maximum attenuation values (usually in 15-minute intervals). The non-linear min/max transformation and the quantizer, which are implemented on the channel attenuation measurements, should be considered during the rain-estimation procedures. In this paper, we examine actual NMS produced attenuation measurements taken from a commercial microwave link during multiple rain events. Using observations from rain-gauge and weather radar, we experimentally demonstrate that the output of the NMS includes bias, which in turn interferes with the rain-estimation process. We show that the detection and the compensation of this bias has the potential to increase the microwave links rain-estimation accuracy dramatically.

Keywords: Quantization Bias, Microwave Links, Precipitation Attenuation

Paper ID: CEST2017_00375

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Fundamental Study of Wet Antenna Attenuation

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Abstract

This article presents a fundamental view on the effect of wet antenna attenuation (WAA) in point-to-point radio links. Wet antenna attenuation is observed as an additional contribution to the overall received signal fading during rain events along the link path. A theoretical model of this effect is developed. It separates the total observed effect into three contributing processes, namely degradation of antenna efficiency, changes in directivity, and variation in antenna feed port reflectivity. The latter is characterized by the antenna's receptivity. To quantify these effects, a pyramidal horn antenna with different grades of radome wetness was analysed at 18 GHz using numerical full-wave simulation. Evaluation was done by generating a homogeneous water film on a prototype antenna and by performing a scan of the radiated near-field in an anechoic chamber. Antenna feed port reflectivity was measured synchronously by the network analyser of the near-field scanning system. In this way, antenna efficiency, directivity, and receptivity could be measured and compared to numerical results. This verified the ternary composition of WAA.

Keywords: wet antenna effect, microwave links, received signal level, radome wetness

Paper ID: CEST2017_00875

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A brief description on measurement data from an operational microwave network in Gothenburg, Sweden

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Abstract

The idea of using operational wireless communication links as a widely deployed sensor network for environmental monitoring has been successfully accepted both in academia and industry since the first papers from the early 2000s. Over ten years of research has shown promising results in various applications, primarily rainfall but also e.g. evaporation and fog. In this paper we will present measurement data from a joint pilot project by Ericsson, Hi3G Sweden and SMHI (Swedish Meteorological and Hydrological Institute). It includes a set of over 20 months' measurement of transmitted and received signal strength from an operational network of 364 bi-directional microwave hops in the Gothenburg area, Sweden. In total there are close to 7.5 billion measurement points with a time resolution of 10s. The purpose of this paper is to present key characteristics of the data set and to make some data available to research institutes around the world to encourage more cross disciplinary works in research topics such as environmental monitoring, sensor networks, big data analytics, machine learning etc. Researchers from different disciplines are encouraged to verify their models and algorithms on data from real communication networks.

Keywords: Wireless communication network, environmental monitoring, sensor network, data set

Paper ID: CEST2017_00472

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Microwave links improve operational rainfall monitoring in Gothenburg, Sweden

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Abstract

Microwave links (MWL) in operational telecommunication networks provide new opportunities to improve rainfall monitoring, especially in cities and low-income countries. We used signal strength data from 364 MWLs sampled every 10s to estimate rainfall in Gothenburg. We compared these estimates with conventional gauges and weather radar. We found that MWLs improve monitoring by providing: higher temporal resolution (1min vs. 15min), greater surface coverage (364 MWLs covering 1040km vs. 10 gauges covering 0.2m^2), higher spatial resolution of rainfall maps (0.25km^2 vs. 4km^2 for radar), better ability than radar to capture peak intensities at local scale, near-surface measurement (30m vs. 1200m for radar), and more robust sampling (10s vs. 15-min snapshots for radar). The MWLs captured temporal dynamics very well (correlation: 0.8), but generally overestimated accumulated volumes (+31%). We used the MWL data to build an operational real-time prototype providing 1-min rainfall maps online. MWLs could be combined with other sensors and models to improve flood forecasting and infrastructure design. Short-duration rainfall extremes are projected to increase in the future, increasing the risk of fast flood events. Hence, MWLs offers a timely opportunity to adapt current monitoring to the future climate, contributing to building more resilient and sustainable societies.

Keywords: accuracy, intense precipitation, opportunistic sensor, real-time monitoring

Paper ID: CEST2017_00249

Rainfall detection by tomographic inversion of commercial radio link data: a pilot project in Italy

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Abstract

Within MOPRAM project, we investigate the use of a network of microwave radio links to a) improve the accuracy and reliability of precipitation fields detection and rainfall estimation and b) to enhance the knowledge of river basins answer, and in particular the prediction of river discharge, based on the availability of more accurate space-time precipitation measurements. A tomographic technique is applied for the first time to reconstruct rain fields from link data collected by the backhauling network of a major mobile phone company operating in Italy. The raw data are a network's by-product, available at almost no-cost, once the network software is properly updated. The tomographic method has to be fine-tuned on the network's topology, to be stable even in the presence of noisy measurements and perform consistently. The proposed methodology could guarantee more accurate information about the rainfall fields with respect to weather radars (lacking in terms of quantitative reliability) or rain gauges (lacking in terms of spatial resolution).

Keywords: radio link, rainfall, tomography, flood

Paper ID: CEST2017_01233

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Atmospheric monitoring using commercial microwave networks

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Abstract

During the last decade, dozens of papers have indicated the ability of commercial microwave networks to monitor and map rainfall. However, other atmospheric phenomena also affect the radio channel, and cause interference that can be measured by these systems. While fog, water vapor and dew are among the additional hydrometeors that can cause signal loss, anomalies in the atmospheric refractive index identified with temperature inversions also affect these communication links. In this paper we review a variety of different research showing the ability that exists in this technology for environmental monitoring.

Keywords: Microwave links, fog, water vapor, dew, temperature inversions

Paper ID: CEST2017_01386

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

On the robustness of rainfall mapping from measurements of the received signal level in communication microwave networks

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Abstract

The use of existing measurements of the received signal level (RSL) at existing communication microwave networks (CMLs) for rainfall 2-D mapping has been recently shown to be a powerful tool. While previous contributions have focused on the rain mapping algorithms and their performance, in this paper we discuss their robustness. As the use of the RSL of microwave links as virtual sensors for rainfall monitoring is an unintended one, the signals are not optimized for best sensing conditions, and the signal processing algorithms need to deal with practical problems. Here we focus on the problem of outliers in the RSL measurements, which can be caused by technical failure or other reasons. We analyze the effect of outliers on the standard rain mapping algorithms, showing that the improved algorithm proposed by Goldstein et al. has inherent robustness. Then, we propose to modify it to further improve its robustness and we demonstrate how. The results are demonstrated with real data and simulations.

Index terms: Spatial interpolation, rainfall mapping, robustness, microwave links

Paper ID: CEST2017_01194

SESSION 12A – ENVIRONMENTAL ODOUR, MONITORING AND CONTROL (2)

Thursday 31 August 2017 –afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Simultaneous observations of moisture behavior and gaseous VOCs removal in a biofiltration system

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Abstract

Relationship between moisture behavior and removal efficiency of gaseous VOCs (volatile organic compounds) with packed tower type biofiltration has not been investigated enough. In this research, holding amount of nutrients, the amount of moisture evaporation, toluene and MEK (methyl ethyl ketone) gas removal were observed simultaneously in a biofiltration in which porous synthetic resin was used as the packing material. Holding amount of nutrient in one of the reactor is higher than other two ones, due to frequent supply of nutrient solution with the process of soaking of the packing layer. This reactor exhibited highest toluene gas removal, however, excess biomass growth was also observed. Another reactor, which was operated with less frequency of nutrient solution supply by soaking, showed a little less removal of toluene, possibly because of the lack of nutrient holding in the packing layer. One more reactor was operated with spraying of the nutrient solution to the packing layer as the common method of moisture supply, and the lowest toluene gas removal was obtained, mainly because of uneven nutrient supply. Moreover, evaporation ratio of moisture in the packing layer during the moisture supply interval was calculated, and heat balance was also evaluated.

Keywords: Biofiltration, gaseous VOCs, Moisture supply, Heat balance

Paper ID: CEST2017_00737

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Fugitive methane and odour emission characterization at a composting plant using remote sensing measurements

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Abstract

Gaseous emissions of biowaste treatment facilities have several adverse effects. In Germany, a law to collect biological waste separately was introduced in January 2015. Since then there is a discussion about greenhouse gases which could be emitted in a significant rate and exceed the positive aspects. Default factors for methane and nitrous oxide from biological treatments given by the Intergovernmental Panel on Climate Change (IPPC) suggests that fugitive emissions even from composting processes should not be neglected. The research work presents an innovative method to quantify fugitive methane and odour emissions at a composting plant. The proposed method uses a combination of a remote sensing measurements and the application of a backwards Lagrangian stochastic (bLs) based micrometeorological dispersion modelling. The remote sensing technology is based on the absorption of infrared light with a wavelength sensitive to the substance to be determined. With the downwind measured methane concentration deducted by the upwind measured background concentration and the known wind conditions, a gas dispersion is simulated back in time to estimate the gas emission rate of a plant. Using the methane emissions as a tracer for dispersion characteristics in the atmosphere it is even possible to estimate a more accurate odour emission rate from passive sources at composting plants.

Keywords: Composting, Methane Emissions, Odour Emissions, Remote Sensing, Biowaste

Paper ID: CEST2017_01042

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Odour management in landfill during the intermediate covering works: mitigation technologies and impacts assessment

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Abstract

Odours are among the main causes of complaints in regards to environmental issues for a variety of plants, including landfills. The emissions from landfills can lead the quality of life and negatively influence the area nearby. To protect people living surrounding from excessive odour exposures, different environmental protection practices may be implemented. In order to optimize technical and economic aspects, various configurations should be taken into account. In this view, the odour dispersion modelling represents a suitable tool to simulate different scenarios. In the present study, the odour impact from a big landfill located in Borgo Montello (Lazio Region, Italy) has been assessed by dispersion model. Different operating conditions were simulated, with a view at minimizing the odour annoyance also during the intermediate covering works. The Calpuff model was selected as it is well recognized among the preferred models for assessing the long range transport of pollutants. The Odour Emission Rates, input of this kind of models, were calculated based on the results of dynamic olfactometry. The results from the dispersion model were investigated to define the best measures for the control of the odour emissions during the most impactful operations.

Keywords: dispersion model, odour annoyance, environmental protection practices, control

Paper ID: CEST2017_01373

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Optimization of a HS-SPME-GC/MS method for analysis of multi-class off-odor compounds in water

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Abstract

Noticeable drinking water problems often involve unusual odors characterized e.g. as rancid, fishy musty, moldy, grassy or swampy. Numerous biogenic or anthropogenic volatile organic compounds of various chemical classes that are present in source water or are introduced during water treatment or in the distribution system can be responsible for those incidents. Chemical classes include e.g. terpenoids, aldehydes, ketones, alcohols, pyrazines, amines, phenols or sulfurous compounds that vary widely in physicochemical and sensory properties.
The aim of this study was to develop an optimized analytical procedure to detect, identify and quantitatively determine in one run a wide multi-class range of odor compounds in water using headspace solid-phase microextraction/gas chromatography–mass spectrometry (HS-SPME/GC–MS). The parameters studied include fiber type, salt addition, stirring rate (rpm), pre-incubation and extraction times, extraction temperature and desorption conditions. Design of experiments involved the screening of influential factors as well as response surface methodologies and desirability functions to determine optimum conditions for selected classes and for the whole multi-class range. Optimized conditions were further validated and protocols for class-targeted and multi-class non-targeted screening were developed. The method is applied as a diagnostic tool in source and drinking water samples and it is proved valuable as a diagnostic tool in cases of off-odor incidents.

Keywords: SPME, optimization, experimental design, water off-odors, GC/MS

Paper ID: CEST2017_00455

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Development of a method to evaluate odour quality based on non-expert analysis

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Abstract

Characterizing odour quality is a complex process that consists in identifying a set of descriptors that best synthesizes the olfactory perception. Generally, this characterization results in a limited set of descriptors provided by professionals in sensorial analysis. These experts previously learnt a common language to describe characteristic odour (Odour wheel or Champ des odeurs©). These sensorial analysis sessions cost industrial manufacturers large sums every year. If this characterization is entrusted to neophytes, the number of participants of a sensorial analysis session can be significantly enlarged while reducing costs. However, each individual description is no more related to a set of non-ambiguous descriptors but to a bag of terms in natural language. Two issues are then related to odour characterization. The first one is how translating free natural language descriptions into structured descriptors; the second one is how summarizing a set of individual characterizations into a consistent and synthetic unique characterization for professional purposes. This paper will propose an approach based on natural language Processing and Knowledge Representation based techniques to formalize and automatize both translation of bags of terms into sets of descriptors and summarization of sets of structured descriptors.

Keywords: Odour Quality, Natural Language, Information Fusion, Taxonomy, Semantic Proximity.

Paper ID: CEST2017_00611

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

On the importance of odour threshold to identify molecules responsible for the odour of a material

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Abstract

In the industrial environment, materials with unpleasant smell are a major problem. Indeed, the odour is one of the most important criteria in the selection, the purchase and the use of a material. An unpleasant odour can cause the rejection of the material by the consumer. Odour control is therefore an important industrial and economic issue. The difficulty is to combine physico-chemical and olfactometric data to identify chemical compounds responsible for the odour. Nowadays, the relationship between these two kinds of data is realized by an expert with his own knowledge. The identification efficiency of the concerned compounds depends on the expertise level. So, to decrease the result interpretation uncertainty, the aim of this project is to develop a protocol allowing to identify compounds of interest in the entire physico-chemical analysis results. This protocol will be developed in the form of an automated toolbox which combines statistical techniques. This identification should be as exhaustive as possible to identify compounds responsible for odour concentration and/or acceptability and/or quality. This tool will allow enhancing the reliability of the odorous compounds identification, realised by expert to this day.

Keywords: Odour, materials, data mining, modelling

Paper ID: CEST2017_00871

Catalytic decomposition of N_2O over Co-Ce mixed oxide catalyst

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Abstract: A series of CoCeOx catalysts with different ratios of Ce/Co were prepared by the hydrothermal method and their activities for the decomposition of N_2O have been investigated. It was found that CoO-CeO_2 mixed oxide catalyst showed higher activity than pure Co_3O_4 and CeO_2. The co-existence of Co_3O_4 and CeO_2 exhibited a synergetic effect, which inhibited the crystallization of the Co_3O_4 phase, leading to the high surface area. More importantly, the redox property of CoO-CeO_2 mixed oxide is also improved due to the interaction between Co_3O_4 and CeO_2. As a result, CoCeOx catalyst exhibited high activity for the decomposition of N_2O.

Keywords: Nitrous oxide; Co-Ce mixed oxide catalyst; Catalytic decomposition

Paper ID: CEST2017_00379

SESSION 12B – ENVIRONMENTAL PLANNING, MANAGEMENT AND POLICIES (1)

Thursday 31 August 2017 – afternoon

Utilization and sustainable development of mountain areas and environmental impact of possible overexploitation

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Abstract

Tourism is one axel of development in Greece. Mountainous areas, with altitude over 700 m, cover 53% of Greece and they are characterized by low population density and long-term unemployment. The Greeks have a dependent connection among environment, economy and society as the history illustrates. The tourism industry is most improperly maintained, or their benefits are minimal compared with the current price per visitor. The aim of the work is to estimate how tourism can utilize a mountainous area based on sustainability but there is always the possibility of overexploitation and that can cause unexpected environmental impacts. The study area is held at Samarina region, a mountainous area of Northern Pindos in Greece. Social data were collected with questionnaires and local visits for better understanding of human resources for forest authorities and other administrative information's. Forest inventory data and tourism data have been derived by previous studies. The development of a Spatial Decision Support System that can concern all the conditions that are need in order to make an estimation of the optimal way of measuring the footprint of tourism in natural environment is really a challenge. A GIS powerful decision support tool is proposed, which can give to the sustainable planners the opportunity to choose the optimal way to develop tourism with an environmental friendly way.

Keywords: utilization, sustainable development, tourism, mountainous area, environmental footprint.

Paper ID: CEST2017_01003

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Policy analysis and recommendations for EU CO_2 utilisation policies

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Abstract

To safeguard the competitiveness of energy-intensive industries, in light of lower-cost energy supplies elsewhere, Europe requires combined resource and energy efficiency technology. Most technical components of CO_2 utilization can in principle be mobilized in Europe in the short term. Nevertheless, infrastructural, logistical, regulatory and business strategic issues must be addressed imminently by all relevant stakeholders. Given the already dense EU policy landscape, industry stakeholders need to assess first the applicability of the current framework and then the impact that policy changes could bring. Notably, connectivity infrastructure requires more analysis and coordination. This paper presents relevant policies to support CO_2 utilisation along the value chain. It outlines the applicability of current policy and benefits of policy enhancements to address barriers to deployment of CO_2-derived products. It also lays out the role of key stakeholders to effect appropriate changes in policy. Finally, it explores the justification for a CO_2 Utilisation Directive, comparable to the Carbon Capture and Storage Directive.

Keywords: CCU, EU Policies, CO_2 Utilisation Directive, Resource Efficiency

Paper ID: CEST2017_00911

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Application of systems thinking in the management of a mineral resource active region.

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Abstract

Most mineral active regions with stocks of mineral and energy resources have undergone decades of extraction, 'fueling' economic development. Although some countries have benefited greatly from mineral extraction and have pursued policies to translate mineral wealth to human and fixed capital, others have failed to capitalize on these, whilst often left with the environmental damage of extractive activities and trade-offs on social and economic variables. Inequity in distribution of resource benefits and cost predispose these regions to conflicts, whilst flows of interaction amongst economic, environmental, and social variables that evolve over time underpin the complex structure that exists in resource systems. These interactions make mineral active regions complex to manage and obscure efforts toward sustainability. Several of the models that evolved to manage subsoil mineral resources lack holistic and multi-disciplinary perspective and fail to address the complexity of the issues. The potential of systems thinking to address these limitations and deliver holistic solutions that are not simply based on competition but collective system benefits has been investigated here in the context of a case study. Findings demonstrate the potential of employing systems tools in understanding and communicating the complexity of these regions, with a conceptual framework for how resources and stakeholders are 'connected' within a 'texture of interdependencies' proposed as an integrated and holistic way to improve management of these regions.

Keywords: Mineral active region. Systems thinking. Sustainability. Environment. Socio-economic.

Paper ID: CEST2017_01262

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Level of service analysis for urban public transportation of Dumlupinar University Evliya Celebi Campus in Kutahya, Turkey

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Abstract

In this study, the public transport system problems between Kutahya city center and Dumlupinar University Evliya Celebi Campus were firstly mentioned. Then, the transit quality of service was evaluated from various aspects such as transit availability, comfort and convenience. For this purpose, at first, transit availability was examined in terms of service frequency and hours of service. Secondly, the comfort and convenience provided by the transit system in Kutahya Dumlupinar University Evliya Celebi Campus was studied. For this reason, the overall crowding levels within the vehicles, headway adherence, and transit-automobile travel time were considered. In order to carry out most of these analyses, the procedures in Transit Cooperative Research Program (TCRP) Report 100 were followed. Finally, the results compared to 2011 results and several recommendations for increasing public transport usage were given.

Keywords: The City of Kutahya, Dumlupinar University, Public Transport, Level of Service, Quality of Service

Paper ID: CEST2017_01290

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ship's environmental performance monitoring in real time using big data techniques

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Abstract

Recently European Union has been proposed a system for monitoring, reporting and verifying (MRV) of CO2 emissions from large ships using EU ports. Ships would thereby be obliged to monitor four parameters on a voyage basis, namely fuel consumption, distance travelled, time spent at sea, and cargo carried. The monitored parameters would need to be verified and different indicators based on these parameters would have to be reported on an annual basis. In our paper a real time systems is proposed based on complex event processing for early detection of any risks created from the monitoring of MRV's . Stream reasoning is an approach that can be used if information (in the form of assertions) arrives as a stream of (time stamped) inputs. The approach has two features that could be helpful: the knowledge base can be continuously updated and reasoning goals continuously re-evaluated as new assertions arrive, the reasoner considers events from a finite time window, and not only at a single instant. A conceptual framework, inspired from airport electronic data real time risk assessment for resilience, for MRV anomaly detection is presented helping ships to early identify and correct arising risks.

Keywords: maritime environment, MRV, big data, stream reasoning

Paper ID: CEST2017_00965

SESSION 13A – AGROFORESTRY AND THE ENVIRONMENT (2)

Thursday 31 August 2017 – afternoon

The traditional agrosilvopastoral valonia oak systems in Kea island - Greece: productivity and ecosystem services

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Abstract

One of the most distinctive valonia oak agrosilvopastoral system in Greece is found in the Aegean island of Kea - Cyclades. Agriculture is not easily practiced in the island due to the xerothermic climate and the rough terrain with steep slopes, rending agrosilvopastoralism with valonia oak an ideal option to support the local economy and preserve the environment. Actually, the characteristic terraces of the island, constructed by the locals since ancient times, are a reference point for the character and economy of the island. These systems are nowadays threatened by abandonment and change of land use (mainly for touristic purposes) endangering by loss of the traditional activities and environmental functions. In a meeting that was organized under the framework of the AGFORWARD (FP7) research project, local stakeholders of the island expressed their interest for the multiple products and uses that this system provides. Based on their suggestions, an experiment was conducted in a traditional system of the island. Two commercial pasture mixes were tested for their productive capacity under shade. Species composition and biomass production were recorded for two years. Shading by valonia oak affected biomass production from both commercial mixtures. The importance of the environmental and economic function of this system is highlighted and suggestions are made for its preservation.

Keywords: Agroforestry, agrosilvopastoral system, Mediterranean region, Quercus ithaburensis subsp. Macrolepis

Paper ID: CEST2017_00927

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of agroforestry systems on pollination services

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Abstract

Mosaic landscapes with hedgerows and agroforestry benefit pollinators, which in turn are needed for crop pollination. Depending on tree age and species, they provide nesting and foraging resources in different quantity and quality and are a source and a refuge for pollinators and their service. As part of the FP7 AGFORWARD project we investigated the added value of agroforestry on landscape scale for wild bees. The research was conducted in eight 1 km^2 landscape test sites (LTS) in north-western Switzerland. The predominant agroforestry system of the region is traditional cherry orchards. Intending to sample contrasting test sites, four LTS were selected with a high percentage area of cherry orchards and four with low coverage. We assessed the spatial distribution of flowering resources and availability of nesting sites to estimate the potential pollination service and we modelled three scenarios: flowering trees, non-flowering trees and without trees on a landscape scale. Flowering and nesting facilities were mapped and the flowering value of cherry trees by counting the amount of flowers on 22 randomly selected trees was assessed. Lonsdorf equations were used to assess the pollinator-habitat interaction. The results indicate that landscapes with agroforestry containing flowering trees increase the provision of pollination services at landscape scale.

Keywords: Agroforestry, Pollination, Biodiversity, Landscape

Paper ID: CEST2017_00930

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Agri-environment measures and Agroforestry European main agricultural driver is the Common Agricultural Policy (CAP)

Santiago Freijanes J.J.[1], Rigueiro-Rodríguez A.[1], Aldrey J.A.[1], Pantera A.[2] and Mosquera-Losada M.R.[1,*]

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Abstract

CAP delineates a common framework to pay the funds to the European Farmers. CAP is divided in two main parts: Pillar I and Pillar II. Pillar II is dealing with the environment and usually linked to the agroforestry implementation. However, Member states have to select from a series of options (i.e. measures) to adapt this CAP to their own environments but also socio-economic situations. One of the most used option to promote agroforestry is the agrienvironment measure identified with the number 214 in the CAP 2007-2013 and with the number 10.1 in the 2014-2020. This paper, aims at to evaluate how agroforestry is promoted through agrienvironment measures in the Mediterranean area of Europe in the CAP.

Keywords: silvopasture, silvoarable, hedgerows, forest farming and homegardens.

Paper ID: CEST2017_00603

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Agroforestry and the CAP: a land use system to be promoted to fulfil Sustainable Development Goals

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Abstract

Agroforestry understood as the deliberately integration of woody vegetation in at least two vertical layers on land, with the bottom layer providing an agricultural product (such crops or forage/pasture which may be consumed by animals) is gaining popularity in different statements to be promoted as sustainable land use practice or system system. Main advantages of agroforestry are related with the better use of the resources, starting by radiation, which allows to increase productivity while reducing negative environment impacts. Different international organizations are also pointing out the relevance of agroforestry for climate mitigation and adaptation. In this paper the main reasons for considering agroforestry as sustainable land use system is discussed under the umbrella of the United Nations Sustainable goals.

Keywords: resource optimization use, perennials, ecosystem services

Paper ID: CEST2017_00671

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Forage-SAFE: a tool to assess the management and economics of wood pasture systems

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Abstract

The Forage-SAFE model has been developed to better understand the impact of trees on the profitability of wood pastures. It assesses the daily balance between the demand for and production of forage to estimate an annual farm net margin. The model allows the modification of selected biophysical and financial parameters related to the tree, pasture and livestock components (such as tree cover density, carrying capacity and livestock species) which can be optimised to maximise net farm income. A case study in a dehesa wood pasture in South-western Spain was used to show the applicability of the model. The case study results showed that net margin was maximised at around 27% tree cover for a carrying capacity of 0.4 livestock unit per hectare from which 61% were ruminants and 39% Iberian pigs. The analysis also showed that high carrying capacities were positively correlated with tree cover profitability. This was accentuated as the proportion of Iberian pigs increased

Keywords: Forage-SAFE, wood pasture, tree cover, bio-economic, profitability

Paper ID: CEST2017_00623

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Pollination biology of *Hemiboea ovalifolia* (Gesneriaceae), an endangered herb from Guangxi, China

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Abstract

Although information on the reproductive biology of the endangered plant family *Gesneriaceae* is well known, the pollination mechanisms of these plants in karst regions are poorly understood. To determine the pollination ecology of *Hemiboea ovalifolia*, a rare and highly geographically restricted endemic species in karst regions, flowering phenology, pollinator observations, and pollination manipulations were conducted in situ. Findings revealed that the anthesis of *H. ovalifolia* often occurred late, during sunset, or early morning, with duration of 2–4 days. The most effective pollinators were *Bombus ignitus* and *Anthophora zonata*. The co-existence of spontaneous self-pollination, protandry and herkogamy in *H. ovalifolia* suggested that this species outcrosses with partial self-compatibility, and exhibits late-acting inbreeding depression in seed sets. Controlled pollination indicated that these plants were pollen limited resulting from the seed set. However, despite the co-existence of large numbers of fruit and seed sets, and vegetative propagation in *H. ovalifolia*, a failure in seedling survival and long duration to establishment of first-year seedlings in natural populations suggests that the species does not easily recover from damage.

Keywords: *Hemiboea ovalifolia*; pollination biology; late-acting inbreeding depression

Paper ID: CEST2017_01119

SESSION 13B – FOOD WASTE

Thursday 31 August 2017 – afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Energy recovery potential by utilising campus food waste in a biogas plant

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Abstract

Estimation of food waste generation represents the first step when considering the energy recovery through the anaerobic digestion. Food waste in universities is produced when students menus are prepared and from leftovers. The estimated food waste daily production from the main university campus canteen in Aristotle University Thessaloniki, Greece, was ranged between 319 and 359 kg. The maximum food wastage during preparation was comprised by cabbage, peeled potatoes and onion and it was 44% w/w of total estimated food waste, while the rest quantity of 56% w/w was mainly leftovers. Aim of this manuscript was the overview of the main constraints and prospects of energy recovery from food waste generated in the main university campus canteen. A literature review took place for evaluating the energy recovery through the anaerobic digestion process of the food waste mentioned above and the potential for their utilization in a biogas plant was assessed.

Keywords: Food waste, campus, biogas

Paper ID: CEST2017_01144

The Chestnut Shell/Kaolin - Reinforced Hybrid Polyester Composite: Preparation, Characterization

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Abstract

The developing world comes to face with unconscious consumption and waste formation as a result of industrialization and urbanization. Urban and food factories bulky food waste is a very heterogeneous material flow usually destined to landfill. Many researchers have been changing their research direction is to improve the end-of-life and disposal of the complex products. Many food processing wastes are suitable to treatments to increase the quantity and quality of recovered materials with highest environmental impact.In this work, one such industrial food waste, chestnut shell fiber and 2 different kind of kaolin were tested comprehensively for their potentiality as reinforcement in polyester matrix to optimize the mechanical properties. Samples not only with chestnut shell and without kaolin but also with kaolin and without chestnut shell exposed for many tests to determine the effect of chestnut shell/kaolin contents on the mechanical, microstructural, thermal and water absorption properties of polyester composites. The polymer composites were characterized by scanning electron microscope, thermogravimetry analysis

Keywords: Chestnut shell waste, Kaolin, Polyester Composite, Thermo-Mechanical Properties, Characterization

Paper ID: CEST2017_00456

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

On the exploitation of kitchen biowastes for ethanol production via co-cultures of the yeasts *Saccharomyces cerevisiae* and *Pichia stipitis*

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Abstract

In the present study, the biotransformation of the pre-dried and shredded organic fraction of kitchen wastes (OFKW) to ethanol was investigated, using mono- and co-cultures of the yeasts *Saccharomyces cerevisiae* and *Pichia stipites*. OFKW represents one of the main type of food wastes that are generated in huge quantities annually and consists of up to 60% of simple and complex carbohydrates. Preliminary experiments with glucose as the sole carbon source were performed, in order to investigate the effect of different operational parameters on the ethanol production efficiency of the co-culture. Subsequently, the ethanol production efficiency from the OFKW was assessed via simultaneous saccharification and fermentation experiments. It was shown that the pH control and the addition of nitrogen were among the key factors for the optimization of the process, and also that the co-cultures led to higher ethanol yields and substrate consumption.

Keywords: bioethanol, kitchen wastes, co-cultures

Paper ID: CEST2017_00510

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Granular activated carbons from avocado seeds

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Abstract

Avocado seeds have proven to be an excellent raw material for the production of Granular Activated Carbons (GAC). This residue, generated in large amounts in centralized facilities dedicated to the transformation of avocado fruit, has no commercial value at present. GAC have been produced by partial gasification of ground seeds under mildly oxidizing conditions (steam/nitrogen mixture). Optimum activation conditions were achieved at 1000 ºC and residence times between 120-150 min, resulting in burn off rates between 34-37 wt% and carbon yields between 12.4-13.0 wt%. These GAC exhibited type IV N_2 gas adsorption isotherm, characteristic of materials containing a mixture of micro and mesopores. Avocado seed GACs exhibited BET surface areas up to 700 m^2/g, CO_2 surface areas up to 900 m^2/g and micro-pore volumes up to 0.31 cm^3/g. This porous structure provided these GAC with a remarkable aqueous adsorption capacity for methylene blue (Langmuir qm = 153.8 mg/g and Freundlich Kf = 113.0 mg/g), which was greater than that determined for a range of GAC commercialized for the treatment of waste and drinking waters.

Keywords: Activated carbons; avocado seeds; adsorption; porosity; surface area

Paper ID: CEST2017_00934

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Collecting food wastes from hospitality units as part of the F4F Life Project: Quantity, Quality and Cost

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Abstract

Food waste is increasingly produced in line with economic development and population growth. Improper management of food waste creates human health and environment problems. During this study, the quantity and quality of food wastes produced in 4-star and 5-star hotels in the island of Crete, Greece was examined. In addition a cost analysis was conducted. A list of hospitality units in the area was created and a survey regarding their needs took place. This survey aim to evaluate: a) the existing source separation system of organic wastes, b) the storage conditions of these wastes, c) the deployed tools (bags, bins etc), d) the quality and quantity of the separated wastes (composition analysis), and e) the existing municipal wastes collection system.

Keywords: collection system, hotels, food consumption

Paper ID: CEST2017_01121

Food waste prevention in the hospitality and food service sector in Greece

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Abstract

According to the United Nations Food and Agriculture Organization (FAO, 2014), almost one third of food (approximately 1.3 billion tonnes per year) produced all over the world for human consumption is spoiled or wasted. Food loss and waste cost the world about $1trillion a year. In particular, in the hospitality and food sector in Greece, an estimated 300,000 tonnes of food is wasted every year (Kaysenet al., 2012). In this paper, the food waste management practices of the hospitality sector (i.e. hotels and restaurants) are reviewed. The strategies of the hospitality sector are further underlined in terms of initiatives and practices, which have been implemented worldwide to facilitate sustainable waste management. In literature, reports on food waste generation and prevention practices in the hospitality sector are still very limited. Detailed recording of flows and waste production at the different critical points of the food preparation and service chain, has been proven to be an effective waste prevention process, as it has demonstrated a significant potential to reduce the food waste production in hotels. Additional studies, in various geographic regions and on different hospitality types, need to be conducted for the investigation of food waste production and good practices to move food waste management up in the waste management hierarchy.

Keywords: Food waste prevention, hotels, hospitality sector.

Paper ID: CEST2017_01401

PLENARY SESSION

Friday 1 September 2017 – morning

Urban mining as a sustainable strategy for the management of residual solid waste

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Abstract

The production of waste represents a pressing issue and its sustainable management is being regarded as one of the greatest challenges of this century. Over the years waste handling strategies have moved from landfilling, often performed under uncontrolled conditions, to recycling processes, in order to reduce the environmental footprint of residue disposal. Although more recently the need to prevent waste production has been pointed out, the relation between consumption patterns and waste production limits the reduction of both amount and hazardousness of waste. This issue is even more serious as it comes along with the depletion of resources aiming at the production of those goods destined to become waste. The level of waste generation is indeed directly related to economic development, rate of industrialization, and public practices Therefore the decoupling of prosperity from resource consumption has been identified as a suitable strategy to promote the decrease of both resource consumption and waste generation, addressing a circular economy approach over the traditional linear one. In a circular economy, the production of goods is preferably pursued by either the use of by-products or waste recycling rather than by virgin resource consumption, so as to close the loop of material streams.

The proper implementation of such approach requires the definition of strategies aiming at the extraction of resources from waste for their reuse, recycle and recovery. Although the regulation enforced in most countries worldwide have been promoting the source sorting of waste for recovery purposes, the possibility of extracting further resources from urban material deposits have driven the development of the "urban mining" concept. Brunner (2011) stated that urban mining refers to the "systematic use of anthropogenic materials from urban areas, which host large stocks of materials in different forms", useful to be reclaimed in order to pursue resource conservation, environmental protection and economic benefits as well.

The strategy of urban mining has been largely applied in landfills, with the aim of recovering materials from the disposed waste as well as of restoring the area used for waste burying and, more recently, it has turned to be applied to different kinds of waste deposits. In Campania Region, urban mining has been proposed to manage the residual waste stored in form of bales in different regional sites.

Waste bales represents the main cumbersome expression of the solid waste management crisis that Campania Region has experienced for more than a decade. In that period, due to administrative difficulties, poor separate collection and substantial shortage of waste processing facilities, the most significant portion of municipal solid waste ended up in the unsorted stream, destined to mechanical and biological treatment plants. The overload of these plants turned into the production of a mechanically sorted rest waste that could not be classified as Refuse Derived Fuel (RDF) and was thus stored in bales.

Preliminary characterization of this waste showed a significant portion of plastics that can be processed for the recovery of either material or energy, as pointed out in studies reporting similar experiences. However the specific characteristics of waste bales, the chemical-physical and biological processes that this waste has undergone over time represents two of the main challenges in the identification of a sustainable process scheme for their recovery under the concept of urban mining

This condition poses the issue of the actual feasibility of urban mining strategies, under both a technical and an economic point of view. Despite the high potential of urban mining strategies, the state of the art of their application is still theoretical. Such aspect limits the identification of applicable systems but opens wide research opportunities for the development of methodology to assess the performance of such activities as well as that of technologies for their sustainable implementation.

Keywords: recovery, resource, solid waste

[6] Invited speech

Paper ID: CEST2017_01438

SESSION 14 – WATER AND WASTEWATER TREATMENT (3)

Friday 1 September 2017 – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Comparative study to assess phosphorus removal from wastewater using aluminum modified clay and chitosan lanthanum adsorbents

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Abstract

This study compares the efficiency of removal of phosphorus from wastewater using two different adsorbents. The first adsorbent is a clay based adsorbent, and the second one is chitosan based adsorbent. The bentonite based adsorbent has been prepared by adding a solution containing hydroxy polycation of aluminum to bentonite suspended in distilled water. The resulting modified clay was filtered and washed many times with distilled water. After filtration, the aluminum-modified clay adsorbent was dried and ground to a suitable size for adsorption experiment. The chitosan lanthanum adsorbent has been prepared by modifying chitosan solution using lanthanum chloride solution. The La (III)/chitosan ratio was chosen to be 112 mg La/g of chitosan.The resulting lanthanum chitosan mixture has been added to a solution containing 6N NaOH to allow the formation of Ct/La flakes. The Ct/La flakes have been collected using a small mesh and washed many times with distilled water. The dried flakes have been used as an adsorbent for phosphorus removal. Results showed that both adsorbents fitted well to the Freundlich and Langmuir adsorption isotherms with R^2 values above 0.95. It was found that the adsorption capacities for Al-Bentonite and La-chitosan were 10.71 and 17.9 mg p/ gm adsorbent respectively. Kinetic studies showed that the two adsorbents were well presented by the pseudo-second order kinetics. The pseudo second order rate was found to be 0.00543, and 0.0021 for Al-Bentonite, and La-chitosan respectively. The study concludes that Ct Lanthanum is effective adsorbent and more efficient that aluminum modified bentonite

Keywords: Phosphorus Removal, Adsorption, Chitosan Lanthanum Adsorbent, Aluminum Modified Clay, Wastewater Treatment.

Paper ID: CEST2017_01239

Prediction of required ozone dosage for pilot recirculating aquaculture systems based on laboratory studies - Study case

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Abstract

In recirculating aquaculture systems (RAS), the water quality changes continuously. Organic and inorganic compounds accumulates creating toxic conditions for the farmed organisms. Ozone improves water quality diminishing significantly both bacteria load and dissolved organic matter. However, in a non-meticulously designed system, residual ozone might reach the culture tanks causing significant harm to cultured species or excess costs. The aim of the study was to predict the suitable ozone dosage in pilot RAS, for water treatment purposes, based on laboratory studies.The ozone effect on water quality of freshwater RAS and system's ozone demand was investigated. Bench-scale ozonation experiments revealed the ozone demand of the system to be 180 mg O_3/h. Three different ozone dosages were applied to four replicated systems with fixed feed loading (1.56 kg feed/m^3 make up water). Results suggested that the optimal ozone dosage was 15g O_3/ kg feed. Selected water quality parameters were measured, assessing biofilters performance as well as nitrogen and carbon–based compound concentration change during ozonation. Overall, this study contributed to a better understanding of the challenges of an ozonated RAS leading to the optimal design of such systems.

Keywords: Ozonation, water quality, recirculating aquaculture systems, pilot-scale, laboratory study

Paper ID: CEST2017_01256

The potential anaerobic-aerobic treatment of increased strength wastewater as a result of the use of food waste disposal units (FWDs)

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Abstract

Anaerobic treatment of increased strength wastewater (WW) as a result of the use of food waste disposal units (FWDs) is considered to be an economically viable intervention. This is because of its potential methane (CH_4) generation and the production of reduced amount of sludge at low capital and operational costs. However, the anaerobic treatment performance in cold areas (<20°C) is considered to be inefficient, necessitating an additional aerobic biological step to ensure the remove of residual carbon and nutrients. This paper using the GPS-X Hydromantis simulator assesses the potential integration of anaerobic-aerobic treatment processes for enabling the successful treatment of increased strength WW at low temperatures, using the UASB reactor as a high-rate bioreactor. Findings demonstrate that while low temperature can be a limiting factor to the performance of anaerobic treatment of increased strength WW, its benefits over conventional aerobic treatment processes may support its uptake. Gaining an improved insight into its limitations and how these can be solved, and investigating its social, economic and environmental aspects, is critical in determining the potential opportunities and threats that this intervention can create. Further research developments should focus on exploring the potential of new technologies and interventions developed in this area of research in order to inform the development of a viable and sustainable plan that could retain the full value of food waste and WW generated, either in the same or separated pathways.

Keywords: Food waste disposal units (FWDs), anaerobic treatment, WW treatment, methane production, GPS-X Hydromantis simulator

Paper ID: CEST2017_01069

Evaluation of Drip and Sprinkler Irrigation during the Germination period of Cotton Crop in Central Greece

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Abstract

A research was conducted at the experimental farm of University of Thessaly, in Velestino, Central Greece, during 2015. Traditionally, Greek farmers use sprinkler irrigation after sowing and during the germination period of cotton and drip irrigation during the rest growing period. The economical cost to buy, maintain and use two different irrigation systems is not economically affordable for them, usually. The objective was to study if drip irrigation system could replace the traditional sprinkler one during germination of cotton. Three treatments in three replications were organized in a randomized complete block design: A) Sprinkler irrigation system (SPI), B) Drip irrigation system with emitter spacing at 0.33cm (DI33) and C) Drip irrigation system with emitter spacing at 0.80cm (DI80). After the seed emergence, the same drip irrigation system with emitter spacing at 0.80m was used in all treatments and the irrigation scheduling was based on the daily evapotranspiration (ETd) as it was calculated by the FAO Penman-Monteith method. The total number of germinated plants per m^2 as well as the final seed cotton production was measured. The results showed that between the treatments there were no differences in the total number of the germinated plants and the total cottonseed production ($P<0.05$).

Keywords: Drip, Sprinkler, Germination, Cotton.

Paper ID: CEST2017_01232

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of Waste Water of Boron Industry on Mortar Properties

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Abstract

During boron production, too much waste water (WW) and mud are composed. People build ponds for the storage of WW. There ponds damage environment and vegetation. Because of boron content, these stored WW cannot find recycling opportunities in industry. Concrete technology may be appropriate for the elimination of wastes in such large quantities. Efforts to utilize WW in concrete is still under discussion. The literature for the utilization of boron in concrete technology but there is no study for WW which is composed during boron production. This study was done to eliminate this deficit. For this purpose, the WW was supplied from Eti Maden Kırka Boron Management. WW was replaced in mortar production by mixing water in the ratio of 0, 10, 20, 40%. Half of the specimens placed in standard cure 28 days, other half placed in the WW 28 days at a constant temperature. Unit weight, ultrasonic pulse velocity, flexural strength and compressive strength experiments were done on the specimens in order to determine the impact of the WW on the mortar properties. As results of the experiments, WW increase the setting time and reduce the strength. Especially in the hot weather, problems arising from early stiffing can be eliminated by using WW. But in the cold weather using this WW is not recommended because of the fact that setting time delays and by using WW this setting time will increase a lot.

Keywords: waste water, boron, physical properties, mortar.

Paper ID: CEST2017_01293

New approach to municipal grey water footprint estimation: A case study for Aegean Region cities in Turkey

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Abstract

This study aimed to develop an approach to investigate grey water footprint-GWF of municipalities in the Aegean Region in Turkey. In this scope 8 out of 81 cities were analyzed in terms of their waste water production (volume), waste water treatment (type of treatment, waste water receiving media etc) in the country. Data was handled, within the series of waste water official surveys at a municipal level published annually/bi-annually by the National Institute of Statistics (TUIK) since 2001. "Total Nitrogen TN" has been selected as a reference variable for GWF calculations. The required additional data/information for the calculations was natural/background nitrogen concentrations, maximum allowable nitrogen concentrations for water bodies. Grey water footprint was calculated for each single city and then spatial differences were determined. Study results revealed that GWF was changeable from one city to another (450-1150 m^3/ca.yr). Higher GWF (treated) compared to the GWF (un-treated) in some regions was explained by higher treatment rate of wastewater. Observation of relatively high values for GWF (treated) in some places was due to type of water treatment processes. Availability of N removal process at treatment plans was major impact on low GWF value. It can be concluded that GWF could be indicator to investigate effectiveness of wastewater management strategies, and determine its environmental effects.

Keywords: GWF grey water footprint, natural background concentration, maximum allowable concentration

Paper ID: CEST2017_01310

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Pharmaceuticals, toxicity and natural fluorescence intensity of biologically treated hospital wastewater removed by pilot and laboratory scale ozonation

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Abstract

We studied a bubble reactor based pilot ozonation system for removal of pharmaceuticals and toxicity from biologically treated hospital wastewater. To remove degradation products generated by ozonation, polishing with suspended biofilm carriers investigated. Removal of pharmaceuticals was comparable between the pilot treatment using a bubble column and offline laboratory experiments applying batch ozone addition. The removal rate constants of pharmaceuticals were normalized to dissolved organic carbon (DOC) and thus the efficiencies were comparable to literatures. Natural fluorescence intensity was used as an easily measurable parameter for the oxidation of organic matter in the wastewater. The remaining fluorescence after ozonation decayed slowly with holding time, but was removed fast by biofilm carriers simulating a possible polishing of ozonated effluent in a downstream biofilter. The toxicity of the hospital wastewater as measured with Microtox® and was found to reduce from 80 % to 50 % inhibition with the biological treatment. Ozonation reduced the inhibition further to 20%.

Keywords: Pharmaceuticals; Ozonation; Toxicity; Fluorescence

Paper ID: CEST2017_01393

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Study of disinfection efficiency of peracetic acid (PAA) on *Escherichia coli* by rapid colorimetric assay based on enzymatic substrates after eliminating hydrogen peroxide from the commercial PAA mixture

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Abstract

Disinfection of combined sewer overflows (CSO) is a quick approach to reduce the indicator bacteria (*E. coli* and *Enterococcus spp*) to maintain the bathing water quality on the receiving waters when CSO are discharged. Peracetic acid (PAA) has been used to disinfect combined sewer overflows.

This study was conducted to investigate the disinfection efficiency of PAA against *E. coli* when hydrogen peroxide was removed from the commercial PAA mixture. Furthermore, disinfection efficiency of PAA, commercial PAA and hydrogen peroxide against *E. coli* was compared. Disinfection efficiency of PAA against *E. coli* was studied by using rapid colorimetric assay using enzymatic substrates 6-Chloro-3-indolyl-β-D-galactopyranoside (Red-Gal) which develops dark red when it reacts to the β-galactosidase enzyme of *E. coli*. The resulting color intensity from the enzymatic substrate interaction was correlated to the bacterial concentration by using plate count method. Median inhibition concentration (IC_{50}) of PAA without hydrogen peroxide, commercial PAA and hydrogen peroxide on *E. coli* was determined by using the area under curve (Ct). IC_{50} of PAA alone on *E. coli* was 32 mg·min/L whilst IC_{50} of commercial PAA was 23 mg·min/L.

Keywords: Disinfection, Peracetic acid, *Escherichia coli*, Red-Gal, Combined sewer overflow

Paper ID: CEST2017_01060

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A novel high retention enzymatic bioreactor system for the removal of pharmaceuticals and personal care products

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Abstract

In previous studies we developed an enzymatic bioreactor coupled with an ultrafiltration (UF) membrane, which prevented enzyme washout, thereby allowing continuous enzymatic degradation of pharmaceuticals. Moreover, some resistant compounds such as naproxen and salicylic acid were retained by enzyme gel layer formed on membrane surface, subsequently resulting in their enhanced biodegradation. Based on this observation it was postulated that integration of high retention membranes with an enzymatic bioreactor can facilitate biodegradation of recalcitrant compounds by retaining both enzyme and PPCPs. This study explores a novel membrane distillation-enzymatic bioreactor (MD-EMBR) system for the removal of PPCPs including four pharmaceuticals namely, diclofenac, naproxen, salicylic acid and ibuprofen as well as two ingredients of personal care products namely, oxybenzone and salicylic acid using purified laccase from genetically modified *A. oryzae*. The results confirmed almost complete retention (>95%) of the PPCPs by the MD membrane. Of particular interest was the fact that the complete retention of the PPCPs improved the enzymatic degradation (10-30%) of compounds that have been reported to be poorly removed in UF-EMBR. Addition of 1-hydrozybenzotriazole improved the oxidation reduction potential of the solution in the enzymatic bioreactor by 16%, thereby enhancing the degradation of diclofenac, naproxen, salicylic acid and ibuprofen by 5-22%. Toxicity analysis showed that the final effluent of MD-EMBR system was nontoxic.

Keywords: Membrane distillation-enzymatic bioreactor (MD-EMBR); Pharmaceuticals; Laccase; Redox-mediators; Effluent toxicity

Paper ID: CEST2017_00450

Continuous removal and degradation of β-lactam antibiotics using organoclay-packed column

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Abstract

β-Lactam antibiotics in water were rapidly removed and degraded by using didodecyldimethylammonium bromide (DDAB)-bentonite (BT) organoclay. The removal increased with increasing the amount of DDAB in the organoclay and could be correlated to the aqueous-octanol distribution coefficient of antibiotic. The degradation of antibiotics significantly increased by the organoclay sorption. Even under the mild conditions (pH 7 and 25 °C), penicillin G (m/z = 335) and oxacillin (m/z = 402) completely degraded into their penicilloic acids (m/z = 353 and 420, respectively) missing β-lactam ring within 24 h. An organoclay-packed column was successfully used for continuous removal and degradation of oxacillin in water and synthesized hospital wastewater. Adjusting flow rate allowed the occurrence of the effluent containing no oxacillin but only its degraded products. Application of this method may reduce environmental risk of antibiotics that can interfere microbial ecosystem.

Keywords: β-Lactam antibiotics. Organoclay. Removal. Degradation. Continuous treatment

Paper ID: CEST2017_00289

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Experimental analysis of a demonstration plant for bilge water treatment and desalination based on humidification dehumidification technology

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Abstract

Next to energy, water can be seen as the foundation for a livable world in the future. Therefore, we need water treatment systems for desalination as well as for treatment of brackish and industrial water. Within this work, a demonstration unit based on the humidification dehumidification process is presented. The test series includes measurements with pure water and brine in various concentrations. The influence of the location of fluid injection into the humidifier as well as the influence of air injection will be discussed theoretically and based on the experimental data. It can be shown that saturation of air strongly depends on bubble size and that a combination of humidification in the bubble column and humidification above the fluid surface occurs. In a next step, the demonstration unit is investigated for bilge water, a mixture of water, heavy oil and sediments which occur in the shipping industry and is so far burned in the cement industry. The goal of our process is the separation and recovery of the oil phase to use it for example as base material for recycling oil.

Keywords: HDH, waste water treatment, desalination, bilge water, heat pump

Paper ID: CEST2017_00314

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biotreatability of selected choline-based deep eutectic solvents

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Abstract

Deep eutectic solvents (DES) are used in laboratory and industrial scale in different processes. One of the most widespread components used for the formation of DES is choline chloride with good solubility in water resulting in their presence in wastewaters. The aim of our study was to compare biotreatability of two choline-based eutectic solvents, made of choline chloride with oxalic and malonic acid. Toxicity to microorganisms was assessed by determination of inhibition of bioluminescence by *Vibrio fisheri* and by determination of inhibition of oxygen consumption by activated sludge. Both DESs were very toxic to heterogenic and nitrifying microorganisms. Their toxicity to *Vibrio fisheri* was lower and they were well biodegradable (90-95%) at non-toxic concentrations. Respirometric measurements in open respirometer, simulating conditions in actual aerobic biological wastewater treatment plant, confirmed biotreatability of both investigated DES at low concentrations.

Keywords: Biotreatability, biological wastewater treatment plant, deep eutectic solvents, toxicity

Paper ID: CEST2017_00350

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of egg shells for different heavy metals removal from aqueous solution

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Abstract

Characteristics and efficiency of eggshells (ES) were investigated as a low-cost adsorbent in removal of different heavy metal ions from aqueous solution. Initial findings showed ES potential to be applied as an effective sorbent due to high concentrations of carbon and calcium and high porosity and availability of functional groups. Adsorption experiments were studied with varying pH, contact time, and ES concentration. Maximum percentages of heavy metal ions removal were recorded at optimum pH, contact time and adsorbent concentration. Evaluation of the isotherms and kinetics confirmed that ES has high value of adsorption capacity. This experiment demonstrated the ability of ES as an effective, sustainable, and low-cost adsorbent for removal of the heavy metal ions in different wastewaters.

Keywords: Adsorption, Eggshells, Heavy metals, Low-cost

Paper ID: CEST2017_00431

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Isolation of microalgae with potential for integrated biomass production and nutrient removal from wastewater

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Abstract

The present study firstly investigates the variations of microalgae in the constructed wetland. Then one of the potential microalgal species was isolated and cultured in autotrophic and mixotrophic growth to compare the performance on biomass production and to evaluate the ability of wastewater treatment and simultaneous biodiesel production. *Scenedesmus* sp. was an abundant strain in the constructed wetland during one year of monitoring. Under both autotrophic and mixotrophic cultivation conditions, an appropriate composition of each source was beneficial for respective biomass production, 8% (v/v) CO_2, and 40% piggery wastewater content. The specific growth rate and lipid productivity obtained with autotrophic growth were slightly higher than those obtained by mixotrophic growth. Both cultivation conditions led to dissimilar fatty acid compositions. Comparing the autotrophic and mixotrophic growth, the mixotrophic cultivation not only produced biomass, but also could assimilate up to 81.5% total nitrogen, 64.6% total phosphorus, and 60.7% chemical oxygen demand (COD) from piggery wastewater, respectively. The high biomass productivity was observed at 16.9:1.1:1 of COD/TN/TP of piggery wastewater.

Keywords: Biodiesel, *Scenedesmus* sp., piggery wastewater

Paper ID: CEST2017_01251

SESSION 15 – EMERGING POLLUTANTS (3)

Friday 1 September 2017 – morning

Target and suspect screening approaches for the identification of new psychoactive substances in raw wastewater samples from Athens by LC-QTOF-MS

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Abstract

Over the last fifteen years, scientific attention was attracted by wastewater-based epidemiology (WBE), an innovative approach that calculates the drug consumption in a community by analyzing specific biomarkers in wastewater. It relies on the fact that almost everything that population consumes is excreted as parent compound or metabolite in urine and faeces and ends up in the sewer network. WBE has widely been applied for the estimation of illicit drug use and has recently been expanded to the challenging detection of new psychoactive substances (NPS). These compounds mimic effects of illicit drugs and are produced to evade law enforcement by introducing slight modifications to chemical structures of controlled illicit drugs. Advanced analytical techniques are required to identify these substances in raw wastewater because of their low concentration and the complexity of the wastewater matrix. Liquid chromatography coupled to high-resolution mass spectrometry (LC-HRMS) allows the wide-scope screening of many parent substances, metabolites and transformation products with an acquisition of accurate-mass full spectrum data. These data can be used for retrospective analysis in order to investigate new substances or unexpected and not searched ones in wastewater, even after years, without additional analysis of the samples. This study reports qualitative screening of new psychoactive substances in raw wastewater samples from the main wastewater treatment plant of Athens in Psyttalia using LC-QTOF-MS. The samples were collected for 8 consecutive days on March 2014, 2015, 2016, 2017 and a solid-phase extraction technique using mixed bed multilayer cartridges containing different extraction sorbents was used for sample clean-up and pre-concentration. Two separate reverse phase chromatographic runs were performed for positive and negative ESI mode. Data were acquired through broad-band Collision Induced Dissociation (bbCID) mode that provided both MS and MS/MS spectra simultaneously, with a mass range of 50-1000 Da and a scan rate of 2 Hz. In target screening approach, an in-house database of approximately 200 new psychoactive substances was used. The database contained precursor ions, retention time, adducts, in-source fragments and MS/MS fragments. The raw data were analyzed with Bruker's TASQ Client 1.0 and DataAnalysis 4.3. Thresholds such as retention time ±0.2 min, mass accuracy ±2.5 mDa and isotopic fitting ≤ 200 mSigma were used for the identification of the compounds. In order to confirm the compounds, MS/MS fragments were examined, as well as adducts and in-source fragments. In suspect screening approach, a database of approximately 500 new psychoactive substances was built using only exact mass as a priory information. The raw data were analyzed with Bruker's TargetAnalysis 1.3 and DataAnalysis 4.3. It was assumed that all suspect compounds produce $[M+H]^+$ or $[M-H]^-$ when they ionized by the ESI source. For the tentative identification of the compounds, specific criteria in area, intensity, signal-to-noise ratio, mass accuracy and isotopic fitting were evaluated. Then, the experimental retention time was compared with the predicted retention time from an in-house QSRR retention time prediction model. Some of these tentative candidates were confirmed in a better confidence level by the presence of characteristic adduct ions and MS/MS fragments. Following the aforementioned procedures, few of the investigated compounds were identified, as they fulfilled all the criteria. The first results indicate an occasional use of NPS in the population of Athens over the years. Specific substances, such as 2-phenethylamine and PMMA are detected every year, while MDAI, methoxetamine, MPPP are detected occasionally. The phenethylamine 2 C-D, the synthetic cannabinoid 5-Cl-AB-PINACA, the piperazine derivative MBPZ are interesting examples of NPS that are detected for the first time in raw wastewater.

Keywords: NPS, WBE, LC-QTOF-MS, target screening, suspect screening

Paper ID: CEST2017_01299

"From toxicity assay to metabolomics analysis". An integrated approach to assess the toxicity of three Benzotriazoles in zebrafish (Danio rerio) embryos

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Abstract

The ever-increasing contamination of the aquatic environment from xenobiotics has raised concerns in the scientific community and the regulatory authorities. Given the large number of xenobiotics, there is an important gap in the literature concerning their adverse effects on aquatic organisms. Benzotriazoles (BTs), a high production volume chemical class, pose low biodegradability and sorption tendency, consequently they are partially or not at all removed from WWTPs. Thus, there is clear evidence that BTs persist in aquatic systems, as they are measured in almost every surface water sample. Consequently, it is urgent to evaluate their potentially toxic effects to aquatic organisms. The zebrafish has emerged as a powerful model organism to study various aspects of developmental and cell biology as well as physiology. In addition, it provides an alternative model for toxicological studies, since mammalian and zebrafish toxicity profiles are strikingly similar. The objectives of this study were to assess to what extent 1-H-benzotriazole (BT), 4-methyl-1-H-benzotriazole (4-MeBT) and 5-methyl-1-H-benzotriazole (5-MeBT) induce toxicity in zebrafish embryos. In addition, we evaluated the uptake and biotransformation of BTs by zebrafish and examined whether biotransformation data could be used complementary to the concentration of the parent compounds to interpret the induced toxicity. The final goal was to establish a wide-scope targeted metabolomics screening method to investigate the induced toxicity in a biochemical perspective and associate the observed toxicity/phenotype with changes in molecular level. More specifically, the zebrafish embryo toxicity assay was used to calculate the LC50 values of BTs as well as to perform the morphological phenotyping. In brief, newly fertilized eggs were exposed to the tested chemicals and their development was recorded up to 96-hours post fertilization (hpf). Concerning the biotransformation and the metabolomics experiment, 96 hpf zebrafish were used. Samples were collected at 5 different time intervals, from 30 s up to 24 hours post exposure (hpe), to examine the time profiles of the parent BTs, their biotransformation products (bio-TPs) and the endogenous metabolites of zebrafish. Extracts were analyzed by RPLC and HILIC methods, in both positive and negative ionization mode, to cover the widest possible range of polarities, using a LC-QTOF-HR-MS/MS instrument. For the detection and identification of tentative bio-TPs, both suspect and non-target screening workflows have been applied. Both oxidative (hydroxylation) and conjugative (sulfation, glucuronidation) bio-TPs were identified. Moreover, the biotransformation rate proved to be informative and correlated well with the observed toxicity. As regards the metabolomics part of the study, a database of over 600 endogenous metabolites (carboxylic acids, amines, nucleotides, mono- and disaccharides etc.) was established, covering a broad range of primary metabolism pathways. The wide-scope targeted metabolomics method proposed in this study constitutes an alternative to the classic targeted methods, as it did not focus at a predefined set of metabolic pathways. The approach to cover a broad range of primary metabolism pathways is hypothesis-generating rather than hypothesis-driven, as it enables to unravel the involvement of unexpected metabolic pathways. The combination of morphological phenotyping information from acute toxicity test with internal concentration and biotransformation data from toxicokinetic experiment, in addition to the biochemical information from the wide-scope targeted metabolomics analysis, constitutes a high-throughput and integrated approach for the toxicity assessment.

Keywords: benzotriazoles, toxicity, zebrafish embryos, biotransformation, wide-scope targeted metabolomics

Paper ID: CEST2017_01345

Determination of legacy pollutants and emerging contaminants in the marine environment of Black Sea

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Abstract

The objective of this project was to describe and document the degree of contamination and the effects of pollution by hazardous substances in the Black Sea, mainly its Eastern (Georgian area) and Western (Ukrainian area) sides. An in-depth contamination survey was carried out based on the profiling of WFD priority substances (2013/39/EC) and the screening of potential Black Sea Specific Pollutants in different environmental compartments (seawater and sediments) and marine organisms (mussels and fish). Target, suspect and non-target screening approaches were followed for the detection of priority pollutants and emerging contaminants, while advanced software and sophisticated tools were used for results' extraction and toxicity prediction. Analysis results indicated that the Ukrainian samples and especially those that were withdrawn closest to the Danube and Rioni estuaries were by far the most polluted ones. Moreover, risk assessment revealed an alarming chemical status concerning the presence of PAHs and OCPs in specific pollution "hot spots" in the Black Sea. Toxicity prediction results of emerging contaminants emphasize the need for monitoring of transformation products (TPs) with wide-scope screening techniques and that TPs need to be included in risk assessment studies.

Paper ID: CEST2017_01404

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Open-source workflow for smart biotransformation product elucidation using LC-HRMS data

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Abstract

RMassScreening (https://github.com/ meowcat/RMassScreening) is presented, a workflow for the elucidation of micropollutant transformation products based on open-source tools. The workflow combines script-based processing with interactive data exploration. The workflow was applied to the elucidation of biotransformation reactions in phytoplankton, finding 14 transformation products for 9 micropollutants, and used for the exploration of biodiversity effects on total biotransformation potential.

Keywords: HRMS, data processing, computational mass spectrometry, transformation products

Paper ID: CEST2017_01416

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Formation of several classes of emerging disinfection by-products in disinfected waters

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Abstract

The present work presents the potential of different source waters to form several classes of emerging disinfection byproducts (DBPs), i.e., haloacetaldehydes and iodine-containing DBPs, which have been scarcely investigated to date. To study this, laboratory controlled chlorination and chloramination reactions were performed with different source waters (in terms of natural organic matter and bromide and iodide content). As expected, the formation of iodo-DBPs (iodo-trihalomethanes, iodo-haloacetic acids, and iodoacetaldehyde) was enhanced in the presence of monochloramine. Overall, iodo-trihalomethanes were the iodo-DBPs that contributed most to total iodo-DBP concentrations. Dihaloacetaldehydes were the main haloacetaldehydes formed under both chlorination and chloramination treatments.

Keywords: iodinated disinfection byproducts, chlorination, chloramination, drinking water, mass spectrometry

Paper ID: CEST2017_00943

AutoSuspect: an R package to Perform Automatic Suspect Screening based on Regulatory Databases

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Abstract

Recent advances on Liquid Chromatography-High Resolution Mass Spectrometry (LC-HRMS) have revolutionized the identification of compounds in the environment. The continuous growing of application of LC-HRMS workflows increased the "peak inventories" reported in environmental samples. This was achieved by using three general workflows, namely "target", "suspect" and "non-target" screening. Although targeted analysis remains the best way to confirm the identification of a compound, it is sometime not widely applicable due to limited access to a high number of reference standards. The vast majority of the substances or peaks detected in samples typically remain unidentified and supportive information such as retention time prediction, MS/MS evaluation and ionization behavior could help increasing the identification confidence. As "peak inventories" increase and the number of regulatory databases grows, an automatic approach is greatly needed to screen for new compounds in environmental samples using "suspect screening". A systematic approach is required to check the mass accuracy of the precursor ion and the experimental and theoretical isotopic fit, prior to chemical structural elucidation based on their retention time, MS/MS and ionization behaviour. The aim of this study is to propose an automatic workflow to screen environmental samples, such as influent wastewater, with a wide-scope regulatory database of chemicals. All the influent wastewater samples considered in this study were collected from the WWTP of Athens (Greece) during 7 days in 2016. Analyses were carried out by reversed-phase liquid chromatography quadrupole-time-of-flight mass spectrometry (RPLC-QToF-MS) with electrospray ionization (ESI), operating in positive mode.

Keywords: Suspect Screening, Regulatory Database, Isotopic fit, Retention Time Indices, Structure Elucidation

Paper ID: CEST2017_01424

Simultaneous enantiomeric analysis of non-steroidal anti-inflammatory drugs in environmental samples by chiral LC-MS/MS: A case study in Beijing, China

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Abstract

A method for directly simultaneous enantiomeric determination of frequently used non-steroidal anti-inflammatory drugs (ibuprofen, naproxen and flurbiprofen) was firstly achieved on Chiralpak AD-RH by UHPLC-MS/MS. The mobile phase composition, pH values, flow rates, and column temperatures were optimized to give high sensitivity and resolution. The overall performance was satisfactory in terms of linearity, precision, accuracy and LODs for environmental analysis. The present method was sensitive, simple and efficient for chiral analysis in environment with MQLs of single enantiomers ranging from 1.2 to 37 ng/L and runtime within 20 min, which are lower and faster than many reported methods. The proposed methodology is successfully applied for monitoring of pharmacologically active compounds (PhACs) at enantiomeric level in environmental samples and superior for its simple and safe system of mobile phase compatible with MS detector under reverse phase mode. Besides, the method was based on a more universal chiral selector that could be adapted for other co-existing chiral PhACs analysis in environment. Furthermore, a monitoring survey in surface water in Beijing, China was conducted to evaluate the pollution of PhACs in Beijing, and for the first time gain an insight into the spatiotemporal variation and chiral characteristics of these emerging pollutants in China.

Keywords: Enantioseparation, Chiral analysis, Pharmaceutical active compounds, LC-MS/MS, River water

Paper ID: CEST2017_00773

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Determination of the biological and adsorption removals of two phenolic emerging micropollutants in a raw hospital wastewater under different sludge retention times

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Abstract

In this study, it was aimed to determine ibuprofen (IBU) and triclosan (TCS) biodegradation and adsorption removals under four different sludge retention times (SRTs) at 5, 30, 45 and 55 days. The amount of adsorption capacity of the micropollutants onto the biological sludge was calculated according to the Langmuir isotherm. Their metabolites which are formed during biological treatment were determined. IBU and TCS biodegradation efficiencies reached to 93.6% and 86.4%, respectively in anaerobic UASB/aerobic CSTR sequential reactor under 55 days of SRT operation. The maximum IBU and TCS adsorption yields were determined as 79.8% and 83.4%, respectively in anaerobic UASB/aerobic CSTR sequential reactor under 55 days of SRT operation. In addition to the evaluation of the IBU and TCS yields, the macropollutants (COD, SCOD and TDS) yields were calculated in the biological reactors. As a result of the study, increasing of the SRT has a positive effect on both macro and micropollutants yields in the anaerobic/aerobic biological reactor system.

Keywords: emerging, hospital wastewater, metabolite, micropollutant, sludge retention time.

Paper ID: CEST2017_00639

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal mechanisms of emerging micropollutants in an innovative low environmental footprint wastewater technology: the SIAL process

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Abstract

New designs for a more sustainable treatment of sewage are including the addition of an anaerobic step in the water line. This study presents the SIAL process which combines an anaerobic UASB reactor with an anoxic-aerobic stage, where the dissolved methane present in the UASB effluent is used as organic carbon source for N removal. The removal of 11 organic micropollutants (OMPs) was assessed. The reactor was operated in two periods: I) attached and suspended biomass and II) only attached biomass in the anoxic-aerobic stage. The best results in terms of N removal were achieved in P1 (24.7 ± 5.9 mg NT L^{-1}), while in P2 the N removal decreased (17.2 ± 5.4 mg NT L^{-1}). This was mainly attributed to the nitrogen species present: nitrite during period 1 and nitrate during period 2. The removal of OMPs was dependent on the redox conditions. Sulfamethoxazole, trimethoprim, and naproxen were readily biodegraded in the anaerobic step, whereas ibuprofen or bisphenol A were mainly removed under aerobic conditions. These results indicate the positive effect related to the combination of different redox conditions as a technological strategy to enhance the removal of OMPs. Evidence of the cometabolic biotransformation of certain OMPs has been found such as the influence of nitrification activity on the removal of bisphenol A.

Keywords: Organic micropollutants, N removal, sewage, redox conditions, methane emissions

Paper ID: CEST2017_00921

Investigating sources of a wide range of organic micropollutants in urban wastewater

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Abstract

Urban wastewaters are often identified as major contamination vectors towards surface waters. The aim of this study was to investigate the presence of a wide range of pollutants (pesticides, biocides, pharmaceuticals, cosmetics, flame retardants, alkylphenols, phthalates …) in the sewage network of Bordeaux city in parallel to what was found in the rivers where the treated effluents are discharged. The study focused on various types of activities (industrial, domestic, hospital, …) in order to precise the main sources of compounds entering the WWTP. Waters from rainwater outlets were also studied. The results of this large-scale study showed the widespread contamination and allowed to establish presence of compounds in relation to main sources. Total concentrations in wastewaters ranged from 50 to 2000 µg L^{-1}. Contaminants were also quantified in rainwater at lower concentrations (2 – 160 µg L^{-1}) but with a higher variability. Compounds found at highest concentrations were often related to domestic origin. Finally, the cross-interpretation of all the results allows to provide a large picture of urban wastewater contamination that could help for a better understanding of pollutant dynamics and to identify source and transfer pathways in order to adapt correct management measures to make cities and territories more sustainable and safer.

Keywords: wastewater, rainwater outlets, sources, organic micropollutants, emerging contaminantas

Paper ID: CEST2017_01017

Occurrence and seasonal variability of personal care products (PCPs) in wastewater treatment and receiving soils

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Abstract

Clean water is a key resource for a series of activities, such as agriculture, power generation and public and industrial supplies. However, wastewater generated by these activities is released into the environment and may represent a potential risk to ecosystems and even human health depending on the presence of certain types and levels of contaminants. This study is focused on personal care products (PCPs), a class of emerging contaminants which includes commonly used cosmetic and personal hygiene products (e.g., fragrances, UV-filters, antimicrobials, surfactants and many others). We have monitored the concentrations of 66 PCPs in influent and effluent wastewater, sludge and compost samples from a wastewater treatment plant (WWTP) at Jerez de la Frontera (SW Spain) over a period of 1 year. Simultaneous analysis of target compounds was performed by means of stir bar sorptive extraction (SBSE) followed by gas chromatography/tandem mass spectrometry (GC-MS/MS). Pressurized liquid extraction (PLE) was used for solid samples. Most target compounds (> 60%) were frequently detected in influent wastewater samples. The highest concentrations were detected in summer and spring, probably related to higher human consumption and intense use of these compounds. Due to the low removal efficiencies for most chemicals (< 60%), 60 of them were always detected in the final effluent. The highest concentrations here were observed for octocrylene, tonalide, OTNE and galaxolide, an UV-filter and three synthetic fragrances, showing average concentrations of 13, 7, 6, 4 µg L^{-1}, respectively. Some target compounds such as nitro musks and galaxolide also showed removal efficiencies that were extremely low (< 10%). Concentration of these compounds in sludge and compost from Jerez de la Frontera WWTP were up to 3000 ng g^{-1}. Additionally, we carried out several sampling campaigns to collect soils samples from the area, where effluent wastewater from the WWTP is used for irrigation. Many of the same compounds often detected in effluent samples were detected at concentrations between < 1 and 300 ng g^{-1} in these soils samples.

Keywords: personal care products, sludge, compost, wastewater, soil

Paper ID: CEST2017_01286

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A method selecting antibiotics for monitoring in municipal wastewater

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Abstract

The widespread occurrence of emerging pollutants in aquatic environment, particularly in wastewater has been well documented in recent years. Pharmaceuticals have emerged as a major class of contaminants, where antibiotics are one of the most frequently observed classes. Of emerging concern is the relationship between the occurrence of antibiotics in the environment and the development of antimicrobial resistant pathogens. The incomplete metabolism and the improper disposal of unused antibiotics often leads to concentrations detected in wastewater, which lead to environmental and human health issues. However, there is currently no structured decision approach systems for making explicit and transparent decisions for antibiotics monitoring in wastewater. The paper presents findings of a recent study that prioritize and rank critically important antibiotics to wastewater treatment based on multi-criteria analysis (MCA) approach. A data set consisting of 14 antibiotics classes and seven evaluation criteria, considering antibiotics pathways into the environment (source, occurrence, fate, effect and toxicity) were used to select antibiotic classes for further study. Five critically important antibiotics were identified for further monitoring studies. The study presents an effective methodology to identify candidate antibiotics for monitoring in wastewater treatment considering usage data, fate in treatment and environmental concerns.

Keywords: antibiotics, multi-criteria analysis (MCA), wastewater, monitoring, ranking

Paper ID: CEST2017_00844

Simultaneous determination of Aflatoxin B1, Fumonisin B1 and Deoxynivalenol in beer samples with a label-free monolithically integrated optoelectronic biosensor

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Abstract

The fast simultaneous determination of Aflatoxin B1 (AFB1), Fumonisin B1 (FB1) and Deoxynivalenol (DON) in beer samples employing an array of ten Mach-Zehnder interferometers (MZIs) monolithically integrated along with their respective light sources onto a Si chip is demonstrated. This is accomplished by functionalizing the sensing arms of individual sensors with mycotoxin-protein conjugates. For the assay, mixtures of calibrators or samples with monoclonal antibodies against the three mycotoxins were run over the chip, followed by reaction with an anti-mouse IgG antibody. Reactions are monitored by continuously recording the MZI output spectra, which are then subjected to discrete Fourier Transform to convert spectrum shifts to phase shifts. The detection limits achieved for AFB1, FB1 and DON were 0.8, 5.6 and 24 ng/ml, respectively, and the assay duration was 12 min. Recovery values ranging from 85 to 115% were determined in beer samples spiked with the three mycotoxins. Different beer types were analyzed with the biosensor developed and the results correlated well with those provided by LC-MS/MS and/or immunochemical methods. Moreover, the proposed immunosensor could be regenerated and re-used at least 20 times. These characteristics along with the small sensor size strengthen its potential for incorporation into a portable instrument for point-of-need applications.

Keywords: Aflatoxin B1, Fumonisin B1, Deoxynivalenol, Monolithically integrated Mach-Zehnder interferometers, Label-free biosensor

Paper ID: CEST2017_00891

SESSION 16 – ADVANCED OXIDATION PROCESSES (1)

Friday 1 September 2017 – morning

Mechanism(s) of Photocatalytic Processes: Revisited!

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Abstract

Charge carrier transfer processes are very important and play a vital role in photocatalytic reactions. The fundamental study of the dynamics of these charge transfer processes is thus crucial from the viewpoint of developing efficient photocatalytic systems for largescale industrialization. The current presentation mainly reviews recent efforts on understanding the charge transfer kinetics in photocatalytic processes. Some fundamental aspects involved in charge transfer processes, such as, charge carrier generation, charge carrier trapping, charge carrier recombination, and electron and hole transfer are discussed based on the results published in the past decades. Moreover, recent studies focusing on the enhancement of the photocatalytic efficiency by improving the charge carrier transfer and separation will also be discussed here. Noble metal loading, plasmonic structure, and graphene loading have been found to be efficient methods to improve charge carrier separation and to suppress charge carrier recombination. Although there have been significant advances in the research of charge transfer dynamics, there are still many processes not fully understood, especially on the molecular-level. There are, for example, hardly any studies associated with electron and hole transfer kinetics in photocatalytic reactions on single crystal TiO_2 surfaces. Most researchers have studied the charge transfer kinetics on a very short timescale, while the charge transfer on a more extended timescale is still unclear. This review highlights the importance of charge transfer processes in photocatalytic reactions the understanding of which can provide possibilities to significantly improve photocatalytic efficiencies.

Paper ID: CEST2017_01429

[7] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of radiolytically produced reactive species on 2-methylisoborneol and geosmin in water

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Abstract

Water radiolysis is known as an Advanced Oxidation Process (AOP) for treatment of organic pollutants but it can also serve as a useful tool to study the effects of highly reactive species that are commonly present in AOPs. Such studies are carried out in simpler homogeneous systems that can be manipulated with use of scavengers to selectively produce different oxidative (OH·, OOH·, O2-, H·) or reductive species (eaq-, H·), at known yields that are proportional to irradiation dose. The aim of this study was to investigate the effects of the above reactive species on two commonly occurring, cyanobacterial taste and odour compounds, 2-methylisoborneol (MIB) and geosmin (GSM), upon steady-state radiolysis using 60Co gamma rays. Degradation processes and products were monitored using headspace (HS) solid phase micro extraction (SPME), followed by GC-MS. Results showed that degradation of both MIB and GSM was faster when hydroxyl radical (OH·) is the reactive species and slower with hydroperoxyl radicals/superoxide (OOH·/O2-) or hydrated electrons (eaq-). Degradation products indicated different reaction pathways that depend on reactive species, i.e. oxidative (OH·) versus reductive (eaq-), as well as on chemical structure of the initial compound. Those results can be valuable in understanding and evaluating the role of reactive species in AOPs for water treatment.

Keywords: Radiation chemistry, Advanced Oxidation Processes (AOPs), 2-methyl-isoborneol (MIB), geosmin, Reactive Oxygen Species (ROS)

Paper ID: CEST2017_00519

Comparison of the hydroxyl oxidative effect in the UV/H2O2 and in the ozonation systems to degrade the dye rhodamine 6G

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Abstract

The aim of the present work is to deepen the study of two different advanced oxidation processes: H_2O_2/UV where UV light is used to generate radicalary species from H_2O_2 and ozonation that uses ozone as oxidant and radical generator agent. The importance of radical oxidation pathway during pollutant degradation in both systems will be studied. As pollutant model, a dye used in textile industries, rhodamine 6G, known because of its resistance to conventional oxidation treatments was selected. Different radical activities were analyzed in the case of H_2O_2/UV varying the molar dosage from 0 to 400 mol H_2O_2/mol R6G. In the ozonation process, the radical activity was modified with pH between 2 and 9.5. In both cases, the oxidation due to the radical HO• is accompanied of other oxidative mechanisms: photolytic in the case of H_2O_2/UV and molecular in the ozonation. The contribution of the photolytic mechanism was always lower than 20% using molar dosages above 20 H_2O_2/mol R6G. On the other hand, in the ozonation, the contribution of the molecular mechanism varied between 100% (pH=2) and 0% (pH=9.5) so that an equilibrium in the contribution of both mechanisms was found at pH = 7.

Keywords: ozonation, radicalary mechanism, dyes, hydrogen peroxide, UV photolysis

Paper ID: CEST2017_00560

Influence of initial organic load on the anodic oxidation and Electro-Fenton combined process – on the way to electrochemical cell design optimization

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Abstract

For the first time, performing a combined anodic oxidation (AO) and an electro-Fenton (EF) process has shown that the initial organic pollutant load variation had an impact on either the heterogeneous •OH production at anode surface by AO (•OH_{hetero}) or the homogeneous •OH generation by EF in bulk solution (•OH_{homo}). Lower initial COD concentration (COD = 1.61 g-O_2 L^{-1}) lead to an equivalent influence (50%) of both •OH_{hetero} and •OH_{homo} on its degradation efficiency while an increase of contaminant amount (from COD = 12.1 g-O_2 L^{-1} to 23.3 g-O_2 L^{-1}) conducted •OH_{hetero} having better degradation rates (70-80%) as compared to •OH_{homo} (20-30%). These trends are related to the competition between charge transfer and mass transport controls that has been confirmed by a mathematical model fitting the experimental data. These results emphasized the need to adapt the reactor design to favor either AO and/or EF according to the load of treated wastewater (micropollutants or heavy industrial effluents).

Keywords: AOPs, anodic oxidation, charge transfer, electro-Fenton, mass transport.

Paper ID: CEST2017_00747

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Leachate treatment by electrocoagulation

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Abstract

Electrocoagulation (EC) method, which is frequently preferred among the electrochemical treatment types, was performed to treatment of leachate. 5, 10, 15, 20 and 25 minute measurements were made with different current values. In the experimental study with aluminum electrode; COD, pH and conductivity parameters were measured. Measurements were made at the beginning and end of the experiment and these results are interpreted. The efficiency of COD removal of leachate with 50 g COD/L are obtained as 58% for the reaction duration of 25 minutes and 50 mA/cm2. Thus, leachate treatment with electrocoagulation should be preferred as a pre treatment stage.

Keywords: Electrocoagulation, leachate, COD, Aluminum electrodes, Taguchi Method.

Paper ID: CEST2017_00751

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Solar photo-Fenton and adsorption on activated carbon for the removal of antibiotics, antibiotic resistance determinants and toxicity from urban wastewater

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Abstract

The presence of contaminants of emerging concern such as antibiotics, antibiotic-resistant bacteria (ARB) and resistance genes (ARG) in wastewater effluents and the inability of the conventional wastewater treatment processes (i.e. conventional activated sludge) to completely eliminate them is one of the most challenging aspects of wastewater reuse. Advanced Oxidation Processes (AOPs), based on the *in situ* generation of hydroxyl radicals ($HO^{\bullet}$) with high efficiency in degrading various microcontaminants, have gained considerable attention the last years with regard to their real-scale application in urban wastewater treatment plants. Among the various AOPs, photo-Fenton is an attractive option for the treatment of wastewater effluents due to its environmentally friendly application and the prospect of operating under natural solar irradiation (i.e. solar photo-Fenton), hence lowering the operating cost of the process considerably. Activated Carbon (AC) adsorption can enhance further the removal of the microcontaminants, as well as reduce the toxicity of the AOPs-treated wastewater due to the potential adsorption of toxic oxidation products.

Within this context, this work aimed at exploring the efficiency of the solar photo-Fenton process at a pilot scale, in removing selected antibiotics and ARB, as well as toxicity from secondary treated wastewater effluents. The degradation of a mixture of antibiotics, namely ampicillin (AMP), clarithromycin (CLA), erythromycin (ERY), ofloxacin (OFL), tetracycline (TET), trimethoprim (TMP) and sulfamethoxazole (SMX), was investigated by testing various oxidant (H_2O_2) concentrations. Ferrous iron concentration was kept constant in all experiments (5 mg/L), to avoid the requirement for iron removal at the end of the process according to the iron discharge limits set in the existing regulation (Cyprus Law, 106(I)/2002). The phyto- and eco-toxicity of the treated samples were also evaluated against three plant species (*Sorghum saccharatum*, *Lepidium sativum*, *Sinapis alba*) and a crustacean (*Daphnia magna*), respectively. Moreover, the disinfection potential of the solar photo-Fenton process as to the inactivation of frequently encountered bacteria in wastewater, which have the potential to harbour antibiotic resistance to selected antibiotics, i.e. *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterococcus* and total heterotrophic bacteria was assessed. Finally, the capacity of solar photo-Fenton was assessed with regard to the inactivation of selected ARG (e.g 16S rRNA, *bla*TEM, *bla*OXA, *bla*CTX, *tet*M, *sul*1, etc).

The obtained results demonstrated the ability of the solar photo-Fenton process to completely degrade all the tested antibiotics under the optimum experimental conditions ([Antibiotics]=100 μg/L; $[Fe^{2+}]$=5 mg/L; $[H_2O_2]$=100 mg/L; pH=2.8-2.9, $t_{30W,n}$=115 min). The photocatalytic removal of all antibiotics followed pseudo-first-order kinetics, with AMP being degraded faster than the other antibiotics. Interestingly, all colonies harbouring resistance to OFL, TMP and ERY apparently survived solar photo-Fenton process, while prolonged treatment time was needed for their complete elimination. Phyto- and eco-toxicity tests showed increased toxicity until 120 min of treatment, induced either by the oxidation of the the dissolved effluent organic matter originally present in wastewater, or the oxidation of the parent antibiotics to more toxic transformation products. Since the ecotoxicity of the treated samples at the end of the oxidation process was similar with that of the untreated wastewater, additional adsorption experiments using granular activated carbon (GAC) were carried out to investigate whether the residual toxicity could be further reduced. The results revelaed that the post-treatment of the solar photo-Fenton treated flow with 500 mg/L of GAC resulted in complete elimination of ecotoxicity within 15 min of contact time, indicating that the toxic oxidation products were rapidly adsorbed onto the GAC surface. Finally, the findings of this study demontrated the capacity of the solar photo-Fenton to inactivate the selected ARG.

Keywords: solar photo-Fenton, antibiotics, antibiotic resistance, activated carbon

PAPER ID: CEST2017_00827

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Photocatalytic degradation of psychoactive drugs Alprazolam, Bromazepam and Diazepam by PhotoFenton

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Abstract

Photo-Fenton has emerged as a prominent strategy for the treatment of drugs and their metabolites. Benzodiazepines and their metabolites represent a significant group of emerging environmental pollutants due to their stability, continuous discharge in the environment and their low removal rates by conventional biological wastewater treatment plants. The objectives of the study were a) to optimize the efficiency of the photo catalytic oxidation of three psychiatric pharmaceuticals Alprazolam, Bromazepam and Diazepam using response surface methodology, b) to evaluate the degradation kinetics of the Photo Fenton reaction and c) to examine the effect of various parameters that affect the efficiency and the rate of the oxidative process. To evaluate the degradation rates of the three drugs, a central composite design was selected in order to observe the effects of Fe^{2+} and H_2O_2. Different H_2O_2: Fe^{2+} molar ratios were examined for their kinetic behavior, which was described effectively by pseudo first order kinetic models. The impact of the factors affecting the rates of oxidation of the three drugs such as different iron sources and initial drug concentrations was also investigated.

Keywords: Benzodiazepines, Photo Fenton, Central Composite Design

Paper ID: CEST2017_00954

Synthesis of Ag_2O/TiO_2 and CuO/TiO_2 composites for the photocatalytical mineralization of iopromide in water under UV and visible light irradiation

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Abstract

X-ray contrast media are emerging contaminants in water. These contaminants are recalcitrant in conventional treatment systems, although advanced oxidation processes, such as heterogeneous photocatalysis, are able to achieve high degradation rates using UV and visible light. In this work, nanoparticles of metal oxides (Ag_2O and CuO) were deposited on TiO_2 in order to increase the photocatalytic mineralization of iopromide using either UV or visible light. The synthesized photocatalysts were characterized by XRD, TEM, XPS, DRS and ICP-OES. Photocatalytic activity was determined using surface modified P25 TiO_2 with different loadings of Ag_2O and CuO nanoparticles. Surface modified TiO_2 showed higher activity compared with photolysis and bare TiO_2. Mineralization rates of 85 and 60% resulted when 2% wt. Ag_2O/TiO_2 and 0.5% wt. CuO/TiO_2, respectively, were tested under UV-C light irradiation. When UVA-visible light was used in irradiation tests, 2% wt. Ag_2O/TiO_2 displayed higher mineralization rate (60%) than the 0.5% wt. CuO/TiO_2 material (<10%). When photocatalysis tests were performed using tap water, mineralization was decreased up to 20% after 5 h of UVA-visible light irradiation when the 2% wt. Ag_2O/TiO_2 was used, while 0.5% wt. CuO/TiO_2 showed negligible activity. Even when mineralization rate was low in tap water, the complete degradation of iopromide molecule was achieved for both materials and BOD increased at the end of irradiation tests. Some of the intermediates were identified by LC-MS/MS, these compounds showed no acute toxicity in bioluminescence tests using *V. fischeri*.

Keywords: emerging pollutants; photocatalysis; X-ray contrast media

Paper ID: CEST2017_01058

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Enhancing photocatalytic degradation of the cyanotoxins microcystin-LR and nodularin with the addition of sulfate-radical generating oxidants

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Abstract

This study dealt with enhancing the photocatalytic oxidation (PCO) of the hepatotoxic cyanotoxins microcystin-LR (MC-LR) and nodularin (NOD) via the addition of the sulfate-radical producing oxidants persulfate (PS) and peroxymonosulfate (PMS). Initially, the optimum experimental conditions were established. The average photon flux at λ=365 nm of the UVA lamp used was determined with ferrioxalate actinometry at 0.59 ± 0.05 W. Oxidant addition showed enhanced PCO rates for both toxins. In the case of MC-LR it reduced the electrical energy of the system by ~14% and ~50%, for PS and PMS, respectively. Quenching studies with methanol and tetra-butyl alcohol asserted the role of sulfate radicals during treatment. Toxicity studies based on the inhibition of the PP1 enzyme showed reduction of toxicity in the treated samples.

Keywords: microcystins, nodularins, persulfate, peroxymonosulfate, TiO2 photocatalysis

Paper ID: CEST2017_01071

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Mode of action of hydrogen peroxide, peroxymonosulfate and persulfate on *Microcystis aeruginosa* strain PCC 7806

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Abstract

Eutrophication of surface water has increased globally the past few decades because of human activities, such as land fertilization, disposal of inadequately processed domestic and industrial wastes, in combination with climate change. Excessive concentrations of phosphorus, a key ingredient to eutrophication, are now detected in freshwater lakes, artificially made reservoirs, and streams. Eutrophic ecosystems host a large range of microorganisms including, the harmful strains of cyanobacteria, such as Microcystis aeruginosa. The latter ones produce bioactive metabolites such as microcystins a group of hepatotoxins that affects both humans and wild life. Investigations on the formation of harmful cyanobacteria in eutrophic lakes and ways to reduced their photosynthetic activity, in order to inhibit their blooming are currently being conducted. This study investigated the application of three environmentally friendly oxidants, hydrogen peroxide (HP), persulfate (PS) and peroxymonosulfate (PMS) for the treatment of Microcystis aeruginosa PCC7806. The results have shown that HP acts like a cyanocide, PMS inhibits the growth of cyanobacteria while PS has no effect on the cells.

Keywords: *Microcystis aeruginosa*, hydrogen peroxide, persulfate, peroxymonosulfate

Paper ID: CEST2017_01176

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Combined application of membrane ultrafiltration, adsorption and ultrasound irradiation for the removal of pharmaceutical compounds from real wastewater

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Abstract

The presence of emerging contaminants (ECs) in water resources has raised a great concern in the last decades due to their persistence in the environment and their chronic toxicological and endocrine disrupting effects on terrestrial and aquatic organisms. Thus, advanced treatment methods are necessary for the removal of these contaminants before wastewater reuse or disposal into aquatic ecosystem. In the present study, the hybrid process USAMe®, which combines ultrasound irradiation (US), adsorption (A) and membrane filtration (Me), was investigated for the removal of ECs from real wastewater. Three pharmaceutical compounds - diclofenac (DCF), carbamazepine (CBZ), and amoxicillin (AMX), were chosen for this study to represent highly consumed and frequently detected pharmaceuticals in the aquatic environment. All three pharmaceuticals were spiked into real wastewater at two concentrations of 10 ppm and 100 ppb. Membrane ultrafiltration and its combination with US (USMe) or adsorption (AMe) were also studied as control tests. The results obtained showed improved pharmaceutical removals in the membrane ultrafiltration process whenever an auxiliary treatment was employed. The degree of pharmaceutical removal was achieved in the order: Me<USMe<AMe<USAMe®. The USAMe® process applied to real wastewater successfully removed the target ECs, displaying its potential as an advanced method for wastewater treatment.

Keywords: emerging contaminants, hybrid membrane process, activated carbon, sonication, ultrasound frequency

Paper ID: CEST2017_01238

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The role of boundary conditions in the treatment of high-load ammonia wastewaters with ozone

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Abstract

This work presents some recent developments concerning the treatment of industrial wastewaters containing high loads of ammonia nitrogen using an ozonation process. It is well known that the direct oxidation of ammonia nitrogen generates nitrate. Nitrate is an unwanted reaction product because of its high eutrophication potential. Towards late Seventies it was demonstrated that an ozonation treatment enhanced by bromide ion may inhibit the generation of nitrate. The depletion of ammonia nitrogen proceeds through the formation and destruction of species that belong to the family of bromoamine, to finally generate nitrogen gas.
Ozonation tests carried out at a lab scale in batch modality demonstrated that the nitrate generation could be lowered to less than 10% of the theoretical value when two conditions coexist. Firstly, all the ammonia nitrogen was present in the form of ammonium (NH_4^+); this happens when the pH of the system is less than 8. Secondly, the ratio between dissolved ozone and bromide must be carefully calibrated, so as to avoid the presence of free ozone and the consequent direct reaction with ammonia nitrogen.

Keywords: bromide, ammonia nitrogen, nitrate, pH, buffering agents

Paper ID: CEST2017_00264

SESSION 17 – SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION (1)

Friday 1 September 2017 – morning

Treatability Studies in Support of Full-scale Design for In Situ Remedies

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Abstract

Ex situ treatment processes are often selected as a means to complete remediation and move towards site redevelopment/re-use. In situ treatment is often more sustainable but also subject to more uncertainty. The cost to excavate and treat materials can be substantial and may not be effective if residual contaminant mass remains which can then re-contaminate materials. Laboratory treatability studies using site soil and groundwater to evaluate treatment effectiveness are very useful for supporting field scale design. After the costs to investigate and delineate a site are incurred it can be challenging to justify more costs to for laboratory assessments for remedy design.

There are remediation technologies for which site specifc laboratory treatability testing can be very useful. Chemical oxidation studies can help measure the natural oxidant demand of site materials and assess the effectiveness of a particular chemical oxidant for specific compounds of concern. Column studies are particularly useful to assess effectiveness of zero valent iron (ZVI) and provide key data to design permeable reactive barriers. Biodegradation tests which can be either laboratory microcosm tests or molecular screening are used to assess the potential for microorganisms to promote degradation of site specific compounds of concern.

Many in situ remedies routinely use treatability tests to verify site specific treatment variables, such as (i) oxidant addition rates, activation chemistry and natural oxidant demand, (ii) evaluation of suitable electron donors or acceptors for degradation of site contaminants, (iii) evaluation of site specific degradation rates, (iv) enumeration and evaluation of specific microbial populations and (v) evaluation of the nature, rate and extent of intrinsic biological and abiotic degradation activities. Customizing laboratory treatability studies based on site-specific geochemical and microbiological conditions provides strong evidence for potential field performance. Success in the laboratory provides technical understanding of the remedial technology and confidence that it can be applied successfully in the field.

This presentation will provide a summary of commonly used laboratory treatability studies, provide a general overview of how this information can be valuable in design for full scale design and give a case study of the benefits of laboratory pre-design tests.

Paper ID: CEST2017_01436

[8] Invited speech

Design of surfactant foam flood for NAPL recovery from shallow subsurface

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Abstract

In this paper, the generation of foam using selected surfactant solutions was investigated in relation to the ability to create foam and its stability. The approach used to generate the foam *in-situ* consists of several cycles (7) of Surfactant-Alternating-Gas (SAG) until foam was observed. More specifically, the cycles were performed by injecting 0,25PV surfactant followed by 0,25PV of air. The pressure drop was used to compute the apparent viscosity. Results showed that the selected surfactant blend can be used to generate foam *in-situ* at a contaminated site. During the flow experiment, no significant visible change of the sand pack was observed but an increase in the differential pressure was measured (ΔP=5 psi) after two cycles. During the third cycle, foam was observed at the first quarter of the column and an additional increase in the differential pressure confirmed the creation of foam within the sand pack. Increases of the pressure drop through the cycles continued. The pressure drop was used to compute the apparent viscosity, which was ranged from 60 to 100cP from the 3rd to 7th cycle, respectively. Foam was collected from the column exit (after three days) as a proof of foam generation and to measure its stability.

Keywords: NAPLs, remediation, foam, surfactant.

Paper ID: CEST2017_00555

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment of contaminated marine sediments by sonolysis

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Abstract

The sediments of the port areas are often affected by the presence of several contaminants, which are generated from anthropic activities. These compounds can be toxic for the human health, thus, also to ensure a correct management and avoid the disposal in landfills, the sediments need to be treated. A novel approach proposal by international literature for sediments remediation is the use of advanced oxidation processes, which include ultrasonic technologies. Ultrasounds could be applied mainly to mineralize organic compounds and to desorb inorganic compounds through chemical and mechanical effects, respectively. The present paper is focused on the effectiveness of sonication to abate organic contaminants. The tests were carried out by ultrasound bath at different times of the treatment and sonication frequencies. The treatment efficiency was evaluated in terms of removal percentage. High percentages of degradation were achieved during the treatments in all the tests. The results demonstrated that ultrasound technology is a possible alternative technology for the treatment of contaminated sediments.

Keywords: ultrasounds, sediments, organic contaminants, AOPs.

Paper ID: CEST2017_00858

Phytoremediation of Sardinian abandoned mine site: a preliminary study on the use of *Helichrysum microphyllum* Cambess. subsp. *tyrrhenicum* Bacch., Brullo & Giusso

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Abstract

Sardinia was an important mine pole in Europe during the 19th and 20th century. Mine waste, rich in heavy metals, were left abandoned in tailing dumps, causing a relevant impact on the quality of water bodies and soils in nearby areas. Consequently, appropriate remediation activities are required in order to reduce the environmental contamination.
Phytoremediation can be applied in these contexts because some plants are able to catch metals in roots or in epigean organs, offering plant coverage, improving soil characteristics and re-launching vegetation dynamics.
This research is focused on *Helichrysum microphyllum* Cambess. subsp. *tyrrhenicum* Bacch., Brullo & Giusso, which is an endemic shrub of Sardinia, Corsica and Balearic Islands and it can grow in different edaphic condition, including mine's environments. The aim of this study is to evaluate the plant's ability to extract heavy metals from mine soils and accumulate them in the plant tissues. Sundry samples of soil, roots and epigean organ were collected in Campo Pisano mine dump and analyzed in order to obtain metals concentration and mineralogical characteristics.
Our preliminary result indicates that *H. microphyllum* subsp. *tyrrhenicum* tolerates high concentration of them, decreasing from roots to epigean organs, thus behaving as a species suitable for phytostabilization.

Keywords: Heavy metals, Phytoremediation, *Helichrysum microphyllum* subsp. *tyrrhenicum*, Mine waste, tolerance

Paper ID: CEST2017_01066

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The baseline report as a tool for potentially contaminated site management in Greece

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Abstract

The baseline report is one of the most powerful tools for potentially contaminated site management in EU and Greece. This report is part of the environmental permitting of the most significant new or existing industrial installations. Based on the European Commission Guidance, the baseline report is divided into two parts: the first part (steps 1-3), is a preliminary assessment, where the actual need for further investigation is evaluated. In the next part of the report (steps 4-8), a detailed assessment of soil and groundwater conditions is carried out. Although the baseline report is laid down in the Greek Law, only a limited number of reports have been prepared and submitted to the pertinent authority so far. This manuscript presents the existing conditions in Greece and a simple and general methodological approach in order to assess whether a more detailed and costly soil and groundwater assessment is required.

Keywords: Baseline report, groundwater, soil, environmental permitting, industrial installations

Paper ID: CEST2017_01410

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Reintegration of contaminated sites in urban transformation and metabolism applying microalgae production

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Abstract

This paper presents the concept of a digital supported urban-integrated concept for the reuse of contaminated sites via agricultural production of basic materials and foodstuffs based on microalgae. The integration of algae cultivation into urban metabolism is intended to allow the material and energetic closure of circles in small and large loops.

Keywords: Urban Agriculture, Algae, Contaminated Sites, Industry 4.0, Circular Economy

Paper ID: CEST2017_00897

Competitive adsorption of hexavalent chromium and inorganic pollutants on goethite

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Abstract

Adsorption is one of the most important processes that affect the transport of heavy metals, like hexavalent chromium (Cr(VI)), and other inorganic contaminants in the aquifers. Iron (hydr)oxides, such as goethite, are ones of the most significant adsorbents for such contaminants in the geoenvironment. The present study investigates the Cr(VI) adsorption on goethite, in the presence of other inorganic contaminants such as phosphates and nitrates; for this purpose, batch experiments testing Cr(VI) adsorption, as a function of pH and Cr(VI) initial concentration, are carried out. At these experiments Cr(VI) is added at concentrations which have previously been detected in areas at which the presence of Cr(VI) is of geogenic origin, assuming also the contribution of some anthropogenic pressures, like agricultural activities. The concentration of nitrates and phosphates has a typical value of concentrations usually detected in groundwater affected by intensive agricultural activities.

Keywords: *Hexavalent chromium; adsorption; goethite; phosphates; nitrates*

Paper ID: CEST2017_01409

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geochemical base line and pollution analysis of heavy metals in Taltal commune, northen Chile

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Abstract

Taltal is a coastal commune of 14,000 inhabitants located in northern Chile, where several abandoned mine wastes have been identified. The objectives of this study were to determine the geochemical baseline for Sb, V, Pb, As, and Cu and evaluate the heavy metal contamination for the soils in Taltal commune. Soil samples were collected at 175 sites. The samples were analyzed for total heavy metal concentrations, pH, and conductivity. Geochemical baseline concentrations of heavy metals were estimated following the upper-whisker limit method. The pollution levels of heavy metals were obtained using geo-accumulation index (Igeo), pollution index (PI), and enrichment factor (EF). The pH and the conductivity of the soils was found in the range of 7.23-9.74 and 8 and 35 $mScm^{-1}$, respectively. The geochemical baseline concentrations of Sb, V, Pb, As, and Cu were 0.180-22.907, 46.325-88.326, 2.770-187.874, 4.130-2,746.114, 8.08-1,591.353 mg kg−1, respectively. The Igeo values indicated that the soils were “moderately to strongly polluted” by Sb, V, Pb, As, and Cu. PI for Sb, V, Pb, As, and Cu was found in the range of 0.008-8.032, 0.094-3.815, 0.015-8.037, 0.002-8.010, 0.005-7.991, respectively. The EF for Sb, Pb, As, and Cu showed values above 5. The baseline values for Sb, V, Pb, As, and Cu in soils of Taltal were determined. It was concluded that the abandoned sites are contaminated with heavy metals.

Keywords: geochemical baseline, heavy metals, soils, mine wastes, pollution

Paper ID: CEST2017_01130

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Potential Environmental Hazardous due to Disposal of Ash from Indian Thermal Power Plants

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Abstract

In present study, the leachability of tracing elements of ash collected from three different Indian coal based power plants were investigated. Leaching experiments have been conducted to establish the environmental impact of bottom ash with variation in time duration, pH values and liquid-to-solid (L/S) ratio. During the experimentation liquid-to-solid (L/S) ratio was varied from 20:1 to 60:1. Time duration was taken as 5, 10, 15 and 20 days. The pH value was ordered from 4to7. The leachability of tracing elements Mg, Mn, Cr, Cu, Pb, Zn, Ni, Co, Fe and Mo was investigated to predict the environmental impact disposed bottom ash. Leaching results indicates that the leachate Mn, Mg, Cu, Cr and Zn were present in major proportion while Mo, Fe, Co and Pb appeared in lower proportion. Also, the pH value was found as a highly influencing parameter followed by liquid to solid ratio and time duration.

Keywords: Bottom ash, leaching, toxic element pH.

Paper ID: CEST2017_01230

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Hexavalent chromium reduction in manganese-rich soils by ZVI nanoparticles: the influence of natural organic matter and manganese oxides

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Abstract

Hexavalent chromium reduction by nano Zero-Valent Iron (nZVI) has been proved fast and efficient, mainly due to nanoparticles large specific surface area and high chemical reactivity. In this work the influence of natural organic matter and manganese oxide was investigated, through a set of experimental tests carried out on a real polluted soils naturally rich in manganese. Soil samples were characterized in terms of initial concentration of Cr, Cr(VI), Mn, pH, and TOC and three different nZVI solutions were used (120, 360 and 600 mg nZVI L^{-1}) for the treatment. At selected interval times (0, 5, 10, 15, 30, 60, 120 min) a slurry sample was filtered and Cr(VI) residual concentration and pH were measured. The same procedure was carried out on an artificial spiked soil, characterized by a similar TOC and poor of Mn. Furthermore the two soils were mixed with different amounts of leonardite, to evaluate the influence of NOM on treatment efficiency.

Keywords: nZVI, Cr(VI), NOM, Manganese Oxide.

Paper ID: CEST2017_00217

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

nZVI particles production for the remediation of soil and water polluted by inorganic Lead

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Abstract

The present study deals with experiments of Pb removal by nano-Zero Valent Iron (nZVI) in aqueous solution and in soil. Synthetic Pb aqueous solutions were treated by nZVI, at a fixed Pb concentration of 100 mg L^{-1}, varying nanoparticles initial concentration in the range between 27 and 270 mg nZVI L^{-1}.A kinetic study was carried out: Pb adsorption followed a first order kinetic, and half life times between 11 and 26.66 min were determined.Soil samples were first characterized, and Pb speciation and concentration by sequential extractions was determined. Adsorption tests were then carried out at three selected amounts of nZVI, to allow Pb stabilization in the soil matrix. To evaluate the treatment efficiency, sequential extractions were also performed on the treated samples.

Keywords: nZVI, soil-remediation, groundwater- pollution, adsorption.

Paper ID: CEST2017_00225

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Groundwater contamination due to a coal-ash landfill - active-passive combined remediation solutions

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Abstract

The present work is based on a case study of a coal ash landfill, focusing on the evidence of groundwater contamination (acid drainage and high levels of sulfates, aluminum, manganese, zinc, iron and nickel) revealed by the periodic monitoring that has been carried on during the last years. The treatment of the available information allowed the development of the site conceptual model using the Groundwater Modelling System (GMS) software. After sampling, laboratory tests were performed to characterize, neutralize and sequentially precipitate the main metals underground using water collected from piezometers of the monitoring net,. The mathematical simulation of groundwater flow, combined with the results of laboratory tests, allowed to establish appropriated treatment alternatives for this case study.

Keywords: Acid mine drainage, coal ash landfill, groundwater modeling, remediation solutions.

Paper ID: CEST2017_00269

Geochemistry of potentially toxic trace elements in soils of mining area: a case study from Zangezur Copper and Molybdenum Combine, Armenia

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Abstract

The primary aim of the study was the determination and evaluation of the impact of mining activity on soil pollution with application of various pollution indices. In this study we selected 8 zones basing on soil maps and marked 13 points for soil sampling. Soil samples were analyzed for heavy metals using Atomic-absorption spectrometer PG990. During the study 11 metals and nonmetals were analyzed and the greater quantities, as compared with control sample, were observed generally in case of copper and molybdenum. These data were obtained by means of both Contamination factors (*Cf*) and Geoaccumulation index (*I-geo*) during the testing of soil contamination level. The correlation analysis revealed the strongest positive correlation between Cu and Mo and that the high content of these two elements in soil is caused by human activities and the presence of a single pollution source. Contamination assessment based on Degree of contamination (*Cd*) showed, that the 58.4% of A horizon soil samples referred to a moderate degree of contamination, 8.3% - to a considerable degree and 33.3% - to a very high degree of contamination. Obtained results will be useful for implementation of control measures of pollution and the remediation techniques in the study area.

Keywords: heavy metals, soil contamination, Degree of contamination, Geoaccumulation index, Armenia

Paper ID: CEST2017_00464

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Bio-induced reduction of Cr(VI) in aquifers by organic substrates injection

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Abstract

Hexavalent chromium is a primary toxic element used in galvanic processes, in metallurgical industry and for the production of dyes and pigments. Conventional methods for Cr(VI) remediation, pump&treat and excavation, are expensive and require a large amount of energy and time. Innovative technologies include bio-induced reduction, that is Cr(VI) reduction to Cr(III) by injection of organic substrates that are readily biodegraded by autochthonous microorganisms in the aquifer, resulting in reducing conditions. Lab scale batch tests were carried out, with two different soil (A and B) and solid/liquid ratios (25% and 50% on weight basis). Initial Cr(VI) concentrations were 5000 or 10000 µg/L. Ultrafiltration permeates of cheese whey and beer distillation residues were used as the organic substrates. In all microcosms, dissolved oxygen decreased from about 6 mg/L to values <1 mg/L after 1-2 d incubation, and the redox potential from approximately +250 mV to -400 mV by 11 d. After about 40 days, the highest Cr(VI) abatements were obtained in soil A microcosms fed with beer distillation residues, as soil A had an initial total heterotrophic bacteria concentration three orders of magnitude higher than soil B. Fe(II) availability was also a key factor in Cr(III) co-precipitation.

Keywords: cheese whey permeate; beer distillation residue; chromium; bioremediation. Cincinnati, OH

Paper ID: CEST2017_00748

Heavy metals release from polluted soil of a traditional gold mining area at Java Island-Indonesia

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Abstract

From thousand years ago, gold mining were established for human desires. The development of technology for the gold exploration can't stop the existence of traditional ways in gold mining. Unfortunately, traditional mining activity generally has a bad waste management level that makes some heavy metals release to the environment. Heavy metal substances like Cd, Pb, Zn, Co, and Hg can be found easily from the traditional gold mining area. Those metal substances are very toxic, moreover they have possibility to introduce into food chain and accumulate in human body. Thus, creates numerous of health problems.The investigation of heavy metals release from polluted soil surrounding gold mining area demands physico-chemical properties of soil were characterized including water content, pH, conductivity, metals content, total organic carbon (TOC), and cation exchange capacity. Afterwards, the adsorption-desorption of heavy metal (Pb) was studied to estimate the mobility of the metals in the environment.From the experiments, sample 1 (nearest the gold mining source) was found containing higher metals concentration than sample 2 (a bit far from the gold mining source). In addition, it was found that higher TOC content of sample 1 was correlated to the higher cation exchange capacity. In the kinetics study, the adsorption of Pb follows the Langmuir adsorption isotherm model with the r^2 at 0.9691. While, maximum adsorption of Pb was 2500 mg/kg and adsorption energy at 32.8 kJ mol^{-1}. For the study of Pb desorption, tartaric acid concentration of 1 mol/L produced maximum desorption ability at 3512.4 mg/kg. From these results, it could figure out that the soil around the traditional gold mining area was polluted with heavy metals with high possibility to enter the food chain due to their high mobility.

Keywords: heavy metals, traditional gold mining, physico-chemical properties, adsorption-desorption.

Paper ID: CEST2017_00594

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Electrokinetic removal of Cr(VI) from contaminated soil matrices: a comparative study with soil and kaolin samples

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Abstract

In the present study electroremediation was evaluated as an option for the remediation of Cr(VI) contaminated soils. The experimental work was carried out in two samples, a contaminated soil sample, collected from Asopos River basin, and a kaolin sample, used as typical inert material. The tests were conducted applying a voltage of 30 Volt to a cylindrical electrokinetic cell of 30 cm length and 4 cm diameter. Initial experiments were conducted using 0.01 M Na_2SO_4 as inert electrolyte and allowing free pH evolution. Additional tests were carried out increasing the concentration of inert electrolyte to 0.04 M and using $Mg(OH)_2$ in the anolyte to neutralize the produced acidity. In the initial tests, Cr(VI) content of treated materials was diminished by 41% in the kaolin and 54% in the soil sample. In the second series of tests the removal of Cr(VI) was improved to 61% for kaolin and 69% for soil. Mass balance calculations, based on the detailed analyses of treated soil/kaolin samples and anolyte/catholyte solutions, indicated that in the case of soil the decrease of Cr(VI) concentration is partially due to the reduction of Cr(VI) in the trivalent state, Cr(III), probably due to the presence of organic matter in the soil sample. In the case of kaolin, the removal of Cr(VI) is primarily due to the electromigration of chromate anion in the anolyte.

Keywords: Chromate, Electroremediation, soil, kaolin

Paper ID: CEST2017_00836

SESSION 18A – SPATIAL ENVIRONMENTAL PLANNING

Friday 1 September – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Appropriate site selection for onshore wind farm applications and energy carrying capacity estimation: The case of Andros (Greece)

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Abstract

Wind energy is one of the most promising forms of Renewable Energy Sources (RES), resulting in increasing global wind farm installation rates. The purpose of this paper is the application of various restrictions established by the Greek institutional framework for the siting of wind farms in Greece with the use of Geographical Information Systems (GIS). The application focuses on Andros Island in Greece, which has over the time attracted strong interest on this issue. The process involves blocking areas defined by the Greek current legislative framework and the combination of exclusion criteria defined by the national legislation such as distance from settlements and technical infrastructure as well as areas of environmental and cultural interest and international literature review such as the distance from rivers and the wind speed. It also provides the exclusion of areas with low wind speed in order the cost efficiency of any wind power plant is reached. Moreover, the areas generated as appropriate for wind farm siting are compared with the areas occupied by wind farms in Andros in different licensing stages. Finally, the energy carrying capacity of the areas obtained as appropriate through the proposed methodology is estimated.

Keywords: Renewable Energy Sources (RES), wind farm siting, exclusion criteria, carrying capacity, Andros, Geographic Information Systems (GIS)

Paper ID: CEST2017_00516

A Methodological Approach for Holistic Energy Planning through Living Lab Concept: The Case of Karditsa Prefecture

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Abstract

The development of urban and rural landscapes constitutes a pioneering era with novel combinations between energy production and consumption and the upcoming changes in the urban and rural fabric including the associated socioeconomic uses. Moreover, the energy initiatives are more viable for development and upscaling and less vulnerable to failure and societal resistance if they are well-integrated in the local and regional contexts. However, institutional questions remain regarding the required level of integration, while simultaneously the sustainable energy planning involves actors with diverse and conflicting objectives that must come to a consensus. Inspired by these findings, a methodological approach has been developed for holistic energy planning on regional/local level within the framework of INTENSSS-PA project that is funded by HORIZON2020. The approach urges for a holistic energy plan beyond a blueprint for allocating renewable technologies with the involvement of the society including aspects such as the development of spatial concepts, new co-creating strategies, business cases, societal alliances and institutional changes and formats. To implement this approach, the Living Lab (LL) concept will be applied. The case of Karditsa, in Greece, will be presented, to provide evidence on the effectiveness of the proposed planning approach.

Keywords: Holistic Energy Planning, Living Labs, Participatory Decision Making, Spatial Planning, Regional Development

Paper ID: CEST2017_01358

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Forecasting land use changes: An empirical approach for East Thessaloniki.

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Abstract

Land use models are tools for predicting future urban development where mathematical models are employed to represent interactions within city environment. This paper focuses on land use transport interaction models, a certain type of urban models that represent interactions between land use development and transportation infrastructure. Given that there has not been any recorded effort of application of such models in Greece, this paper records and assess the difficulties and bottlenecks arose in the process of data acquisition, calibration and forecasting. The land use transport interaction model is applied to two municipalities in East Thessaloniki, Greece.

Keywords: Land use planning, land use models, urban models, applicability of models.

Paper ID: CEST2017_00717

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Aspects of spatial planning and governance in marine environments

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Abstract

Marine environment is under threat, due to the constantly growing and unplanned use of the marine resources and the constantly growing (in volume and size) human activities taking place in the sea. Given these facts and tendencies, spatial planning in marine environments (Marine Spatial Planning - MSP) has lately become a promising procedure of growing importance in tackling developmental and environmental issues related to the oceans and seas. However, even though spatial planning has a long tradition in land (Terrestrial Spatial Planning), not all procedures and philosophy can be "transplanted" to MSP. Governance issues fall into the same delimitation. Indeed, marine space has rarely had administrative limits designated or even an EZZ proclaimed. This means that decision making when planning in the sea may involve an unusual number of Offices/Heads, in some cases deriving from different countries. At the same time it may involve new types of stakeholders (e.g. fishermen) previously not involved in spatial planning procedures.The paper deals with complexities related to governance issues for spatial and environmental planning in marine ecosystems. The paper aims to highlight irregularities and differences when planning in the sea. The ultimate objective is to contribute to the discussion on how marine ecosystems will maintain their ability to deliver valuable services both to the environment and to humans.

Keywords: Marine Spatial Planning (MSP), environmental planning, governance, Greece

Paper ID: CEST2017_00778

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Spatial environmental planning in Athens and Thessaloniki

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Abstract

Urban green space is an element of vital importance to the city, enhancing quality of life, maintaining sustainable development and fostering the livability of an area. Most importantly, spatial environmental planning ensures further environmental benefits for residents, as it reconciles environmental concerns with social and economic aspirations. The current paper aims to evaluate the enhancement of green spaces in statutory planning processes in Greece through a study of the Master Plans of Athens and Thessaloniki, giving emphasis to the recently reformed metropolitan planning. However, even if environmental planning in Greece was inspired and innovative from an ecological point of view, provisions for urban green spaces and green infrastructure only partially managed to be implemented due to the peculiarities of the historical evolution of Greek cities. This fact becomes even harder to tackle at this time, because of the current fiscal crisis that in many cases triggers an endless discussion on whether the remaining open spaces should be converted into built-up areas to generate public revenue.

Keywords: green spaces, environmental planning, Athens, Thessaloniki

Paper ID: CEST2017_01368

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The pain of being in a city

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Abstract

Every day citizens and visitors in Greek cities often find themselves constantly struggling with impediments: obstacles to their movement, their vision, their breath of air, etc. One cannot walk without being cautious so as not to stumble upon some poor workmanship that was once done to the sidewalk; although there is the possibility of repair. You may find yourself next to the sea, but masses of blocks of flats may hide it from you, restricting you to an endless maze; even though studies highlight the benefits for human health when coexisting with the natural element of water. One almost seems to be always in a suffocating distance to roads with many car lanes; again despite the fact that studies highlight the effects of car emissions to health. Why is this happening? Why do we choose and create such conditions? Is this a distinct phenomenon of just some Greek modern cities? This paper will attempt to shed some light on these questions by examining historical references, as well as contemporary ones.

Keywords: urban environmental design, urban degradation, urbanisation problems and causes

Paper ID: CEST2017_00995

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Island-Mainland Nexus: The case of the Coastal Livelihood of Tingloy Island and the Southwestern portion of Batangas, Philippines

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Abstract

The research explored the natural resources base of the island municipality of Tingloy, Batangas. It looks at fisheries as island economic resource and how this activity is linked with the larger economic context of the mainland. Tingloy serves as a rural settlement that was spatio-economically linked with the mainland through fisheries for livelihood generation. Fishing is done for subsistence, and surplus is exported to mainland. However, fishery product flow analyses show that fisher folk of Tingloy were marginalized by the disproportionate income distribution in favor of middlemen and fish dealers. Support facilities (such as ports, cold storage, processing units, trading posts, etc.) to further improve the local economy of the island is limited and must be upgraded. Also, transport facilities and other infrastructures to assure the integration of the local-regional economic function of the island municipality must be carefully crafted. Interventions to further improve local economic condition of the island and its integration to the mainland are directed towards improved institutional arrangements, stricter implementation of existing local ordinances, and regional development planning that would take a holistic view and consider the vast resource base of the concerned local government units.

Keywords: Natural Resources, Livelihood, Island-Mainland Interaction, Spatio-Economic Linkage, Spatial Planning

Paper ID: CEST2017_01006

The importance of spatial scale in the evaluation of the environment of coastal areas

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Abstract

The index-based method constitutes one of the most common methods for the evaluation of coastal vulnerability. The spatial scale used each time determines the type of data collected and the level of coastal vulnerability. There is not any "one size fits all" index that can be applied to all scales. The spatial scale can determine the final result. A region can be considered susceptible to a particular scale and viable in another. Additionally, there is not only one scale that is suitable for all needs. Different scales reflect different priorities and the influence of a given variable will increase or decrease accordingly as scale changes. The aim of this paper is to present studies conducted in the past in order to create a multi-scale index. Their conclusion on the role of spatial scale in the application of an index methodology are about to be reported and evaluated. Finally, the creation of a new multi-scale index is proposed which will assess coastal vulnerability through an environmental perspective by evaluating not only the geographical features of the coastal area but also the socio-economic characteristics in order to assess the potential impact of these on natural environment of coastal zone.

Keywords: index-based method, spatial scale, multi-scale index, coastal vulnerability

Paper ID: CEST2017_00938

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of Spatial Analysis and Decision Assistance (SADA) Potential for Clean Up

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Abstract

United States (U.S.) federal and state regulations related to brownfields promote applicable practices that contain inherent problems. The primary issue with federal and state regulations governing brownfields is that risk assessment measures and spatial distribution of contaminants are not prominently factored in brownfield redevelopment. These boundaries of the contaminants are critical for establishing proper protection of the potential exposed population such as clean-up workers. Public domain software developments such as the Spatial Analysis and Decision Assistance (SADA) software can provide a reliable and cost effective tool for developing a comprehensive approach to brownfield redevelopment which will account for the spatial distribution of the contaminants and provide a rational solution to critical operational issues such as hotspots, restrictive zones for the protection of workers, and prioritization of clean-up operations. Actual data from a brownfield site in Cook County, Illinois, was used in this study to evaluate SADA applicability to brownfield redevelopment. Soil data from historical investigations were captured within SADA to identify hotspots of contaminants of concern and to create worker restrictive zones based on future redevelopment. The results for the brownfield site classified statically significant to actual results observed, and it appears that SADA is an appropriate tool for brownfield redevelopment.

Keywords: Risk Visualization, Modelling, Spatial Distribution

Paper ID: CEST2017_01174

Drought risk assessment using GIS and remote sensing: A case study of District Khushab, Pakistan

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Abstract

Drought is the most complex but least understood of all natural hazards. It is broadly defined as "sever water shortage". In recent years, Geographic Information System (GIS) and Remote Sensing (RS) have played a key role in studying different types if hazards either natural or man-made. This study stresses upon the use of RS and GIS in the field of Drought Risk assessment. In this study an effort has been made to derive spatial-temporal drought risk areas facing agriculture as well as meteorological drought by use of temporal images from Landsat ETM based Normalize Difference Vegetation Index (NDVI) (2003, 2009 and 2015) and meteorological based Standardized Precipitation Index (SPI). Correlation analysis was performed between NDVI, SPI, and rainfall anomaly. SPI values were interpolated to get the spatial pattern of meteorological based drought. NDVI threshold was identified to get the agriculture drought risk. Similarly rainfall and NDVI were correlated and a spatial temporal drought risk maps were generated. Study area District Khushab was divided into three zones including no drought, slight drought and moderate drought. The results revealed that 41.43% are under no drought, 28.36% area under slight drought and 30.21% is the area under moderate drought. It was evident from the study that southern part of District Khushab was a rainfall deficit area with scarce vegetation and hence was the area with the highest drought prevalence. The results obtained can be helpful for drought management plans and will help in revealing true drought situation in the area.

Keywords: Drought, GIS and Remote Sensing, Vegetation Index, Precipitation Index

Paper ID: CEST2017_00658

SESSION 18B – SOLID WASTE MANAGEMENT (1)

Friday 1 September 2017 – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Identifying crucial factors affecting Waste Oils collection from shipping sector in Greece

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Abstract

The shipping sector is one of the major lubricant oil users in Greece, along with the industrial and vehicles sectors. Nevertheless, waste lubricant oil collection remains proportionally extremely poor compared to that of other sectors, considering the intense shipping activity and the number of ports in Greece. This is why the new National Planning for the Hazardous Waste Management points out the non-separation of WLO and other hazardous liquid waste, as the main problem in waste management at the Ports. Waste collection and management status in main Greek ports and the obligations arising from Extended Producer Responsibility legislation for the shipping sector are explained in order to better analyze the present situation and determine the characteristics of the problem. A connection to the national obligation concerning the collection and regeneration targets in waste oil management is also attempted. Multiple ministries, port authorities, shipping companies, waste collection companies and the ship personnel seem to hold a key player role. Which parameters feed the existing situation? What is the existing legal status adequacy? Crucial factors affecting the shipping lubricant waste oils management are investigated in order to come up with short term and long term suggestions. Focusing in specific target groups and actions is likely to have significant positive effects in waste oils collection.

Keywords: Waste Oils, Ships, Ports, Recycling, national targets

Paper ID: CEST2017_00667

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ultrasound pretreatment of cotton gin waste for methane production and adsorption of metals

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Abstract

In the present study, ultrasound irradiation was applied to cotton gin waste. The scope of this procedure was to evaluate the use of the obtained pretreated materials as substrates for anaerobic digestion for methane production and as adsorbents for metal (Ni^{2+}, Cu^{2+}, Cd^{2+} and Pb^{2+}) removal from aqueous solutions. Results showed a limited effect of pretreatment on material solubilization, however an increase in methane yield was obtained for a pretreatment duration of 60 min. Adsorption assays revealed a greater affinity of the investigated adsorbents for Pb^{2+} and Cu^{2+}, compared with Ni^{2+} and Cd^{2+}, with the samples produced after 30 and 15 min of pretreatment being more effective for metal removal.

Keywords: ultrasound, cotton, waste, anaerobic digestion, adsorption

Paper ID: CEST2017_00835

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterization of slaughterhouse by-products bottom ash

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Abstract

The objective of this study was to characterize slaughterhouse by-products bottom ash (SHASH), as well as evaluate its potential toxic effect during its use in agriculture. The investigated sample was characterized by a low volatile solids content and a high mineral content, with an evident presence of Hydroxylapatite ($Ca_5(PO_4)_3(OH)$), Whitlockite ($Ca_9(MgFe)(PO_4)_6PO_3OH$) and Quartz (SiO_2). On the other hand, metal concentrations were found not particularly elevated. Highly toxic effects on three types of plants were verified when mixing SHASH with soil at amendment rates above 2.5%.

Keywords: characterization, slaughterhouse, animal by-products, ash

Paper ID: CEST2017_00838

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Thermodynamic Simulation of Plasma Gasification for the Treatment of Solid Wastes

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Abstract

Plasma gasification is an effective and environmentally friendly process for solid waste treatment and energy utilization. This study presents the extension of a model developed in our laboratory, which is able to perform a complete thermodynamic analysis of the plasma gasification process. This analysis includes prediction of the main gaseous components produced (CO, H_2, CH_4, H_2O, CO_2 and N_2), prediction of the concentrations of the impurities in the raw synthesis gas (HCl, H_2S and Cl_2) as well as energy calculations. The results of the new model, called as Modified Gasifeq, are compared against two sets of experimental data taken from the literature. In the first case the model predictions are compared against experimental data for wood gasification, while in the second with real operational experimental data from a commercially-available plasma gasification process of MSW. The comparison between the model predictions and the experimental data shows a close agreement between them. The Modified Gasifed model can be thus used as a tool for predicting the composition of the synthesis gas and serve in the design of a complete plasma gasification process of solid wastes.

Keywords: Plasma; gasification, solid waste; waste to energy.

Paper ID: CEST2017_00631

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of chicken feather and boron compounds as filler on mechanical and flame retardancy properties of polymer composite materials

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Abstract

Sustainable utilization of solid waste has been influenced by increasing population of the world. Benefits of using solid waste based on natural fiber in polymer material are biodegradability and cost effectiveness. In poultry farms, chicken poultry, one of the slaughterhouse wastes, is confronted as 30 thousand tons of waste per year in Turkey. The evaluation of this waste, which is quite rich in keratin, is extremely important both for the solution of the waste problem and for bringing this valuable material to the economy. These fibers are stable, durable and biodegradable because they have a crystalline structure. However, this valuable waste will have a positive effect when used together with boron minerals which both increase the mechanical properties, flame retardancy and biodegradation of composite material. The aim of this study is to manufacture superior polyester-based composite materials reinforced with three kinds of boron minerals such as; boron oxide, borax pentahydrate, borax decahydrate and fibers recycled from waste chicken feathers. The effect of different filling ratios of filling materials on the mechanical and physical properties of composite materials was examined. Flame retardancy properties of the composites with best mechanical results were investigated. After pouring by means of the pre-casting process, the water absorption and swelling thickness of final products, as well as density, bending strength, flexural modulus, limiting oxygen index (LOI), TGA (Thermogravimetric Analysis) and SEM analysis, was performed. Mixing prescriptions and conditions with the best properties were determined. According to mechanical, physical and flame retardancy analysis it can be concluded that chicken feather and boron compounds have a good synergic effect when used together in composite material instead of using boron compounds /chicken feather alone.

Keywords: Polymer matrix composites, boron, waste chicken feather, flame retardancy, mechanical properties

Paper ID: CEST2017_01281

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Identifying the main physical and socio-economic drivers of illegal landfills on the island of Gran Canaria, Spain.

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Abstract

The proliferation of illegal landfills (IL) has negative impacts on the environment and the economy, especially in both ecologically sensitive and touristic areas. This work focuses on the characterisation of illegal landfills located on the island of Gran Canaria. 287 IL were obtained through fieldwork and the visual interpretation of digital orthoimages at a spatial resolution 0.5 m from 2012 and 2015. This information was included in a geospatial database together with a set of 177 potential explanatory features of different types: waste type, surveillance and control, socioeconomics, accessibility, distance to elements of interest, visibility and terrain features. Multivariate analyses such as exploratory analysis (EA), factor analysis (FA) and discriminant analysis (DA) were applied to assess the degree of association between the explanatory features and IL occurrence. FA explained a cumulative variance of 81.83% considering 6 factors (Kaiser-Meyer-Olkin test: 0.71). DA showed a canonical correlation of 0.78, and lead to discrimination between affected and unaffected areas by using the distance of feature types to elements of interest, such as: industrial areas, large commercial areas and coastline. Additionally, FA identified the above features as the main drivers of IL occurrence.

Keywords: Illegal landfill, factor analysis, discriminant analysis

Paper ID: CEST2017_00290

Assessing impact of Olive Mill Waste disposal on soil at nine randomly selected disposal areas in Crete, Greece.

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Abstract

In European Mediterranean countries the disposal of Olive Mill Wastes (OMW) is a major environmental problem. Following an extent study on the risks for soil quality caused by the disposal of OMW, in the framework of the LIFE PROSODOL project, eight soils indicators appropriate for defining soil degradation risk at OMW disposal areas were defined, namely pH, organic matter, electrical conductivity, total nitrogen, polyphenols, exchangeable potassium, available phosphorus and iron. In order to confirm the indicators and also other results as regards impact on soil quality outside the main pilot area of PROSODOL project in Rethymnon, Crete, nine OMW disposal areas were randomly selected and studied. It was confirmed that soils that accept OMW have high electrical conductivity; increased amount of organic matter and nitrogen; high concentrations of exchangeable K and Mg as well as of available P, B, Fe and Cu. Available Mn and Zn were also high, however Zn was above threshold only in two cases while Mn in three. Finally it was also confirmed that soils with high $CaCO_3$ content, maintain their pH values and neutralize OMW acidity.

Keywords: Olive mill waste-OMW, soil, indicators.

Paper ID: CEST2017_00940

SESSION 19A – ECOLOGY AND ECOSYSTEM MANAGEMENT (2)

Friday 1 September 2017 – morning

Post-Fire Fuel and Vegetation Dynamics in an Ungrazed Phryganic Community of Crete, Greece

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Abstract

The effects of overgrazing and frequent burnings on phrygana are relatively known-by scientists, but limited attention has been paid to the functioning of these communities when grazing and fires are suppressed. The aim of this study is to investigate post-fire vegetation and fuel dynamics in an ungrazed S. spinosium dominated phrygana in northwestern Crete. Fuel was first analyzed according to shrub, herb, litter, and total load; then live and dead materials; and finally, 0-0.5 cm and 0.6-2.5 cm diameter classes. Vegetation was analyzed based on cover and life form composition and dynamics. Also, species richness, diversity, and dynamics were investigated. One-way ANOVA was used to test for fuel and vegetation differences among sites, and Shannon-Wiener and Equitability indices were used to assess both diversity and evenness. Results showed a rapid reestablishment of both the vegetation (cover, life form, species richness and diversity) and fuel, as early as the 3rd and the 6th post-fire year, respectively. Fuel and vegetation were tremendously dominated by unpalatable and highly flammable dwarf shrubs which smothered herbaceous plants. Species diversity was relatively low, indicating that few species crushingly structured the community by their high cover, while the remaining species were poorly abundant.

Keywords: Biomass, Phrygana, Post-Fire Dynamics, Species Diversity, Species Richness.

Paper ID: CEST2017_00222

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Application of the DPSIR model in a transboundary river basin (Aoos/Vjosa): success or failure to achieve good ecological status

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Abstract

The European Water Policy introduced the necessity to apply new methodological approaches for water resources sustainable management. The incorporation of the EU Water Framework Directive (WFD) – 2000/60/EC and the "Sister Directives" (Flood and Habitat), as an obligation by all Member States, set the basis for catchment-based governance for successful water quality and quantity management in transboundary river basins. Aoos/Vjosa is the largest river of Epirus geographical region (NW Greece) flowing through Albania and discharging into Adriatic Sea. The Driving Force-Pressure-State-Impact-Response (DPSIR) model was applied as framework for the case study of the transboundary Aoos river basin. The ecological classification of the Aoos River, based on WFD criteria, indicated definite impact caused by human activities. The results of the present paper might support an integrated management identifying the restoration priorities for the study area

Keywords: DPSIR, WFD, Pollution Assessment, Transboundary River Basin Management

Paper ID: CEST2017_00720

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Organic agriculture and the environment: Opinions of organic olive farmers on the island of Rhodes.

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Abstract

This work, which is part of a wider investigation, is an attempt to explore the opinions of organic olive growers of the island of Rhodes on issues related to organic farming, the environment and olive cultivation, particularly, the opinions of organic farmers about environmental protection, environmentally friendly agricultural practices and scientific guidance. The research is a case study in the region of Rhodes island and was conducted between November 2015 and February 2016. The population of the survey consists of 33 currently active organic olive farmers. The data was captured with the use of a questionnaire. According to the findings, there is strong evidence that organic farmers are environmentally conscious and believe that the practices used in conventional agriculture, such as chemical fertilizers and pesticides have adverse effects on the environment. The research also found that one of the main reasons they chose organic olive cultivation is environmental protection. It is also of interest that respondents consider the presence of an agronomist important for the provision of consultancy and technical support in organic olive cultivation.

Keywords: organic agriculture, organic olive cultivation, Rhodes, olive farming

Paper ID: CEST2017_00754

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Everything is social: Stakeholder values-based assessment of remediation sustainability

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Abstract

The Portland Harbor Superfund Site (PHSS), contaminated by more than 100 years of agricultural, urban, wartime, industrial, combined sewer overflow, and storm water inputs, encompasses about 10 miles of the Willamette River in downtown Portland, Oregon. This site affects residents, businesses, tribes, recreation and wildlife; there is considerable contention over remedial options. The Environmental Protection Agency (EPA) released a proposed plan for the Site on June 8, 2016. Although the plan addresses trade-offs in option selection, inviting public comment, this analysis is qualitative, and sustainability is only invoked as the application of best management practices after option selection. However, regulatory decisions should consider affected communities' needs, and how these might be impacted; this requires that diverse stakeholders are able to engage in a transparent consideration of value trade-offs and of the distribution of risks and benefits of remedial actions and outcomes. The PHSP assessed the sustainability of a range of remedial options, including the EPA's preferred option. The Sustainable Values Assessment (SVA) tool was developed to link environmental quality, economic viability and social equity metrics to a range of stakeholder values; metrics were scored and aggregated and options were ranked in terms of stakeholder group (SG) priorities.

Keywords: Sediment remediation, social sustainability, Portland Harbor Superfund Site, social equity, Sustainable Values Assessment (SVA)

Paper ID: CEST2017_00792

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Protected areas and green jobs versus environmental goods and services sector – competitive analysis

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Abstract

The aim of the article is to compare three main definitions which are intertwined with green economy: protected areas and green jobs, versus environmental goods and services sector. This article refers to the most accepted approaches towards greening economy, which is based on sustainable development concept. Based on selected definition of green jobs the article presents an analysis of possible prevention young people's unemployment. In Poland about 15% of young people find their first employment in green jobs sector. Green jobs characteristic based on PKD is more specific than proposed by Eurostat EGSS definition.

Keywords: ecodevelopment, European public goods, green jobs, protected areas.

Paper ID: CEST2017_00808

Evaluation of Nano Zinc Oxide feed additive on tilapia Growth and Immunity

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Abstract

Aquaculture is the last frontier to solve the problem of the global deficiency of white protein. Some studies reported that, nano-particles have enormous potential in controlling the pathogens, improve the immune and growth functions in aquaculture. The present investigation was carried out to evaluate nano-ZnO (nZnO) in comparison to its conventional form as a fish feed additive in growth promoting and immunostimulation of Nile tilapia (*Oreochromis niloticus*). Zinc oxide nanoparticles were prepared using the chemical method and mixed with the fish feed. 405 *Oreochromis niloticus* were fed for 120 days on Zinc oxide conventional bulk scale (ZnO) and nanoscale (nZnO) supplemented feed in different concentrations (15, 30, 45 and 60 mg/kg of the feed) in addition to the control which was fed on ZnO free feed. nZnO (15mg/kg) achieved specific growth rates like the higher concentrations of bulk ZnO (60mg/kg). The 60mg/kg nZnO gave the highest rates of Specific growth rates(4 folds than control). growth hormone was higher in serum of fish fed on nZnO supplemented feed than the bulk form. Immunity was assessed through the measurement of total protein and IgM titer and IL1-beta (IL-1β) gene expression. Total protein and IgM titers revealed high values increasing with the increase of concentration of ZnO feed additive in its two forms compared to the control, but nZnO showed better results than conventional ZnO. Analysis of IL1-beta gene expression revealed that 60mg/kg conventional ZnO was the best concentration for up-regulating the IL1-beta followed by the concentration 30mg/kg in the two forms; the nano and the conventional form. The inorganic conventional ZnO up-regulated the IL-1β better than the nZnO form. Zinc was concentrated higher in muscles of fish fed on nZnO supplemented feed more than conventional ZnO fed fish but still within the permissible limits. One way ANOVA statistical analysis was used in all analyses with $p<0.05$.

Keywords: Zinc Oxide Nanoparticles, Interleukin 1-beta Expression, Growth, *Oreochromis niloticus*.

PAPER ID: CEST2017_01342

SESSION 19B – REFINING THE ASSESMENT OF HUMAN EXPOSURES TO EMERGING CONTAMINANTS AND THEIR HEALTH EFFECTS

Friday 1 September 2017 – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Stress in Fish: The use of Serum Amyloid A as a Biomarker in Farmed Fish

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Abstract

The stress response is a non-specific mechanism by the host organism in response to exposure to a stressor, physical damage or infection. It involves the Acute Phase Reaction (APR) which is activated by the immune system, and involves the expression of Acute Phase Proteins (APPs) which include Serum Amyloid A (SAA) and C-Reactive Protein (CRP). SAA is a major APP which increases in concentration by up to 1000-fold during the APR. Stress and disease is of major economic and welfare concerns in farmed fish such as Rainbow Trout (*Oncorhynchus mykiss)*, and the development of a fast molecular based bioassay to monitor this biomarker would be of benefit to the industry. The level of SAA expression was measured using mRNA extracted from the internal organs (liver, spleen, kidney, reproductive organs, heart and fatty tissue) of *O. mykiss*, as the initial test subject, using both standard PCR and qRT- PCR. A baseline level of SAA expression has been determined for the different organs/tissue and will be used as a comparator for SAA expression levels in fish obtained from sites considered polluted or under stress.

Keywords: SAA, APR, APP, *Oncorhynchus mykiss*, qPCR

Paper ID: CEST2017_00219

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Correlation Analysis of Long Term Exposure of Particulate Matter and Vehicular Traffic, on the Incidence of Respiratory Diseases in Two Urban Areas in the Philippines

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Abstract

A number studies reported in literature have highlighted the role of road traffic in pushing up the levels of ambient particulate matter as well as the contribution of particulate matter in increasing the incidence of certain respiratory health endpoints. This study investigates the evidence of the impacts of traffic by looking at the situation at the city-level through the assessment of the relationship of PM_{10} concentration, traffic in passenger car units, and incidence of asthma and acute bronchitis among children ages 0 to 59 months in two major Philippine cities.Results indicate a positive correlation between annual level of particulates and traffic in both cities. Assessing the correlation between particulate pollution and public health requires quantitative knowledge about the relationship between exposure and health. The risk assessment conducted revealed that 8% and 12% of children getting sick of asthma in Quezon City and Makati City respectively may be attributed to particulate matter exposure. On the other hand, 3% and 6% of acute bronchitis cases in Quezon City and Makati City respectively are likely due to particulates. GIS was also utilized to estimate the PM_{10} concentration per district in both cities and the number of children that might be exposed to it. The study found that a sizable number of children in both cities live in polluted areas making PM_{10} a persistent environmental health hazard for children 0-59 months.

Keywords: traffic, particulate matter, respiratory diseases, correlation

Paper ID: CEST2017_00365

Polyunsaturated aldehydes as bioactive secondary metabolites in the aquatic environment

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Abstract

Polyunsaturated aldehydes (PUAs) are compounds that can be released into the natural aquatic environment by phytoplankton as bioactive secondary metabolites. These metabolites aid photosynthetic organisms in important functions as protection, competition, and species interactions. The production of PUAs result from the lipoxygenase-mediated degradation of free polyunsaturated fatty acids released by phospho- and galactolipids hydrolysis. This reaction is activated immediately after the cell integrity is broken by lysis or mastication by grazers. PUAs have negative impact on algae grazers causing carcinogenic and mutagenic effects. The aim of the presented studies is to identify polyunsaturated aldehydes in natural freshwaters. The highest PUAs concentrations were identified in autumn and in waters with high concentration of organic matters. A high coefficient of correlation (r = 0.93) was determined between the total concentration of aldehydes identified in natural surface waters and the absorbance measured at a wavelength of 254 nm characteristic for aromatic compounds. The influence of other factors such as temperature, sun-light, and presence of natural bacteria on the destruction of aldehydes was also estimated. A technique of gas chromatography with the electron capture detector and derivatization process with o-(2,3,4,5,6-pentafluorobenzyl) hydroxylamine was applied for qualitative and quantitative determination of PUAs.

Keywords: Polyunsaturated aldehydes, secondary metabolites, freshwaters, gas chromatography

Paper ID: CEST2017_00719

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Restructuring the long-term moss biomonitoring of atmospheric deposition in Germany

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Abstract

The determination of atmospheric deposition in forests can be accomplished using technical sampling devices (bulk samplers, wet only samplers), biomonitors or modelling. In Europe, since 1990 moss sampled every five years at up to 7300 places in up to 36 countries was used as biomonitor. In the moss specimens, heavy metals (HM), nitrogen (N, since 2005) and persistent organic pollutants (POPs, since 2010) were determined. Germany participated in all surveys with the exception of that in 2010. For the moss survey 2015, the biomonitoring network applied in the 2005 campaign should be reorganized. To this end, a complex statistically based methodology including a decision support system was developed and implemented. Its application yielded a network with a reduction of sample points from 726 to 402. By use of the data collected in 2005 the performance of the reorganized network did not reveal significant loss of statistical validity.

Keywords: Decision support system; Minimum sample size; Spatial sampling design.

Paper ID: CEST2017_00834

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of human exposures: Bioaccessibility studies of some toxic metals in tea (*Camellia sinensis* L.) samples

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Abstract

In this study, As, Cd, Cr, and Pb were determined from black, green, and earl grey tea samples after microwave digestion and in-vitro methods that simulate stomach and intestinal digestive conditions. Leachabilities were assessed after brewing of tea samples. Inductively coupled plasma-mass spectrometry (ICP-MS) was used for all measurements. The bioaccessibility from tea samples were found to be varied between 3 to 100% of the leachable levels.

Keywords: Tea *(Camellia sinensis* L.), bioaccessibility, toxic elements, inductively coupled plasma-mass spectrometry (ICP-MS)

Paper ID: CEST2017_01047

Bisphenol A exposure and anthropometry in Turkish children aged 8-9 years in Konya

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Abstract

This study aimed to determine the levels of Bisphenol A (BPA) and the relationship between BPA and anthropometric measurements of children aged 8-9 years in a sample representing urban and rural areas of Konya in Turkey. Urine samples were collected in glass vials in the morning and were stored at −20 °C until analysis. BPA analyses were performed using LC–MS/MS. Weight-for-age, height-for-age, body mass index -for-age were expressed in Z score (WAZ, HAZ, BAZ, respectively). BPA were divided into three categories [low<20%; 20%≤middle≤80%; high>80%]. Of 587 enrolled children, 65.8% were from urban areas, 50.3% male. Urinary BPA concentrations were detectable in 79.6%. A median (25p-75p) concentration of creatinine-corrected BPA concentrations was 5.9 (2.1-12.0) µg/g-creatinine. Children from urban residence had significantly lower BPA concentrations than rural ones. BPA concentrations were not associated with gender and BAZ. Children with low creatinine-corrected BPA levels (<20%) had significantly higher HAZ than those with high BPA levels (p=0.017). After adjusting age, residence and gender, BPA levels significantly affected HAZ of children. As a result, BPA exposure changed with residence of children. BPA exposure might negatively affect height during prepubertal period. Further studies are necessary to evaluate the effect of BPA exposure on child growth.

Keywords: Bisphenol A, exposure, urine, children, anthropometry, height

Paper ID: CEST2017_01073

Human health effects of drinking water fluoride contamination: Indian scenario

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Abstract

Fluoride is one of the main contaminants in groundwater present naturally in many parts of the globe causing a set of human health symptoms known commonly as Fluorosis. India lies in the geographical belt with 225 districts of 19 States having high fluoride concentrations (> 1.5 mg/l) in groundwater. For many rural as well as urban areas in India, hand-pumps and tube-wells are the only source of safe drinking water. With increasing population and increasing demands of water from below the ground, the fluoride contamination is spreading to newer areas every year. About 62 million people in India suffer from dental, skeletal and non-skeletal fluorosis including 6 million children below the age of 14 years. This paper presents quantitative assessment of fluoride contamination in groundwater and the associated fluorosis severity reported from various parts of India. It also summarizes research carried out in the country on reversal of dental and skeletal fluorosis through oral medicines; role of aluminium in aggravation of fluorosis; and dietary interventions in large communities across the country as possible remedies for this serious public health problem.

Keywords: Fluorosis, ground water, public health, India.

Paper ID: CEST2017_00852

SESSION 20 – ENVIRONMENTAL DATA ANALYSIS AND MODELLING (1)

Friday 1 September 2017 – morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Time variations of the physicochemical parameters in a Mediterranean Lake

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Abstract

Nowadays, water resources are under increasing pollution pressures globally. Anthropogenic activities such as intensive agriculture, industrial sprawl and urban development, together with climate change and poor water management practices, impact the ecological integrity of water bodies and lead to the deterioration of water resources quality. To mitigate these pressures, efficient monitoring efforts should be established with the use of state-of-the-art equipment that can operate in low cost and long term basis. In the particular effort, the daily physicochemical data (temperature, dissolved oxygen-DO and electric conductivity) of the period 2011-2015 from an automatic monitoring station in Koumoundourou Lake, West Attica-Greece were statistically elaborated to identify time trends that can be related to documented pollution pressures in the associated catchment.

Keywords: Koumoundourou Lake, monitoring survey, pollution pressures, statistical analysis

Paper ID: CEST2017_00152

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Forest fire danger rating systems assessment in the Mediterranean type environment, Crete, Greece

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Abstract

The Fire Weather Index (FWI) module of the Canadian Forest Fire Danger Rating System (CFFDRS) was tested under the Mediterranean- type conditions of Crete (Greece) for the two fire seasons 2008-2009. High correlations were found between the Fine Fuel Moisture Code (FFMC) and the Duff Moisture Code (DMC. The Drought Code (DC) was poorly correlated with the soil moisture content. No significant correlation was found between the area burned by wildfires and any component of the FWI system during the studied period, unlike fire occurrence with which most of the components were highly correlated. Meanwhile, the Keetch-Byram Drought Index (KBDI) of the American Forest Fire Danger Rating System (NFFDRS) was also evaluated under the same conditions. It provided a useful means of monitoring general wetting and drying cycles, but is inadequate for indicating daily fire danger throughout the fire season in our region. Weak correlations between the KBDI- the fire occurrence and the area burned were found for the two fire seasons studied-2008-2009. Correlations between the KBDI and litter, duff and soil did not give statistically sound results. On the contrary, the KBDI seemed to predict with high accuracy the moisture content of three annual plants.

Keywords: Danger Rating Systems, Data Analysis, Forecasting, Forest Fires, Fires Risk, Moisture Content

Paper ID: CEST2017_00213

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Consideration of Soil Water Consumption of *Juniperus macrocarpa* in Semi-Arid Ecosystem in Western Crete, Greece.

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Abstract

This study aimed at determining the transpiration water use of *Juniperus macrocarpa* in a closely to 40 year-old even-aged stand categorized into three classes based on canopy size, over a two-year period (2011-2012) located in Palaiochora, 77 km south of Chania, Crete. Sap flow techniques (Granier-type) were used to determine water use. Annual trends in sap flow were generally bell-shaped, and varying significantly between seasons and canopy classes. Winter sap flow was minimal but trees were active when temperatures were above freezing point and trees depended on deep water (below 60 cm) for transpiration. Rates increased from 1.46Ld-1 in winter to 3.32 Ld-1 in the spring, irrespective of tree canopy class, because of improvement in weather conditions. Maximum transpiration rates were observed during the growing season with an average of 134.42 Ld-1 for dominant trees and 8.68Ld-1 for suppressed ones. The daily variations in photosynthetically active radiation, vapor pressure deficit, air temperature, and surface soil water were the principal drivers for transpiration during the growing season. The findings have shown that climate in Crete does not limit the expansion of *J. macrocarpa* and that this expansion will have potential significant impacts on the ecohydrology of the system.

Keywords: *Juniperus macrocarpa*, Sap flow, Semi-arid ecosystems, Soil water content, Transpiration rates.

Paper ID: CEST2017_00237

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The worth of hydro geochemical data factor analysis (PCA) in interpretation of underground water origin. Megalopolis lignite bearing fields mine water and regional waters relations case study

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Abstract

In the region of Megalopolis basin (Peloponnese, South Greece), a number of lignite open pit mines are developed by Public Power Corporation S.A. in order to provide the electric power plants of 1200 MW with lignite. From environmental point of view is important to avoid negative effects of mines exploitation to significant regional ground and surface water reservoirs. In this paper there was an effort to implement factor analysis in order to determine principal components on water analysis acquisition data in the region of Megalopolis Greece. The results of Principal Component Analysis (PCA) indicate two between five significant Principal components corresponding to samples collected from the internal mines dumping sites or pumping sites. The regional samples of water outside mines areas have factor scores insignificant to these two principal components. Thus beside national legislation and international standard limitations compliance, that is company's environmental policy, PCA analysis confirmed the fact that there is no effect on the regional ground and surface water system by mine water.

Keywords: Statistics, Principal Component Analysis, hydro chemistry.

Paper ID: CEST2017_00246

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geometrical characteristics' impact over the thermal plume modelling with breathing thermal manikins

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Abstract

The presented paper reveals a CFD based analyses of the complexity in the geometrical shape of the thermal manikins, related to their thermal and breathing functions. Both impacts, over velocity and temperature fields in the manikin's thermal plume zone above the head are analyzed for two different geometrical shapes – a physiologically identified (*Humanoid Manikin*) and one designed to match the overall 95th percentile of the anthropometric size of the standard person (*Polygonal Manikin*). The first model represents a comprehensive multifaceted figure of a manikin with high degree of physiological identity with a female human being. The second one is simplified, but still with anatomically realistic component forms, accurately representing the anthropometric size of a standard person. This model, suggested by the authors, allows completely realistic positioning of the hands and legs in the space, and the manikin itself is more convenient for manufacturing of real breathing prototype. The obtained numerical results demonstrate the noticeable impact of the manikins' geometrical characteristics over the simulated breathing and convective flows. The resulting differences have indicted the need of geometrical improvements of the *Polygonal Manikin* in order to match better the real human body thermal plume characteristics.

Keywords: Thermal manikins, CFD modelling, breathing phases

Paper ID: CEST2017_00414

Comparison of different CFD techniques for transient modelling of virtual breathing thermal manikins

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Abstract

The presented paper reveals comparative analyses of three different CFD based transient modelling techniques (URANS, DES and LES) for flow simulations with virtual thermal manikins. The interaction between the simulated breathing flow and the free convection flow from the heated virtual manikin's surface for two breathing phases is performed under controlled room conditions. Recent studies of the authors' show that simulations under steady state conditions can lead to overprediction of the resultant fields, so the implementation of transient simulation methods is recommended in that case. Qualitative analyses between the different techniques are made, in terms of temperature and velocity fields' comparison. Considering that these virtual thermal manikins are modern complex tools for virtual design and assessment of the occupants' thermal comfort, as well as for virtual analyses of indoor air quality, the results achieved in the present study will provide new and valuable approach for the integration of various modelling techniques in the presented area.The CFD results has demonstrated a flow pattern similarities in both DES and LES solution methods, while in URANS simulations it was observed a deflection of the thermal plume with almost 0.4 m at 2.5 m height from the floor, under free convection conditions. Nevertheless, for the exhale phase of the breathing cycle, there was a good correlation between the different techniques, in the breathing zones of the manikin.

Keywords: CFD, URANS, DES, LES, Virtual Thermal Manikin, Breathing Flow Modelling

Paper ID: CEST2017_00415

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Modelling heavy metal background concentrations in Bulgarian monitoring soil quality network

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Abstract

Defining baseline concentrations for toxic elements in soils is essential for recognizing and managing soil pollution. Estimation of heavy metal baseline concentrations in soils, especially on national scale, has been fraught with many difficulties to cover different soil types, natural and anthropogenic impacts on regional level. The present study deals with univariate and multivariate statistical treatment of 358 samples from the Bulgarian monitoring network for soil quality assessment. The surface soil samples were analyzed for 8 critical heavy metals: Cu, Zn, Cd, Pb, Ni, Cr, As, Hg. Two decision tools (box-plot method and Principal component analysis) were applied for identification of contaminated sites. Comparison between both methods was performed using GIS based maps.

Keywords: heavy metals, soil pollution, baseline values, statistics

Paper ID: CEST2017_00446

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Identification by geophysical/geochemical methods of the areas polluted by anthropogenic emission of airborne elements - a case study of city park in the vicinity of a steel plant, Southern Poland

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Abstract

The recognition of a hazard to human health and the environment from the emissions of airborne pollutants resulted in the adoption of the Convention on Long-Range Transboundary Air Pollution (CLRTAP, 1979) and EMEP co-operative program. Extensive efforts have been undertaken to improve identification of soil contamination with airborne pollutants, in particular with potentially toxic elements (PTEs). An extremely useful, easy-to-use and reliable tool widely investigated for over two decades, is a geophysical method of screening soil pollution with PTEs by surface measurements of magnetic susceptibility κ. The extensive works on the method resulted in the development within the Polish-Norwegian IMPACT project (2014-2016) of an international standard ISO/CD 21226 (adoption procedure pending). Here, the use of this method is exemplified in a case study on assessment of soil pollution with PTEs in the city park area in the vicinity of a steel plant operating since 1976. The spatial distribution of magnetic susceptibility in the area indicated high pollution with PTEs in the whole area, with two centres of maximum κ values. These data were in conformity with concentrations of PTEs in soils in the area, in particular of Cd, Zn and Pb that occurred in concentrations posing threat to the environment.

Keywords: soil spatial pollution, airborne elements, magnetic susceptibility, steel plant emission, metal mobility

Paper ID: CEST2017_00664

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Downscaling GRACE data to estimate groundwater use at the aquifer scale

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Abstract

Sustainable groundwater management requires an operational in situ monitoring network. Concerning groundwater quantity, the EU Water Framework Directive (WFD) requires groundwater level and abstraction monitoring so as to ensure that changes in groundwater storage do not exceed the natural replenishment of the groundwater system. However, there are cases, e.g. Greece, where WFD monitoring program has not yet become fully operational due to various constraints which are more evident during the recent economic crisis. Over the last few decades, satellites have provided useful information to hydrologists, not only concerning surface water resources but also concerning groundwater conditions. The present study aims at quantifying groundwater use at the aquifer scale by using Gravity Recovery and Climate Experiment (GRACE) satellite data in combination with available meteorological data of the study area. To achieve this goal, gridded GRACE Total Water Storage data were statistically downscaled using an Artificial Neural Network (ANN). The methodology was applied in an aquifer in Thrace region (NE Greece) during the time period 2005 - 2014. Results showed that monthly quantity of water extracted from a certain aquifer can be efficiently estimated offering an inexpensive alternative when in situ observations are not available.

Keywords: Groundwater use, statistical downscaling, Artificial Neural Networks, GRACE, Thrace Greece

Paper ID: CEST2017_00743

Modeling Calcium Carbonate Precipitation in the Acigöl Lake Using AQUATOX

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Abstract

Due to the low costs of production processes, many industries use $CaCO_3$ broadly as an inorganic mineral that appears in forms of limestone. The aim of this research is to model $CaCO_3$ precipitation in the Acıgöl Lake, using water quality data obtained from the field measurements and meteorological data from the Turkish State Meteorological Service (TSMS) for the years 2013 and 2015. To achieve this aim, Environmental Protection Agency's (EPA) AQUATOX model is used to model the lake's water quality and $CaCO_3$ precipitation. Firstly, a surrogate site is selected from AQUATOX library, which would represent the lake's characteristics in the best possible manner. The model is then calibrated for nine stations of the lake using parameters related to nutrients, plants, water quality, site characteristics, inflow loadings and lake hydrodynamics. Calibration dataset is obtained from field measurements and meteorological data for the year 2013. Model validation is conducted both using data from the laboratory experiments carried out in 30^0C, and field observations obtained in August, 2015. Model results suggest that the amount of $CaCO_3$ precipitation in the system ranges between 35.16 to 128.48 $mgL^{-1}d^{-1}$. The NRMSE between the modeled and observed values are found to be 0.29.

Keywords: Modeling, Lake, $CaCO_3$ precipitation, AQUATOX

Paper ID: CEST2017_00753

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Investigating the influence of environmental heterogeneity on plant species richness pattern of the Eastern Himalaya

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Abstract

Species richness pattern is poorly understood at local scales. Here we analyse impacts of physiography, climate, and edaphic factors on species richness pattern of the Eastern Himalaya using 376 spatial location points, collected through scientifically designed national level sampling assessment. We fitted nonlinear predictive model technique for 1470 species and selected eight least correlated predictors through multicollinearity and principal component analysis tests. Independently, physiography was poorly associated with species richness than edaphic and climatic factors. Climate explained the maximum deviance of 48 % with a dominant contribution from aridity and precipitation of the driest quarter. However, the cumulative effects of potential evaporation and temperature seasonality expressed significantly with interactions. The water stress due to dryness and low precipitation play determining role species richness pattern and long-term fluctuations in temperature increase their vulnerability to climate change. The warmer south is less likely to be affected by these changes than the north experiencing climatic extremes describing its environmental stability. The collective effect of all variables and their interactions explained the maximum deviance of 58 %; and described climate's synergy with physiography and soil in shaping species richness pattern. The study would support for conservation prioritisation of the region.

Keywords: Species richness; generalised additive model; climate; soil; physiography

Paper ID: CEST2017_00876

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Vegetation changes in Natura 2000 sites in Greece using remote sensing data

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Abstract

It is widely accepted that land use changes due to human intervention have caused degradation in various ecosystems. Advances in remote sensing enable us to detect spatial and temporal changes on earth's surface. The present work deals with the determination of temporal and spatial vegetation changes in the Natura 2000 designated areas in Greece, using remotely sensed data. The MODerate Resolution Imaging Spectroradiometer (MODIS) Normalized Difference Vegetation Index (NDVI) was used as a proxy for the computation of changes related to vegetation during the time period 2000 - 2016. The seasonal changes have also been examined, so as to unveil any possible changes that might suggest potential degradation of protected sites in Greece. The whole process has been developed combining R statistical package with QGIS, both open and free software packages, and using publicly available MODIS data. Results showed that the methodology constitutes an efficient and inexpensive tool of monitoring protected sites and helps in finding out whether the implementation of a protection policy has resulted in sustainable ecosystems.

Keywords: Vegetation changes, NDVI, MODIS, Greece

Paper ID: CEST2017_00892

C-FOOT CTRL-tool: Development of an integrated tool for the assessment of the greenhouse gas emissions in wastewater treatment plants

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Abstract

The goal of the C-FOOT-CTRL is the development of a new software tool that is able to conduct online monitoring, control and mitigate greenhouse gas (GHG) emissions in wastewater treatment plants (WWTP). The software tool comprises of three basic components, the online measurements, the database and the dynamic model. The online measurements will be provided by GHG sensors, energy meters and other sensors that are installed in a WWTP and will be imported in the database. Also, the user will be able to record values for all parameters, i.e. design values and hourly or daily values for specific variables. Hence, historical series of carbon footprint will be generated for the whole WWTP and for each individual stage as well. The dynamic model, that will be able to predict the carbon footprint of the WWTP and its various processes, was also developed. The main purpose of the model is to support the user in identifying whether a specific operational change can trigger a significant difference in the GHG emissions and consequently, in the carbon footprint of the plant. The results of the dynamic model will also be imported into the database to compare real-time measurements with the prediction of GHG production.

Keywords: simulation; modeling; greenhouse gases; emission; control

Paper ID: CEST2017_00990

Stochastic monthly rainfall time series analysis, modeling and forecasting in Karyes, Chios Island, Greece, Central-Eastern Mediterranen Basin

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Abstract

Rainfall is one of the most important sources of water on earth supporting the existence of the majority of living organisms. Time series analysis, modeling and forecasting constitutes a tool of paramount importance with reference to a wide range of scientific purposes in meteorology (e.g. precipitation, humidity, temperature, solar radiation, floods and draughts). Chios island, in general, suffers shortages of freshwater leading the local municipal authoriries to employ a desalination plant in order to cover water needs of the local population. Karyes village, Chios island, is abundant of freshwater springs, enriched every year by the rainfall occured over the district, feeding, in turn, enhanced by the local geological patterns, some high quality freshwater acquiring spots into the capital of Chios and thus constitutes a very important freshwater source of the entire Chios island itself. The present research applies the Box-Jenkins approach, employing SARIMA (Seasonal Autorregressive Integrated Moving Average) model to perform short term forecasts of monthly rainfall in Karyes village, Prefecture of Chios island, Region of North-Aegean Sea, Central-Eastern Greece, Central-Eastern Mediterranean Basin, modeling past rainfall time series components structure and predicting future quantities in accordance to the past. The model which is mostly fit to both describe the past rainfall data and thus generate the most reliable future forecasts is selected rated by means of the R-squared, Stationary R-squared, R.M.S.E., M.AP.E., M.A.E. and Normalized BIC- model evaluation criteria. The conclusions of this research will provide local authorities (e.g. General Secretariat for Civil Protection, European Center for Forest Fires, Deputy Governor of Agricultural Economy, daily fire risk maps designers, hydraulic, irrigation and environmental engineers, city inhabitants, farmers etc.) to develop strategic plans, policies and appropriate use of available water resources in Karyes village, Chios island district.

Keywords: Rainfall time series forecasting, auto regressive moving average models, trend, seasonality, SARIMA models.

Paper ID: CEST2017_01008

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Water-Energy dynamics derives the plant species richness patterns in the major bio-geographic zones of India

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Abstract

Regional differences in climate variable affect patterns of plant species by modifying their niches. Thus, more robust research on plant species richness (SR) in response to various drivers is must for formalising suitable conservation measures. We have modelled the plant SR pattern of two major biogeographic zones i.e. Deccan Peninsula (DP) and Arid and Semi-arid (ASA) zone of India by testing various statistical models including generalised linear model (GLM), Random forest (RF), Generalised boosted model (GBM) and Support vector machine (SVM) to predict the SR of the zones using climatic variables. Water variables (combination of minimum and maximum precipitation) played dominant role in deriving SR in DP zone explaining significantly 15% to 51% of correlation respectively. In contrast, ASA zone showed an influence of energy (temperature; bio7) and water variables (average precipitation; bio 13 and bio 14) explaining correlation of 54% to 80% respectively in combination. The dominant role of water over energy variables in warmer climates at lower latitudes supports the climate tolerance hypothesis (CTH) resulting the high species richness of Eastern Ghats in DP zone. However, low species richness in the ASA zone was attributed to the lower ranges of precipitation and higher ranges of temperature variables showing significant correlation with species richness.

Keywords: Species Richness, Biogeographic zone, India, modeling

Paper ID: CEST2017_01284

SESSION 21 – WATER AND WASTEWATER TREATMENT (4)

Friday 1 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Environmental effect of the WWTP discharge on the quality of the receptor river

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Abstract

The aim of this paper is to examine the Po River water quality in a small stretch in Piedmont (northern Italy). In this stretch a large pollution load, derived from the wastewater treatment plant of Torino area (more than 2 million inhabitants), is discharged and diluted in the water. In this study this load has been quantified and modeled in order to understand the sources, destinations and effects of the emitted pollutants. The objective was to determine the impact produced by the Torino Wastewater Treatment Plant on the quality of the water, based on various hydrological conditions and the possible intervention on the point and diffuse loads.

Keywords: water quality; flow rate; wastewater treatment plant, pollution load

Paper ID: CEST2017_00619

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of nitrous oxide production and system performance for a full-scale anammox plant combining activated sludge and granular activated carbon biofilm: a model-based study

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Abstract

In this work, experimental and long-term one-dimensional mathematical modelling approaches were combined to investigate the mechanisms and the main drivers influencing on emission of nitrous oxide in a full scale anammox plant whereby anaerobic ammonium oxidation (anammox), ammonia oxidizing bacteria, nitrite oxidizing bacteria and heterotrophic denitrifying bacteria enriches in activated sludge treatment process, then grow on granular activated carbon surfaces as biofilms. The model was calibrated and validated using the actual real-time data of nitrogen components concentration in the effluent. The abundancy of various genera of anammox as dominant microbial group was estimated in the model by quantitative fluorescent in situ-hybridization (FISH) and image processing. A parameter identifiability protocol was applied to express the growth kinetic characteristics of microbial groups in the plant. Since nitrous oxide (N_2O) is a greenhouse gas with important impacts on our environment, various pathways of the formation of nitrous oxide were considered and simulated. Finally, the system performance in terms of nitrogen and carbon biological removal efficiency and nitrous oxide production of the plant was optimized and analyzed under different simulation scenarios such as different total nitrogen loading rate, organic substrate rate as well as hydraulic retention times.

Keywords: anammox, granular activated carbon; biofilm, nitrous oxide; system performance optimization; mathematical modeling

Paper ID: CEST2017_00701

Evaluation of the dynamics of microalgae population structure and process performance during piggery wastewater treatment in algal-bacterial photobioreactors

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Abstract

Microalgae cultivation in wastewater is crucial to the development of microalgae-based biorefineries for biofuel or biofertilizer production, whose viability depends on the supply of a biomass with a consistent year-round composition and characteristics. This work evaluated the dynamics of microalgae populations during piggery wastewater (PWW) treatment in 4 open photobioreactors inoculated with (R1) *Chlorella*, (R2) *Acutudesmus, (*R3) *Oscillatoria* and in the absence of inoculum (R4). In addition, TSS concentration and organic matter, nutrient, and heavy metal removals were assessed. The photobioreactors were fed with PWW diluted at 15% at a HRT of 27-days under 12h/12h light/dark irradiation cycles at 2800µEm^{-2}·s^{-1}. The pH was maintained at 8 via external CO_2 supplementation. *Chlorella* sp. and *Acutudesmus obliquus* were the dominant microalgae species regardless of the tested photobioreactor. The highest TSS concentration (3625 mg TSS/L) was recorded in R4 (the photobioreactor without initial microalgae addition) which showed the robustness of acclimation of native species to PWW. No significant differences were recorded among the 4 photobioreactors in terms of removal efficiencies of TOC (86-87%), IC (62-71%), TN (82-85%) and TP (90-92%). However, higher Zn removal efficiencies (47%) took place in the photobioreactors at higher biomass concentration.

Keywords: Algal-bacterial processes, Biomass production, Heavy metal removal, Microalgae dynamics, Piggery wastewater treatment.

Paper ID: CEST2017_00716

Effect of calcium ions on aluminum recovery by fluidized-bed homogeneous granulation process

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Abstract

Fluidized-bed homogeneous granulation process (FBHGP) is an innovative process that can synthesize solid granules in the absence of a seed material. This unique technology is highly efficient, no sludge, low moisture, saves land and capital cost. The granules are formed inside the reactor by altering the reactor designs and conditions as hydraulic parameters were varied. The effects of Ca^{2+} ions on Al (aluminum) recovery and granulation ratio (GR) were further investigated by adjusting 200-400 $mg \cdot L^{-1}$ of influent Al^{3+} concentrations, 5.5-6.5 molar ratios (MR) of $[OH^-]_{in}/[Al^{3+}]_{in}$, and 11.5-12.1 pH of precipitant with 11.8 of pH_e. Results showed that 99.2% of *Al removal* and 98.9% of *GR* were achieved at 1.15 $kg \cdot m^{-2}h^{-1}$ of cross-section loading (L), 200 $mg \cdot L^{-1}$ of influent Al^{3+}concentration, 6.0 MR of $[OH^-]_{in}/[Al^{3+}]_{in}$, and 12.1 pH of precipitant, whereas the 32.47 $m \cdot h^{-1}$ of hydraulic loading (U) was achieved at the same parameters with 99% of *Al removal* and 97.6% of *GR*, Ca^{2+} ions affect the Al granule composition, while it has no effect on the Al removal. To conclude, a useful way of recovering Al^{3+} in the form of tetra calcium dialuminum dodecahydroxide carbonate pentahydrate ($Al_2Ca_4H_{22}O_{20}$) from aqueous solution was successfully done.

Keywords: Fluidized-bed, homogeneous granulation, calcium ions, supersaturation, granules

Paper ID: CEST2017_00746

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluating the performance of nitritation-denitritation process for sludge liquors treatment

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Abstract

Treatment and handling of sewage sludge (anaerobic digestion, thickening, dewatering, etc) results in the production of sludge liquors with a high ammonium content and low COD:N ratio, which are recycled back to the main wastewater treatment line thus contributing about 15-20% of the total nitrogen load of the wastewater treatment plants. Nitritation- denitritation process is often used for ammonia removal from sludge liquors. This process is based on the prevalence of ammonia-oxidizing bacteria and the inhibition of nitrite-oxidizing bacteria. The objective of this study was to evaluate the effect of temperature and the type of external organic carbon source on the performance of the nitritation–denitritation process for the treatment of sludge liquors with a high ammonia content. The study was performed through the monitoring of the operation of a 5L lab-scale SBR for a period of 350 d under alternative conditions (two different external organic carbon types and three temperatures). Based on the results the process can be sustained even at low temperatures (15ºC) with lower rates though. Furthermore, the use of a highly biodegradable organic carbon source can provide for the achievement of very satisfactory denitritation rates thus allowing for the increase of system's overall treatment capacity.

Keywords: AOB; nitritation; denitritation; sludge liquors

Paper ID: CEST2017_00803

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Development of an unstructured nitrification-denitrification model in an industrial-scale SBR for treating the liquid wastes from a potato industry

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Abstract

The liquid wastes from potato industries have high nitrogen concentrations (50-500 mg/L). A typical biotreatment technology for such type of wastes is anaerobic digestion followed by aerobic treatment. Anaerobic digestion consumes only the incoming carbon leaving at the outlet high nitrogen amounts which are removed in two stages during the aerobic treatment. The first step requires strong oxidized conditions, so that the organic nitrogen converts to nitrate (nitrification) and the second stage requires anoxic conditions in order the nitrate to be reduced to nitrogen gas (denitrification). This two-stage procedure, typically, requires a carbon to nitrogen ratio of at least 3:1. However, in our case this ratio is lower. This study presents the results of a new nitrification-denitrification method in one stage using a Sequencing Batch Reactor in which the diluted oxygen is varied between 0 (anoxic conditions) to 2.4 (aerobic conditions). The COD inlet was 685 mg/L and the inlet nitrogen was 140 mg/L while the COD outlet was 48 mg/L and the nitrogen 17 mg/L. Moreover, an unstructured nitrification-denitrification model was developed to predict the behavior of the most important variables.

Keywords: SBR system, industrial scale study, liquid wastes from potato industry, modeling

Paper ID: CEST2017_00862

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Priority pollutants removal in an MBR-RO wastewater treatment system

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Abstract

A small footprint wastewater treatment plant that consists of a membrane bioreactor coupled with a reverse osmosis unit (MBR-RO) has been placed and set in operation for 12 months in EYDAP's R&D department in order to evaluate the quality of the effluent and to explore the feasibility of reuse of the reclaimed water as specified in the Greek National legal framework. A sustainable technology called sewer mining has been approached, which abstracts raw wastewater directly from the sewerage network, treats it on site and provides water at the point of demand. Monitoring of system's performance was achieved through a series of lab analyses and on-line measurements. Besides the microbiological and conventional parameters, final effluent was also analyzed for heavy metals, priority pollutants and emerging contaminants in order to examine compliance with the threshold values set in Greece in order to allow for wastewater reuse for Wastewater Treatment Plants with a population equivalent greater than 100,000. Results showed that the MBR-RO technology provides for the achievement of a high quality effluent, suitable for many reuse purposes. The research confirmed the need for RO as a post treatment level in the case of saline wastewater and/or very strict threshold values for organic micropollutants.

Keywords: Sewer mining, Membrane bioreactor, Reverse osmosis, Emerging contaminants, Priority pollutants, heavy metals

Paper ID: CEST2017_00888

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation of nitrous oxide gaseous emissions from a partial nitritation reactor operating under different conditions

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Abstract

In this study, continuous measurements of nitrous oxide gaseous emissions from a lab-scale partial nitritation (PN) chemostat treating ammonium-rich (1500 mgN/L) synthetic wastewater were performed, in order to achieve a deeper knowledge about its potential environmental impact. The reactor was operated at constant hydraulic retention time (HRT, 1 d) and nitrogen loading rate (NLR, 1500 mgN/L·d), with different influent alkalinity/nitrogen molar ratios (alk/N, 1 and 1.3) and dissolved oxygen concentrations (DO, 5.0, 3.0, 2.0, 1.5 and 1.0 mgO_2/L). As DO ranged between 5.0 and 1.5 mgO_2/L, the partial conversion of ammonium to nitrite was successfully achieved, with a negligible production of nitrate and nitrous oxide. When alk/N was increased from 1 to 1.3 (DO was not limiting, i.e. 2 mgO_2/L), the increase in ammonium-nitrogen removal rate (ANRR, from 717±17 to 945±21 $mgNH_4$-N/L·d) and the simultaneous decrease in specific N_2O-N production (from 0.33±0.01 to 0.23±0.01% of ANRR) were observed. When DO was set to 1.0 mgO_2/L, partial nitritation was irreversibly compromised, and a corresponding increase in specific N_2O-N production was observed (from 0.22±0.01 to 0.61±0.03% of ANRR). The results indicate a clear correlation between N_2O production and autotrophic ammonium to nitrite oxidation rate.

Keywords: alkalinity, ammonium, greenhouse gas emissions, nitrous oxide, partial nitritation

Paper ID: CEST2017_00931

Development of method to quantify bioactive pollutants due to wastewater irrigation in environmental matrices

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Abstract

Wastewater has been shown to be the main point source of bioactive pollutants into the aquatic environment. Irrigation water comes from surface water and or re-used wastewater (treated or raw, depending on the country) meaning that the ubiquitous presence of bioactive pollutants in aquatic environments is of concern in the food growing industry. This work presents a method to analyse several matrices, namely wastewater influent and effluent, soils and plants to be able to determine the prevalence, fate and remediation of 35 of these pollutants in the context of wastewater re-use for agriculture. The extraction step varies depending on the matrix e.g. (Solid Phase Extraction and Ultra sonication) and the quantification is done by LC-MS/MS. Several parameters were studied such as pH of extraction and additives such as Na_2EDTA to improve method metrics. Most analytes presented recoveries higher than 60%, with the exception of a few such as the sulphonamides. However internal standards were used to account for matrix effects and accurately quantify recoveries. As part of the validation steps the method was tested on wastewater effluent were most of the analytes were quantified in the ng/L range, with pollutants such as tramadol, erythromycin and carbamazepine in the μg/L range.

Keywords: bioactive pollutants, wastewater, irrigation, crops, analytics

Paper ID: CEST2017_00955

Optimization of primary sludge hydrolysis for nutrient removal in wastewater treatment plants

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Abstract

Primary sludge biological hydrolysis may be employed to produce readily biodegradable carbon, used to enhance biological nutrient removal processes applied in wastewater treatment plants. The objective of this work was to evaluate the efficiency of primary sludge hydrolysis to produce readily biodegradable organic carbon. Lab-scale units operated, as acid digesters in order to evaluate the effect of: 1) HRT, 2) SRT, 3) temperature and 4) sludge recycle on the efficiency of primary sludge hydrolysis. Primary sludge acid digesters without recycle operating within an HRT range between 2 d – 5 d may achieve a soluble COD efficiency that ranges between 5% - 8% of influent particulate COD, at ambient temperatures. The temperature dependency of solubilization rates can be described by an Arrhenius type equation with a temperature dependence coefficient θ equal to 0.073. Primary sludge acid digesters with sludge recycling can achieve much higher efficiencies in terms of readily biodegradable COD and VFAs production even at low HRTs of 1 day. The efficiency of acid digesters with sludge recycle in terms of soluble COD production was found to be approximately 10% of the particulate COD in the influent, at ambient temperatures.

Keywords: anaerobic sludge hydrolysis, acid digester, prefermenter, readily biodegradable COD production

Paper ID: CEST2017_00980

Evaluation of a pilot plant for a secondary treatment of mining effluents

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Abstract

Mining effluents can often contain heavy metals such as Lead (Pb), Zinc (Zn), Iron (Fe), Manganese (Mn), Cadmium (Cd), Arsenic (As) and if left untreated can cause damage to the local aquatic environment. In this study, we demonstrate the operation of a 9 m^3/h pilot unit (PU) installed in Greece. It consists of a pH regulation and oxidation stage, followed by filtration to a catalytic multimedia filter, activated carbon filter and a reverse osmosis (RO) unit. PU is fed by the existing pretreatment installation outlet. Our results prove that PU installing improved the water quality of water discharge, so that the final concentrations of dissolved metals to be even lower than the legislation limits for potable water. The removal of Fe, Mn and Zn was 97 – 100 %, As, Cd and Pb was 80 – 93 %. Operational data demonstrated very good removal efficiency of the Filtration Stage so that RO stage can be omitted. PU successful application enables design to be applied covering the complete installation needs. The operation of PU is simple, automatic, and constant. It is environmentally friendly and economically viable in terms of fixed and operational cost.

Keywords: Mine, Effluents, Heavy, Metals, Filtration

Paper ID: CEST2017_01022

An efficient removal of Dimozol Red from waste water by adsorption onto chitosan/marble powder composite: a novel low cost adsorbent

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Abstract

In the present study, chitosan (C)/marble powder (M) composites with different weight ratio percentage (C100M0, C70M30, C50M50 and C30M70) were prepared with marble powder and chitosan and characterized by Scanning Electron Microscopy (SEM). The composites were used for the adsorption of Dimozol Red dye from aqueous solutions. The influence of contact time, pH, adsorbent dosage, initial dye concentration and temperature on Dimozol Red adsorption onto the composites was investigated. Equilibrium data were analyzed by model equations such as Langmuir and Freundlich isotherms and were best represented by Freundlich isotherm model. Kinetic adsorption data were analyzed using the pseudo-first-order kinetic model and the pseudo-second-order kinetic model. The adsorption kinetics well fitted with a pseudo-second-order kinetic model. Thermodynamic parameters, $\Delta G°$, $\Delta H°$ and $\Delta S°$, were calculated, indicating that the adsorption of Dimozol Red onto the composites was spontaneous and exothermic in nature.

Keywords: Adsorption, Chitosan, Dimozol Red, Marble powder

Paper ID: CEST2017_01228

SESSION 22A – MICROPLASTICS IN THE MARINE ENVIRONMENT

Friday 1 September 2017 - afternoon

Persistent Organic Pollutants (PCBs and PAHs) adsorbed on plastic debris: distribution and concentration versus source

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Abstract

Marine plastic debris collected at the surface of Indian Ocean (Indonesian Cilacap coast) and North Atlantic gyre have respectively been studied. The concentration of 15 PAHs and 61 PCBs were evaluated using UPLC-fluorescence detector and GC-MS. PE debris from North Atlantic gyre contain PAHs in a concentration range 0.2-115 ng per gram of polymer while for Indonesian coast debris, concentrations were 17 times higher. PCBs have been detected in 60% of the debris from North Atlantic gyre with concentrations in the range 0.6-59 ng per gram of polymer while coastal debris show concentrations around 300 times higher. Gyre debris appear to contain higher proportion of heavy PAHs (maximum of 95%) and tetra chlorinated PCBs *i.e.* LC-PCBs. Coastal debris mainly contain light PAHs (maximum of 71%) but also HC-PCBs. This results clearly proved the spatial distribution and concentration of PAHs and PCBs dependency of marine area compartments (open ocean versus coast)**.**

Keywords: Plastic debris, PAHs, PCBs, spatial distribution, marine coast, gyre

Paper ID: CEST2017_00855

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Alterations in swimming behavior of *Daphnia* exposed to polymer and mineral particles: towards understanding effects of microplastics on planktonic filtrators

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Abstract

Concerns have been raised that microplastics (MP) can impact aquatic organisms by compromising their nutrition. However, little is understood about the mechanisms of the adverse effects in suspension-feeders that routinely ingest particles of various nutritional value, including various mineral particles. We compared effects of non-edible particles (MP and kaolin) mixed with microalgae on the swimming behavior of a planktonic filtrator *Daphnia magna*; incubations with only algae served as controls. The following questions were addressed: (1) Are there differences in swimming movements between the daphnids exposed to MP and those exposed to kaolin, and (2) Whether occurrence of biofilm on the particle surface affects daphnid filtering and jumping movements, and (3) How these effects differ between kaolin and MP. We found that both particle types altered filtration-related movements albeit in opposite way: kaoline decreased the time spent on filtration, whereas MP increased it. Exposure to both kaolin and MP resulted in higher jumping activity. The differences between the particle-specific responses were amplified in the coated particles, indicating that daphnids exposed to MP might spend more energy, and even more when the MP are carrying biofilm. The increased swimming activity may translate into inefficient feeding, changes in energy balance and growth.

Keywords: Microplastics, Swimming behavior, Planktonic filtrators, Daphnia, Time budget

Paper ID: CEST2017_00616

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ingested microplastic is not correlated to HOC concentrations in Baltic Sea herring

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Abstract

Plastic debris and microscopic particles (MP) are ubiquitous in our waters, and can be ingested by various aquatic organisms. Ingestion of MP has been linked to decreased food intake and bioaccumulation of organic contaminants carried by MP. However, field data on MP ingestion and linkages between MP and contaminant levels in biota are limited. We examined occurrence of plastic particles in the stomachs of herring (*Clupea harengus membras*) collected along the Baltic west coast in concert with environmental contaminant concentrations in fish muscle. We found that MP are common in fish stomachs and their quantity varies geographically. Approximately 50% of the fish examined had ingested plastics, which is ~10-fold greater than what has previously been reported for herring in the southern Baltic Sea. The median number of particles per fish was however, low (0-1 per sea basin). Moreover, the number of MP in the stomachs decreased with age and reproductive stage but increased with body size. Contaminant concentrations in the muscle tissue were not related to MP occurrence in the stomachs, suggesting no connection between the bioaccumulation of contaminants and MP ingestion. Thus, although present ubiquitously, MP contribute only a minor part of the diet and are not likely to measurably contribute to the total body burden in the Baltic herring.

Keywords: Microplastic, Baltic Sea, herring, hydrophobic organic contaminants, marine monitoring

Paper ID: CEST2017_00690

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Microplastics from synthetic clothes: environmental impact and mitigation strategies

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Abstract

Microplastics represent a new and very alarming source of pollution for marine environment. Classified as plastic fragments smaller than 5 mm, they mainly derive from the deterioration of scraps of large dimensions, from abrasives or from cosmetics. However, in 2011, another source was identified in the domestic and industrial washing processes of synthetic clothes. The real impact of this newly discovered source of microplastics is not clear yet, so quantitative investigations are highly necessary. For this purpose, the present work aims to assess the role of domestic and industrial washing processes of synthetic clothes, on the release of microfibres. Firstly, standard fabrics were washed simulating both industrial and domestic washing processes, using different detergents and washing conditions. The washing liquor was then filtered and the filters were observed by scanning electron microscopy (SEM). A specific counting method was set up to evaluate the amount of microfibres contained in each filter. Secondly, several finishing treatments were applied on the fabrics to prevent or reduce the amount of microplastics released during the washing process. The obtained results identified the best detergents, washing conditions and treatments to use in order to mitigate the impact of such source of pollutants.

Keywords: Microplastic, synthetic fabric, textile washing process, finishing treatment.

Paper ID: CEST2017_00698

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Occurrence of anthropogenic particles in the fish *Squalius cephalus* from the Seine and Marne Rivers

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Abstract

Plastic pollution is a growing concern worldwide but was mainly focused on the marine environment. Few studies dealt with plastic pollution in lakes and rivers and the associated biota. In our study, we aimed to evaluate plastic occurrence in three target tissues (stomach contents, liver and muscle) of a wild freshwater fish (the chub *Squalius cephalus*) in the Seine and Marne Rivers. These rivers are under significant urban pressure with the Parisian conurbation (about 8 million of inhabitants) and low water flows. Several stations were sampled upstream and downstream of Paris conurbation. Fish were dissected and the three tissues were degraded using previous validated protocol. Particles were isolated and were then analyzed by Raman spectroscopy. Preliminary results showed that plastic particles and other anthropogenic particles such as textile fibers were found in several guts at different stations. Observed fibers were made of plastic polymer, such as polyethylene terephthalate or polypropylene, or were probably cellulose, dyed with artificial pigments. Our preliminary results confirmed that *S. cephalus* ingested microplastics, mainly fibers, probably because of the contamination of the river water column.

Keywords: microplastics, Seine River, freshwater fish, *Squalius cephalus*, fiber

Paper ID: CEST2017_00764

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterisation of microplastics in Irish freshwaters

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Abstract

Microplastics (MPs) in water is an emerging environmental issue worldwide. This study aims to assess the prevalence of microplastics in Irish freshwater and wastewaters and to characterise the interactions of microplastics with organic pollutants and microorgansims. Microplastics recovered from five cosmetic products were used as reference materials in order to develop and assess techniques for recovery and preliminary characterisation of microplastics. Most of the microbeads extracted from various personal care products were polyethylene with particle sizes between 100 and 1000 µm. Polyethylene microplastic was recovered from River Barrow using three steps adapted from National Oceanic and Atmospheric Administration (NOAA) standard method which includes visual extraction, sieving, and flotation, followed by polymer identification using infrared spectrometry. The reference material exhibited gradual changes in its infrared spectrum between three weeks and two months.

Keywords: Microplastics, freshwaters, sediment, sampling, detection

Paper ID: CEST2017_00288

SESSION 22B – HAZARDOUS WASTE MANAGEMENT

Friday 1 September 2017 – afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Reuse of paint sludge in road pavements: technological and environmental issues

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Abstract

This paper presents some of the results obtained in a research project focused on the use of paint sludge as a modifying agent in the production of bituminous binders for paving applications. The scope of the project was to provide an innovative, sustainable and profitable solution to waste management problems which automotive industries have to face worldwide as a result of the production of paint sludge. Following laboratory investigations carried out with the cooperation of an Italian automotive company, the authors applied for a patent which defines the industrial process for the production of paint sludge modified binders. This papers highlights some of the critical aspects which affect technological feasibility and environmental compatibility of such a process. Technological issues are addressed by referring to the flow behavior of binders during production and to their resistance to segregation during storage. Environmental issues are examined by considering gaseous emissions during binder preparation and the potential leaching behavior of corresponding bituminous mixtures employed in road paving operations.

Keywords: Paint sludge, bituminous binders, road pavements, gaseous emissions.

Paper ID: CEST2017_00500

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Waste management in the scope of a gold mine project

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Abstract

In mining industry, waste management is a key issue since it starts in the conceptual project phase and lasts beyond the mine closure. Tailings and rock wastes have gained such an environmental importance that the *a priori* definition of its management has been caused the unfeasibility of promising mining projects, such as the case of the Castromil gold mine project presented in this work. Located in the NW part of Portugal, the Castromil Au-Ag deposit was intermittently exploited since Phoenician and Roman times until 1940's. In 1990's Castromil area attracted several exploration programs, having in 2000 been rejected due to environmental concerns the last application for an exploitation license. In this study, a strategy is tested in order to avoid or reduce the acid drainage using an acid consuming waste "dregs" from a pulp and paper industry. The residues resulting from laboratory metallurgical tests of technical feasibility, were subjected to several static and dynamic tests of forecast of acidic drainage and evaluate the efficiency of co-disposal of the dregs with the mine tailings such as Net Acid Generation test (NAG), Net Acid Production Potential test (NAPP) and leach column tests.

Keywords: Gold mine wastes, tailings, Acid Mine Drainage, Net Acid Generation, Net Acid Production Potential

Paper ID: CEST2017_00059

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

E-Waste: Generation, Collection, Awareness

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Abstract

European Union has underwritten to reduce the generation and to increase the amount of recycled WEEE. This work analyses the generation and processing tendencies of WEEE in Baltic countries, to evaluate the attitudes and habits of students and pupils regarding WEEE in Lithuania. Analysis showed that WEEE has decreased in 2008 in Baltic countries due to global economic crisis. But new EEE released to the internal market, e-waste collection, sorting and recycling has been on increase since 2009. Most of collected WEEE is large home appliances, IT and telecommunication equipment, monitoring and control devices. Estonia successfully implemented the EU Directive 2002/96/EC and has collected 4.2 kg/capita of WEEE already in 2010, in Lithuania only in 2012 4.48 kg/capita of WEEE was collected. The survey showed that 74.7% respondents need information about EEE, as respondents do not know exactly what is classified as EEE. Even 67% of pupils and 69% of students attributed batteries and accumulators to EEE. 55% of pupils and 48% of the students indicated that the toys with batteries are also attributed to EEE (though they are not). 21% of respondents stated discarding small WEEE together with municipal waste. 69.7% of the respondents indicated that more collection points are needed. Respondents, living in flats (χ^2=0.98, $p<0.05$) and women (χ^2=7.79, $p<0.1$) more often said, that there is not enough infrastructure to sort and give out WEEE.

Keywords: E-waste; waste generation, waste collection, public awareness

Paper ID: CEST2017_00130

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterization, destruction and recycling of pure asbestos and asbestos containing waste (ACW)

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Abstract

In the current context, the treatment of industrial waste is an essential economic and environmental issue. At this time, considering the safety standards which banish asbestos from the environment, the stocks of asbestos containing waste are considerable and their elimination is a major problem. This work is based on the development of new processes of destructions termed "green" to replace the plasma process, which is used today and which presents a prohibitive energy and economic cost. Various techniques (SEM-EDX, XRD, NMR, IR-ARO and TEM) were used to characterize pure asbestos and ACW. XRD is the most efficient technique to distinguish the different kinds of asbestos like chrysotile and amphiboles. Based on these results, an acid treatment is applied allowing to dissolve the cement matrix and to transform the chrysotile. In the case of chrysotile containing waste, the solid obtained is pure silica which is then used to synthesize a nitrate-cancrinite. In the case of the presence of amphiboles in the starting ACW, a treatment in a basic environment is applied under hydrothermal conditions leading to entirely dissolve the waste.

Keywords: Asbestos, destruction, recycling, process, nitrate-cancrinite.

Paper ID: CEST2017_00278

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment and disposal of glass-wool and asbestos bearing waste-insulation materials from ship dismantling yards in India

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Abstract

In the recent years, there have been serious efforts to perform ship recycling activity in an environmentally sound manner with the help of appropriate technology, management framework and regulatory pressure (Hong-Kong Convention by the International Maritime Organization and Regulation on Eco-friendly Ship Recycling by the European Commission). Like in India, several yards in China, Pakistan, Bangladesh and Turkey have been the important players in this sector. Approximately150 Ship-Recycling Yards (SRY) along the 12 km shoreline in Alang-Sosiya Ship Recycling Zone in the State of Gujarat on the West-Coast of India, probably the largest facility for ship breaking and recycling of metals in the world, has been breaking 300 to 400 large obsolete ships (cumulative capacity) every year.This study presents an assessment of the waste-insulation materials (asbestos and glass-wool) collected from the yards in Alang. The waste-insulation matrixes were analyzed for their elemental, morphological, and other physico-chemical characteristics by using analytical techniques including Inductively Coupled Plasma-Atomic Emission Spectroscopy and Scanning Electron Microscopy. On the basis of analysis,a framework for management of waste insulation material has been proposed for the environmental sound management of glasswool and asbestos bearing wastes. Finally, some practical and scientifically defendable alternatives have been reported for treatment and disposal of these voluminous hazardous wastes.

Keywords: Asbestos, Glasswool, Hazardous wastes, Ship recycling, Ship dismantling, Alang

Paper ID: CEST2017_00548

Anode potential for sulfide removal in oil spill contaminated marine sediments

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Abstract

Bioelectrochemical techniques have been recently evolving as an alternative in-situ low cost method for oil spills bioremediation. Hydrocarbons bioremediation involves toxic sulfide accumulation due to the sulfate reducing microorganisms activity. Determining the optimal anodic potential for efficient electrobioremediation and simultaneous removal of toxicants becomes a challenge. In this experiment the (bio)electrochemical removal of sulfide was tested at different anodic potentials (i.e. -205 mV, +195 mV and +300 mV *vs* Ag/AgCl) with the addition of a pure culture of *Desulfobulbus propionicus*. Current production, sulfide concentration and sulfate concentration were measured over time. At the end of the experiment sulfur deposition on the electrodes was measured by SEM-EDS and the microbial communities were characterized by next generation sequencing of the 16S rRNA gene. Current production is linked to sulfide removal and sulfate was formed after inoculation. The highest electron recovery was obtained at -205 mV anode polarization.

Keywords: sulfide oxidation; bioelectrochemical systems; *Desulfobulbus propionicus.*

Paper ID: CEST2017_01258

SESSION 23 – ADVANCED OXIDATION PROCESSES (2)

Friday 1 September 2017 – afternoon

Advances in the field of Advanced Oxidation Processes for the treatment of cyanotoxins, pharmaceuticals, pesticides and other contaminants of concern

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Abstract

Professor Dionysiou will provide an overview of activities pursue in his group as well as few other groups around the world on emerging topics concerning treatment of cyanotoxins from source water impacted by formation of Harmful Algal Blooms (HABs). Details will be presented on mechanistic aspects of degradation of microcystins and cylindrospermopsin using advanced oxidation processes (AOPs) and some other selected physical chemical processes. The presentation will highlight occurrence and consequent impacts of HABs at global scale. Discussion on treatment of cyanotoxins in source water will include performance of various processes, degradation kinetics, formation and fate of reaction intermediates, detailed degradation pathways, role of water quality parameters, opportunities and challenges. Results will include reactivity of oxidizing species generated in various AOPs, role of functional groups of target contaminants and in some cases structure activity relationships. Prof. Dionysiou will also present selected results on the treatment of pharmaceuticals, personal care products (PPCPs), pesticides and other contaminants of concern in consideration of drinking and groundwater treatment as well as water reuse applications by AOPs and other selected advanced water treatment technologies. Discussion will include both heterogeneous (including nanotechnologies) and homogeneous AOPs as well as photochemical (UV, solar, visible) and not photochemical processes.

Keywords: AOPs, AOTs, Cyanotoxins, PPCPs, Emerging, Contaminants, Water, Surface, Treatment, Intermediates, Mechanism, Reuse, Groundwater, Pharmaceuticals, Pesticides, Harmful Algal Blooms, HABs, Nanotechnology

Paper ID: CEST2017_01041

[9] Invited speech

Removal of water emerging contaminants using nanostructured titania photocatalysts in advanced oxidation and reduction reactions

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Abstract

Advanced nanostructures of titanium dioxide are intensively investigated in nanotechnological applications for environmental protection. The latest developments in the field pay special attention to innovative and highly performing titania nanomaterials with original functionalities and tailored properties (visible light activated photocatalysts-VLA), the elucidation of the corresponding mechanisms (interaction of light with matter at the nanoscale and resulting photoinduced electron transfer reactions) as well as the design and fabrication of devices (photocatalytic reactors) for efficient removal of emerging contaminants from water (Fig.1).

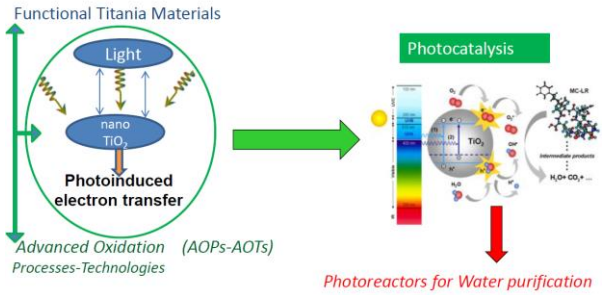

Figure 1. Holistic approach combining nanostructured titania materials, advanced oxidation processes and photocatalytic reactors for water purification.

Keywords: Titania photocatalysis; emerging water contaminants; advanced oxidation and reduction reactions.

Paper ID: CEST2017_00802

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Degradation of erythromycin by photoelectrochemical process using a metal mixed oxide anode

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Abstract

The macrolide antibiotic erythromycin (ERY) was included in the watch list by European Union in the decision number 2015/495. In view of this problem, the photoelectrochemical (PEC) process, using (70-30%) TiO_2RuO_2-Ti as electrode, was applied aiming the ERY degradation. The PEC process was evaluated in terms of total organic carbon (TOC), chemical oxygen demand (COD) and pH. The electric consumption (E_{EO}) and degradation kinetic (k') were also calculated. Voltammetry study demonstrated that the direct oxidation between the work electrode and ERY did not occur. Furthermore, the UV irradiation results demonstrated that direct photolysis is not an important ERY degradation pathway. This means that ERY degradation will occur meanly by radicals, by photocatalytic and electrocatalytic processes at the electrode/catalysis surface. TOC and COD removal are parallel, which means that the portion of ERY that is being oxidized is also mineralized. At the treatment time of 240 minutes, ERY degradation by PEC process shows a TOC abatement of 56%. Also, a first-order kinetics with k' = 0.0034 min^{-1} and an electric consumption of 666351 kWh m^{-3} $order^{-1}$ was found.

Keywords: Photoelectrochemical process; Metal mixed oxide anode; Erythromycin; Total organic carbon abatement.

Paper ID: CEST2017_00805

Advanced oxidation processes for the removal of pesticides from wastewater: Recent review and trends

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Abstract

Several emerging chemical contaminants may occur in wastewater as a result of human activities. Pesticides is one of the most common groups of pollutants found in wastewater effluents due to their widespread use in agriculture in order to maintain crop quality and quantity [Ternes, 2007; Schwarzenbach *et al*., 2010]. These micropollutants are usually detected in trace concentrations (ng L^{-1} or μg L^{-1}) and are resistant to conventional wastewater treatment systems of urban wastewater treatment plants (WWTP) such as biological processes (secondary treatment). Consequently, the use of advanced oxidation processes (AOPs) is crucial and effective for the removal of these substances to levels that are deemed acceptable. This work studies the application of different types of AOPs as tertiary treatment for removal of different classes of pesticides from polluted water and wastewater.

Keywords: Advanced oxidation processes, pesticides, water treatment, photocatalysis, mineralization

Paper ID: CEST2017_01225

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Photochemical oxidation of alcohol ethoxylate (Brij30®) by PS/UV-C process

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Abstract

In the present study, photochemical oxidation of an alcohol ethoxylate (AE) was experimentally explored. Poly(oxyethylene) (4) lauryl ether, commercially known as Brij30®, was selected as a model AE. Persulfate (PS)/UV-C oxidation of aqueous Brij30® (20mg/L) was investigated at a wide range of initial PS dosage varying between 0.5-5.0 mM and at two initial reaction pH values (3.0 and 6.0). The results obtained for both initial pH values indicated that increasing PS dosage did not have a significant effect on Brij30® removal efficiency and higher than 90% Brij30® abatements could be achieved after 60 minutes of treatment time. Total organic carbon (TOC) removals were significantly improved with increasing initial PS dosages for both initial pH values tested. PS dosages higher than 1.5 mM yielded higher than 90 % TOC abatement efficiencies. Second-order reaction rate coefficients for Brij30® and TOC with sulfate radical ($SO_4^{\bullet-}$) was determined as $1.62\times10^9\pm 3.5\times10^7$ $M^{-1}s^{-1}$ and $1.2\times10^6 \pm 2.39\times10^5 M^{-1}s^{-1}$, respectively. Toxicity of PS/UV-C treated aqueous Brij30® solutions towards the marine photobacterium *Vibrio fischeri* was also investigated to determine the possible toxic behavior of oxidation products.

Keywords: Alcohol ethoxylate, Kinetic modeling, Photochemical oxidation, PS/UV-C process, *Vibrio fischeri* inhibition

Paper ID: CEST2017_00870

Ozonation as a cost effective technology in antimicrobial resistance management of wastewater and sludge

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Abstract

Use of antibiotics in modern society is an important source of environmental contamination, especially in case of environmentally persistent molecules. Even low concentrations of antibiotics in the environment promotes the selection of antibiotic resistance genes and antibiotic resistant bacteria. This issue is getting an alarming scale, as several commonly used antibiotics are no longer effective against certain bacteria. Identifying and mitigating the risk factors and managing contamination sources becomes a key challenge for environmental engineers. The aim of our research was to develop a process that removes antibiotic activity of the selected veterinary antibiotic (Tiamulin) and make it suitable for a conventional biological treatment. Tiamulin was selected as a model substance with high environmental persistence. Ozonation was identified as one of the promising oxidation techniques, to deliver on a technology that is cost-effective and robust enough, that can be used both in wastewater and sludge management. Our study indicates that already small doses of ozone remove toxicity of the antibiotic to the activated sludge. Ozone with a selective oxidation mode is ideally suited for the technology, as it delivers desired toxicity reduction even in the complex matrix of a biological sludge.

Keywords: Antibiotic resistance, ozone, wastewater

Paper ID: CEST2017_00582

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

TiO_2/Ag-nanoparticle as a Photocatalyst for Dyes Degradation

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Abstract

Visible light active TiO_2/Ag-nanoparticle (TiO_2/Ag-NP) photocatalyst was prepared and tested for phenolic dye degradation. The dye photodegradation was performed in batch reaction under visible light irradiation for various predetermined times. The results showed that the increase in initial Ag(I) concentration caused the amount of Ag deposited on the TiO_2 solid to increase. However, no more Ag deposited into the TiO_2 phases was observed for further increase in Ag(I) concentration. Further, small amount of Ag(I) in the solution mixture gave Ag nanoparticles deposited on the TiO_2 phase, while high initial Ag(I) content produced large Ag aggregates. The dye photodegradation under visible light irradiation over TiO_2/Ag-NP was more effective than unmodified TiO_2. The increase in Ag content in the photocatalyst improved dye photodegradation reaction, while the further increase in Ag content led to decrease in the dye photodegradation. The dye photodegradation can be best performed for 45 min of visible light irradiation.

Keywords: TiO_2, Ag nanoparticle, photocatalyst, dye, photodegradation

Paper ID: CEST2017_00615

Analysis of control parameters in a TiO_2/UV reacting system for wastewater treatment containing benzothiazole and aniline

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Abstract

Heterogeneous photocatalysis UV/TiO_2 is considered in this work for the treatment of a highly toxic industrial effluent, as an economical and sustainable alternative to conventional processes. To this end, some favorable conditions and modes of operation have been selected to treat an industrial effluent by means of a pilot plant scale tubular reactor. The aqueous effluent contains aniline and benzothiazole at 22.0 mg/L, two contaminants collected in the list of priority substances. The analysis of the different operating variables was performed considering the kinetics of degradation, approaching pseudo-first order kinetics. It was determined that the most favorable conditions for a degradation higher than 95%, after 15 h of reaction and room temperature, was for aniline at pH=12.0 and catalyst dose of 100.0 mg/L with k_{app}=0.39 1/h. Meanwhile, for benzothiazole was at pH=8.0 and a TiO_2 dose of about 100.0 mg/L with k_{app}=0.18 1/h. Finally, it was found that the arrangement of the catalyst in a support was more advantageous than in suspension. In addition, it is not necessary to apply subsequent separation steps and it reduces catalyst losses, which facilitates its industrial implementation.

Keywords: TiO_2, degradation kinetics, aniline, benzothiazole, photocatalysis

Paper ID: CEST2017_00448

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Influence of fenton reagent ratios and of hydrogen peroxide dosage on the Photo-Fenton process efficiency

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Abstract

The present study addresses the role of Fenton reagent ratios (H2O2:PCT, H2O2:Fe(II)) and the influence of H2O2 dosage in the performance of the photo-Fenton process. Paracetamol (PCT), the most widely used antipyretic, was adopted as model contaminant.Design of experiments was used to first test the most suitable H2O2:PCT ratio so to fix the PCT concentration to be used in the subsequent study of the H2O2:Fe(II) ratio. In all cases, PCT total remediation was attained, but the highest mineralization rate (≈75%) was obtained when 378 mg L-1 of H2O2 and 5 mg L-1 of Fe(II) were used. The mineralization increased by increasing both the H2O2:PCT and the H2O2:Fe(II) ratio, and the more efficient values were 10 and 40, respectively (for higher values a plateau was reached). Hence, the total amount of H2O2 and Fe(II) was fixed to 378 and 5 mg L-1, and a dosage protocol, involving an initial release of H2O2 ([H2O2]t0) and the time at which the dosage begins (tin), was studied. Preliminary results revealed that assays performed with an initial release of at least 20% of the total amount of H2O2 can lead to higher mineralization rates (≥5%), showing that the H2O2 dosage can enhance photo-Fenton performance.

Keywords: photo-Fenton, pharmaceuticals, Fenton reagents ratios, H2O2 dosage.

PAPER ID: CEST2017_00562

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of annealing atmosphere on the properties and performance of V + Mo Codoped TiO_2 thin films

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Abstract

Molybdenum (Mo) and vanadium (V) codoped TiO_2 thin films were deposited by spin coating a sol-gel solution on fused silica substrates, followed by annealing in air or argon at 450°C for 2 h. The effects of varying codopant levels (0.01-1.00 mol% each) on the mineralogical, optical, topographical, and chemical properties of the films as well as their photocatalytic performance were analysed. The results show that the atmosphere played a key role in the mechanisms of structural and nanostructural development. These depended upon codopant solubilities within and beyond the saturation limits, associated lattice destabilization and precipitation, change in the Ti^{3+} and oxygen vacancy concentrations, grain growth, and eutectic liquid formation. The detection of oxidized valences following reduction conditions and *vice versa* is explained by the process of multivalence charge transfer.

Keywords: Codoping, TiO_2 Thin Film, Photocatalysis

Paper ID: CEST2017_00508

SESSION 24A – SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION (2)

Friday 1 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation of chromate removal by green iron nanoparticles in a pilot scale application

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Abstract

In this study the results of a pilot-scale injection of green iron nanoparticles (GT-nZVI) and the formation of a reaction zone (RZ) for Cr(VI) removal are presented. A pilot scale tank was constructed with dimensions 1.5m (height) × 2.5m (width) × 3.75m (length) which was filled with 24 tons of soil. A network of 48 sampling points was installed inside the tank to monitor water quality. Nano ZVI was synthesized on-site by batches of 300 L. A total amount of 2.8 m^3 GT-nZVI suspension was injected via 3 injection wells in order to create a RZ zone, perpendicular to the groundwater flow. After the injection of GT-nZVI suspension, the supply of contaminated water containing 5 mg/L Cr(VI) was initiated. Pore water samples taken upstream and downstream of the RZ indicated that the zone operated effectively, since all the downstream samples were not found to contain any Cr(VI) and Cr(tot) had very low concentrations varying between <6 and 15 μg/L. Monitoring data for a period of 12 months indicated that the reactive wall maintained its effectiveness during this period of time.

Keywords: pilot scale, iron nanoparticles, nZVI, chromate reduction, green iron nanoparticles.

Paper ID: CEST2017_00759

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The effect of harvest period on the total uptake of metals by willows and poplars

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Abstract

The development and evaluation of environmental technologies for the removal of metals from contaminated soils is a high priority research. Results from pot experiments showed sufficient extraction capacity by several plants, fast growing trees becoming due to their easy biomass valorization among the most required. The evaluation of pot experiments in field conditions is lacking. Field experiments were set up on anthropogenically medium contaminated soil by Cd and Pb in 2008 and 2009 to evaluate the remediation potential of harvested mature trees and to take into account autumn harvest containing trunks, twigs and leaves as well. The results showed that first harvest after four years was about three fold lower than the second one after another two years. The metal contents in trunks and twigs adversely correlated with the yield. Biomass yield was more important for the metal removal, the remediation factor reached up to 1 % in the second harvest in case of Cd and willow, for Pb was negligible 0.001 % for both plants. Autumn harvest including leaves showed twice more higher Cd removal than winter one in case of willows, differences for Pb were lower for both plants.

Keywords: Cadmium, Lead, Phytoextraction, Field experiment, Remediation factor

Paper ID: CEST2017_00804

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Lab-scale investigation on remediation of sediments contaminated with hydrocarbons by using super-expanded graphite

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Abstract

In view of necessity to develop simple, rapid, and efficient methods for monitoring and removal contaminants from soil, a new graphene-based material is presented for treatment of hydrocarbon-contaminated soils.Lab-scale experiments on three soil matrices featured by increasing granulometry were carried to evaluate graphene adsorption capability, as removal efficiency. Soil samples, firstly contaminated with different quantities of mineral exhausted oil up to final concentrations of 12500, 25000, 50000 $mgkg^{-1}$, respectively, were treated with opportune amount of graphene.Results show as the removal efficiency of graphene is directly proportional to contamination level of the soil. Particularly, the best removal efficiency (87.04%) was reached during treatment of gravel samples at maximum contamination level using the highest dosage of graphene, even though good results (80.83%) were also achieved using lower graphene/pollutant ratio. Moreover, graphene at ratio 1/10 showed worse removal efficiencies in treating sea (81.17%) and silica sand (63.52%) than gravel. In this study, also the thermal regeneration was investigated in order to evaluate a possible reuse of graphene with subsequent technical and economic advantages. Graphene-technique proves to be technologically and economically competitive with other currently used technologies, revealing the best choice for the remediation of hydrocarbon-contaminated soils.

Keywords: contaminated sediments, hydrocarbons, remediation, super-expanded graphite

Paper ID: CEST2017_00542

Electrokinetic remediation of Cd contaminated soil at field condition

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Abstract

Electrokinetic removal of heavy metals from contaminated soils seems an innovative approach for their remediation. However, employing that method in calcareous soils and soils with great adsorption capacity for heavy metals needs to be studied thoroughly. In this research a clayey loam soil spiked with Cd used to investigate electrokinetic remediation in three depths (0, 15 and 30 cm) at four plots at field condition. All experiments were imposed with a constant voltage gradient of 1 V/cm for 2, 4 and 6 days at a field in Marand area, North West of Iran. The soil contained large amount of Cd (24, 21, 17 mg/kg in 0, 15 and 30 cm depths respectively). The results indicated that the removal efficiencies for Cd were significantly influenced by time duration. Maximum metal removal efficiency of Cd for three depths (0, 15 and 30) were 30.2%, 62.3% and 85% respectively. High lime content (13%) of the examined soil appears hindered the removal efficiency. In addition, the pH changes along the soil plots showed an increasing trend from the anode to the cathode.

Keywords: Cadmium, Electrokinetic, Heavy metal, Removal, Soil

Paper ID: CEST2017_00591

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Possible effects of mineralization and Lithological interactions on natural water of J. Ed Dair J. Dumbeir areas, North Kordofan State-Western Sudan

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Abstract

This paper studies possible effects of mineralization and water-Lithological interactions on natural water of J. Ed Dair – J. Dumbeir area, which is situated in Northern Kordofan state and is geographically considered to represent the northern parts of Nuba Mountains. This area is bounded by the coordinates: longitudes 30˚25′ -30˚ 55′ E and latitudes 12˚ 15′- 12˚ 55′ N. Samples of surface and underground water were collected from different localities during wet and dry seasons. Physical and Chemical analyses were performed in different laboratories according to standard methods. Seasonal variation of physico-chemical properties in j. Ed –Dair area were illustrated by drawing seasonal variation graphs and by comparing the data with WHO Standards. Analytical work shows that the constituents which significantly affect health of human being are not within the recommended value limits of the WHO guidelines, but still below the maximum values, except for fluorite and Cadmium in some localities.The suitability of the waters for irrigation purposes has been also studied in the area. Assessment of water chemistry was investigated by using different statistical techniques. We also have conducted geochemical modelling for groundwater interactions with the lithological unit.

Keywords: North Kordofan, Mineralization, water quality, Hydrochemistry.

Paper ID: CEST2017_00243

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

An Advanced Synthetic Technique of Nitrate Fertilizer supported by a Clay Material shows a Remarkable Controlled Release behavior into soils

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Abstract

Here, we offer an advanced technique of supporting nitrogen into soil in a controlled release process. Mg-Al-layered double hydroxide (LDH) material was used as a carrier for nitrogen which was loaded into LDH in a nitrate form by using a reconstruction-incorporation process. The prepared materials were characterized by different spectroscopic techniques including; elemental analysis, X-ray powder spectroscopy, Infrared spectroscopy, scanning electron microscopy, transmittance electron microscopy, and thermal gravimetric analysis. The release process of nitrate was conducted in different soil types at different climate conditions, showing a remarkable controlled release of nitrate from LDH. Hence, our technique can support as a new nitrogen fertilizer source into soils.

Keywords: Soil Nitrate; layered double hydroxide; controlled release; reconstruction-incorporation process

Paper ID: CEST2017_01362

SESSION 24B – ENVIRONMENTAL PLANNING, MANAGEMENT AND POLICIES (2)

Friday 1 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Managing diffuse water pollution from agriculture through integrated catchment management in the age of uncertainty: Experiences from East Anglia

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Abstract

On 24th June 2016, UK voters made a decision to leave the country's EU membership. This raised many uncertainties around the future of the UK's environmental policies. This paper discusses post-Brexit uncertainties to be considered by the UK water sector to mitigate Diffuse Water Pollution from Agriculture, by engaging with stakeholders in the agricultural sector as part of their Integrated Catchment Management strategies. In the agriculture-intensive eastern region of England, pesticides carried by surface runoff present in raw water used to produce drinking water is a recurring issue, especially those that are not easily removed through conventional treatment such as Metaldehyde. The local water company, Anglian Water Services Ltd. has taken on the catchment advisory role to actively engage with the agricultural community within the region to encourage behavioural changes and the implementation of best practices to reduce pollution at source, in line with Article 7 and 14 of the EU Water Framework Directive (Directive 2000/60/EC). Though measures such as product substitution may seem straightforward, the agricultural sector's decisions are heavily reliant on their regulatory and economic priorities. The question is, what will the future of agricultural policies look like after Brexit, and how will this impact the water environment?

Keywords: Integrated Catchment Management, Stakeholder Engagement, Water Framework Directive, Brexit, Agriculture

Paper ID: CEST2017_00958

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Progress with the WFD implementation in five European basins: Significant differences but similar problems

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Abstract

The river basin approach of the Water Framework Directive (WFD) and the introduction of ecological status represent a shift in the assessment and management of freshwater systems from discipline-specific to more holistic, catchment-based principles. At the core of the WFD's approach are the catchments as highly interconnected systems. Despite the strict timetables, progress towards achieving the WFD objectives has been slow with deterioration in some cases not been halted. In this paper, looking at evidence from five European basins, we identify some of the key implementation challenges faced by each catchment and investigate their potential causes. Despite significant differences - socio-ecological conditions, wide geographic coverage and different levels of ambition in the implementation between these catchments, findings highlight some key similar problems. Gaps in monitoring networks and assessment methodologies used, as well as misunderstandings and lack of ambition with some of the innovations the WFD introduced, have limited the potential of River Basin Management Plans (RBMPs) to deliver water quality improvements. With many of these issues not easy to be resolved at the catchment level, we identify opportunities for policy improvement at the EU or National level that could facilitate the implementation of the Directive and the delivery of water quality improvements the WFD was introduced for.

Keywords: Policy, Systems thinking, Catchment management, Implementation

Paper ID: CEST2017_00953

The Establishment of the EXcellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment (EXCELSIOR) for the Eastern Mediterranean Region

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Abstract

The aim of this paper is to present our vision to upgrade the existing ERATOSTHENES Research Centre (ERC) established within the Cyprus University of Technology (CUT) into a sustainable, viable and autonomous Centre of Excellence (CoE) for Earth Surveillance and Space-Based Monitoring of the Environment (EXCELSIOR), which will provide the highest quality of related services on the National, European and International levels. The implementation of the vision will be addressed through a robust Business Plan that will be developed with in Phase 1 of EXCELSIOR project and will establish the foundations for the development of a competitive and high competence profile to expand the Centre's visibility beyond the national level and develop transnational regional cooperation. The Business Plan is key to ensure the sustainability of the CoE and will also provide the necessary guarantees for a self-sustained operation. The long term aim of the upgraded Centre is to create new opportunities for conducting basic and applied research and innovation (R&I) in the areas of the integrated use of remote sensing and space-based techniques for monitoring the environment.

Keywords: Center of Excellence, remote sensing, Cyprus, environmental monitoring

Paper ID: CEST2017_01296

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Sustainable decommissioning and integrated closure planning of selected mine sites in the Bicol Region, Philippines

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Abstract

The study assessed the status of the Rapu-Rapu Minerals Incorporated (RRMI) and the Filminera Resources Corporation (FRC) which are the polymetallic and mineral mining sites, respectively in the Bicol Region, Philippines regarding their mine closure and decommissioning procedures in relation to the impact communities that they engaged. It is in this context that the study was implemented to set a management direction in the inevitable event of mine closure and decommissioning. The study utilized the qualitative and quantitative methods of research. Respondents consisted of the key officials of government agencies and municipal and barangay officials as well as households of the host and impact communities covering the two mining sites of Rapu-Rapu and Aroroy as well as community organizations and mining company representatives. Findings showed that both mining sites extract similar resources and have been paying taxes to the Philippine government. Although the RRMI has initiated its mine closure process, decommissioning is underway and still needs to undergo its standard procedure with various stakeholders, while FRC has its operations ongoing. It is recommended that mine closure planning must be integrated within the overall mine operations plan, and should be integral to the operational life cycle of the mine sites.

Keywords: sustainable decommissioning, integrated closure planning

Paper ID: CEST2017_01078

Potentials Development of the Sub – Regional Growth Area (Roxas-Dumaran-Taytay) in Tourism Industry of Northern Mainland Palawan

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Abstract

Majority of the tourism industry in Palawan are located in northern mainland part of the province. El Nido and Puerto Princesa city act as tourism growth poles by ranking as the most visited tourist areas in Palawan. The municipalities between the growth poles are considered as sub – regional growth area (Roxas, Dumaran and Taytay) since they serve as transition areas from one growth pole to another. The study intended to explore the tourism potentials of the sub – regional growth area through the use of potentials analysis. By looking into the cases of Roxas, Dumaran and Taytay, various potentials were identified that could contribute to the development of the island region. Characterization resulted to the determination of competitive advantages of each municipality to one another which were used in developing strategic regional directions to complement and assure a sustainable growth of the sub – regional growth area along with the tourism growth poles in terms of tourism development

Keywords: tourism growth poles, tourism development, potentials analysis, tourism spatial strategy John Wiley and Sons, Inc. 3rd Ed

Paper ID: CEST2017_01133

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Integration of vertical agriculture and farming into urban homes

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Abstract

Nowadays, the idea of embedding oneself into the city and business life, and living with the hopes of escaping from this life when the time of retiring comes, unfortunately, remarkably increased (Stress). People see working life and nature in the two opposite ends of the spectrum of life; humankind must propel in terms of science, technology, and art while finding serenity in nature, both for the societies' progression and people's well-being. Thus, agriculture and farming should be integrated into the daily lives of working people in a way that they don't need to waste time raveling long distances to get away from the city. Nature shall be unified with business life that these people can involve in nature related occupations such as feeding animals, watering plants, and getting products from the nature such as receiving eggs and tomatoes. For such an integration, small vertical farming units can be designed to be put on the balcony of these, preferably working, people; various levels of the vertical agriculture unit with many levels can include both plants of different kinds, birds of Galliformes such as quails, and aquariums so that one can get a glimpse of nature while eating natural products.

Keywords: Urban, Agriculture, Farming, Combination, Nature

Paper ID: CEST2017_01192

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

River Acheron: natural landscape and historical place-monuments

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Abstract

The river Acheron was known in antiquity as the river which led the souls to Hades. The region has undergone many changes over the centuries, changes related to the size of the "Gliki Limena" current bay Fanar, the exact position of Acherousian lake, which was dried after the Second World War, and of course the bed of the river itself in the classical period (eg floating Kastri). However the area, where many geological changes without completely changing the geomorphological state from ancient times to nowadays, is described by several writers and travelers from ancient to modern times. The region of Acheron river is a cultural landscape and a place of natural beauty. A good visibility and proper use will contribute to tourism promotion and development. The development should respect the natural environment and monuments that surround the river, the history and importance of the site. This abstract tries to show the natural landscapes and archaeological monuments and areas around the river Acheron and actions appropriate for tourism promotion and development. The abstract consists of two parts: 1. landscape, archaeological monuments and sites 2. tourist promotion of the area with respect for the monuments and landscape.

Keywords: river Acheron, antiquity, monuments, landscape, management of cultural heritage, tourism promotion and development

Paper ID: CEST2017_00438

SESSION 25 – SOLID WASTE MANAGEMENT (2)

Friday 1 September 2017 – afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Production of naphtho-gamma-pyrones by *Aspergillus niger* under solid-state-fermentation

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Abstract

Aspergillus niger is one of the most important microorganisms used in biotechnology sector. This species is able to produce naphtho-gamma-pyrones (NγPs), which have excellent antioxidant activity. In the present study, spores and NγPs production has been investigated through solid state fermentation (SSF) of A. niger on different agricultural by-products which, from an economical perspective, constitute cheaper substrates than the synthetic ones, in addition of being more eco-friendly. An optimized NγP yields of 8,12 mg/g dry matter was obtained after 10 days of SSF at 27°C using a mix of sugarcane bagasse, wheat bran and potatoes flour (50/30/20 (w/w/w) respectively. Cultures were carried out in ORSTOM bioreactor using Raimbault glass columns (diameter: 4cm, length: 20cm) packed with 3g solids. Initial moisture content was 75% with an initial aeration rate of 60 ml/min of saturated humid. A significant positive correlation between ergosterol – specific sterol produced by fungi and a biomass marker – and NγP contents was observed.

Keywords: *Aspergillus niger*, solid state fermentation, naphtho-gamma-pyrone, antioxidant activity, sugarcane bagasse

Paper ID: CEST2017_01253

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The waste is the limit

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Abstract

The increasing demands of higher recovery rates requires more and more sensor based sorting technology. At the same time different processing methods and existing waste treatment plants demand a highly flexible and reliable sorting machinery. This presentation shows how Steinert uses and improves the HSI technology to adapt to changing market requirements.

Paper ID: CEST2017_00474

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Waste of the secondary glass waste (glass waste [3]): new solutions for a sustainable industrial recovery

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Abstract

Nowadays glassy sand, obtained from the secondary waste of glass, is well accepted by glass factories. However, a plant producing this kind of secondary glass generates 3% of waste (glass waste [3]) made of all the impurities usually present in glass waste. In particular, the materials not recovered are represented by ceramics, stones, magnetic and non-magnetic metals, paper, plastics, cork, synthetic corks etc., which are not always easily removable. Glass waste [3] is therefore made of exploitable product fractions with different particle sizes and physical (such as density, shape and resistance) properties.

This research is based on data collected from the SASIL plant, and is aimed at solving the issue of the waste of this kind of process implementing a pilot plant already present.

Representative samples of feed material (glass waste [3]) and of different products of the pilot plant have been characterized and laboratory tests were executed to improve separation efficiency and to valorise the different product fractions. A new treatment plant has been designed and economic evaluation has been made. The materials to be traded as secondary raw materials (SRM) – such as plastics, metals, synthetic and cork stoppers – are near 90% of the total feed of the plant.

Keywords: density separation; jig; new treatment plant design; bath extractor

Paper ID: CEST2017_00488

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Waste sorting social technology in Brazilian informal Materials Recovery Facilities

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Abstract

It is commonly accepted that the recycling and reuse of solid waste materials in developing countries has the potential to create many social, environmental and financial benefits. Given that the majority of recycling in these locations is carried out informally by waste pickers, it is also recognised that their inclusion into formal service provision could be the most efficient way of maintaining and increasing the recycling rates of a city. In the absence of sophisticated equipment, the informal recycling sector (IRS) has developed a wealth of self-taught knowledge and skills for manually identifying and processing waste materials. Using primary and secondary data gathered from a materials recovery facility (MRF) in Belo Horizonte, Brazil, this study describes the so called 'social technology' techniques used to sort municipal waste materials by a cooperative of informal sector recycling workers. This involves identifying and separating 17 types of plastic polymers by visual and tactile sorting skills. The methods presented are compared and contrasted with manual sorting techniques used mainly in the near past in the UK. To conclude, the study discusses whether these techniques provide a viable method for increasing recycling rates at scale in the Global South.

Keywords: Waste pickers, Informal recycling, Brazil, Materials recovery facility, Solid waste

Paper ID: CEST2017_00557

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Development of silica coating on pyrite particles using Si-catechol complexes

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Abstract

The release of acidic mine waters in the environment constitutes a major problem faced by the mining industry. These acidic waters, known as Acid Mine Drainage (AMD), are related to the oxidation of sulphide minerals and especially pyrite (FeS_2) in the presence of oxygen, water and bacteria. An innovative and environmentally friendly alternative to prevent the generation of acidic waters is related to the formation of artificial coatings around pyrite grains. In this way, the direct contact between pyrite and oxidizing agents is avoided and thus the oxidation reactions are inhibited. Batch-type coating experiments were carried out with solutions contained Si-catechol complexes. In order to evaluate the stability of coating, oxidative leaching tests were conducted on samples previously subjected to the Si-catechol coating procedure. The investigated parameters included the FeS_2-particle size (-250+125, -125+75, -75+45 μm), the pH (3, 5, 6, 7, 9) and the treatment duration (up to 6 hours). Based on the results obtained by the oxidative leaching tests, it was found that an efficient silica layer can be developed within 6 hours using a coating solution with pH 6, as the release of SO_4^{-2} was reduced by 40% compared to the fresh, non-treated pyrite (control test).

Keywords: Acid Mine Drainage, Sulphidic wastes, Pyrite, Silica coating, Si-catechol complexes

Paper ID: CEST2017_00318

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Resource Recovery Potential of MSWI Bottom Ash in the Czech Republic

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Abstract

Bottom ash (BA) from waste-to-energy (WtE) plants contains valuable components, especially Fe and NFe metals, which can be recovered. Metal-free mineral fractions can be used in the construction industry. To assess the resource recovery potential of BA, it was necessary to obtain the information about its material composition. We analyzed six samples from all three WtE plants in the Czech Republic. It was found that the raw BA contained 10–23 % of glass, 2–5 % of ceramics, 10–16 % of magnetic fraction, 6–11 % of ferrous scrap, and around 1.3–2.8 % of non-ferrous metals (NFe). The contents of individual components were also studied with respect to the granulometry. This paper summarizes the results and outlines the bottom ash potential as well as the economic aspects of bottom ash treatment and material recovery.

Keywords: bottom ash, urban mining, waste-to-energy, metal recovery

Paper ID: CEST2017_00718

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Industrial waste characterization as a tool for sustainable management: The case of secondary aluminum wastes

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Abstract

Waste characterization and classification provides the basis for ensuring their sustainable collection, transportation, storage and treatment in compliance with legal requirements. The aim of this article is to summarize the prevailing framework for industrial waste classification in EU and its application in the characterization of wastes that present mirror entries in the European Waste Catalogue. Within this framework a methodology based on the Commission Regulation (EU) No 1357/2014 was developed for the characterization of dross wastes from a secondary aluminum unit plant in Greece and presented in this article. Chemical and mineralogical analyses and laboratory tests for the assessment of the hazardous properties were conducted in accredited European laboratories. Then based on the evaluation of analytical & experimental results the properties of the materials under study were recorded and compared with the prevailing regulated limits. The methodology developed can be generally applied for the characterization of aluminum bearing wastes, and their classification as hazardous, or as their respective non-hazardous mirror entry. Based on the above the sustainable management of these wastes will be designed with the implementation of the measures corresponding to their respective properties.

Keywords: aluminum dross wastes, waste classification, hazardous properties

Paper ID: CEST2017_00800

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Environmental Policies for Drinks Packaging in Georgia

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Abstract

The paper investigates various approaches to an environmental policy regarding drinks containers in Georgia. Currently, most of the waste containers are landfilled or pollute the environment through littering. Separate collection and recycling of drinks containers is almost non-existent.The paper proposes a solution for Georgia, and provides some cost estimates for this recommended solution. Practical experiences from Austria, Bulgaria and Germany are discussed and yield an international framework.

Keywords: Drinks containers; EPR policy; Waste hierarchy; Georgia

Paper ID: CEST2017_00756

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Alternative calcium-based chemical stabilisers for ground improvement: Paper Sludge Ash treatment of London Clay

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Abstract

Due to the recent focus on promoting sustainable construction practices, chemical ground improvement of problematic soils for construction has been increasingly used worldwide. However conventional soil stabilisers such as cement or lime still suffer from the use of non-renewable natural resources, high energy consumption and CO_2 emissions for their production. Consequently alternative stabilisers are intensively sought; these would be linked to lower or even zero CO_2 emissions if these come from waste. The paper studies the effect of waste paper sludge ash (PSA) as an alternative to lime for the treatment of London clay (a moderately expansive soil). The effectiveness of the treatment is assessed comparing a number of PSA-treated soil properties (plasticity characteristics, unconfined compressive strength and stiffness) to those of the same soil treated with lime. In most cases the PSA-treated soil specimens are shown to have a better performance than the lime-treated ones. The findings on the macroscopic properties are complemented by microstructural analysis

Keywords: Solid waste management, paper sludge ash, chemical soil stabilisation, geotechnical properties

Paper ID: CEST2017_01028

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Conversion of greenhouse gases (CO_2 and CH_4) from biowastes to energy and chemical using innovative calcium phosphates catalysts

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Abstract

The increasing levels of CO_2 and CH_4 concentration in the atmosphere, especially due to fossil fuels combustion for energy production, agricultural activities and other industrial processes have led to severe climate changes. CO_2 reforming of methane ($CH_4+CO_2 \leftrightarrow 2H_2+2CO$) has gained increasing attention due to the conversion of these greenhouse gases into synthetic gas (syngas), which can be used for energy production or synthesis of high-value chemicals. Also, this reaction could be used for the valorization of biogas, natural gas and CO_2 waste streams. However, rapid catalyst deactivation is commonly observed in this reaction, mostly due to coke deposit on the catalyst active sites and to catalyst sintering. In the present work, the hydroxyapatite-supported nickel catalysts were synthesized and evaluated in this reaction. The catalysts presented high greenhouse gases conversion and high syngas selectivity during long periods of time (>300 h). Moreover, the comparison between these catalysts with the conventional ones highlighted the competitiveness of hydroxyapatite-supported nickel catalyst. The good performance of these catalysts was linked to their physico-chemical properties, such as nickel particle size, metal-support interaction and supports basicity. In addition, the occurrence of carbon gasification reaction ($C(s) + H_2O \leftrightarrow H_2+CO$) was crucial not only for lowering coke selectivity but also for increasing syngas production. Characterization of spent catalysts revealed that besides the amount of coke, the type of carbon had an influence on the catalysts deactivation. In-situ regeneration under air flow was also performed in order to evaluate the reuse of the catalysts.

Keywords: syngas, phosphate, CO_2

Paper ID: CEST2017_01083

Nutrient recovery from olive by-products through vermicomposting with *Eisenia andrei*

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Abstract

In this study, *Eisenia andrei* potential for detoxification of the olive by-products was evaluated. A standard mixture containing 600 g of olive pomace (OP), 300 g of horse manure and 100 g of wheat straw was imbibed by various olive mill wastewater (OMW) ratios (0%, 10%, 25% and 50%) to prepare four mixtures (M1, M2, M3 and M4 respectively), then inoculated with adult earthworms. The biological parameters related to earthworm's biomass gain and reproduction rate were better in the mixture M1 which used as control mixture (10.7 mg worm^{-1} day^{-1} and 0.17 cocoons worm^{-1} day^{-1} respectively) followed by M2 and M3. When OMW ratio exceeded 50% of OMW (M4), mortality of earthworm occurred after 7 days of incubation. The reduction of phenol concentration was higher in mixture M1 (91%) compared to other mixtures (M2: 72%, M3: 54%). The C/N ratio decreased in all mixtures to reach values between 17 and 22 at the end of vermicomposting process. The phytotoxicity test revealed that the overall germination index was greater than 80% in M1, M2 and M3, which showed that vermicompost produced can be used as organic amendment for biological and sustainable agriculture.

Keywords: Olive pomace; Olive mille wastewaters; Vermicomposting; *Eisenia andrei*; Total phenols.

Paper ID: CEST2017_01125

Methane production from co-digestion of food wastes and septage in two-phase system involving upflow anaerobic sludge blanket reactors

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Abstract

With rapidly increasing population in large cities in the Philippines, there is need for compact treatment systems for large amounts of generated solid wastes, ca. 40% of which is biodegradable food wastes. In this study anaerobic codigestion of food wastes and septage in two-phase system is explored. The first phase of the system was a set of four intermittently fed hydrolysis-acidogenesis reactors while the second phase was a set of three upflow anaerobic sludge bed (UASB) reactors. Prior to the two phase codigestion experiment, the best ratio of the co-substrates was determined among 0:100, 30:70, 50:50, 70:30 and 100:0 food waste-to-septage ratios (v/v) in batch runs. The 70:30 digestion run had the highest methane production (92.0 mL.g^{-1} VS), highest VS removal (44%), best TCOD removal (24.7%) and best hydrolysis rate (first-order kinetic constant, k = 0.1462 day^{-1}). With 50% higher amount of seed sludge, the methane production increased to 137.8 mL g^{-1} VS. The VS and TCOD removals were also increased to 56.1% and 36.6%, respectively. The hydrolysis rate also increased (k = 0.1542 day^{-1}). When fed into the two-phase system, a higher methane yield of 295.8 mL g^{-1} VS was obtained from 70:30 food waste – septage mixture at 16 days solid retention time.

Keywords: biogas, biosolids, hydrolysis, septage

Paper ID: CEST2017_01079

SESSION 26 – BIOWASTE

Friday 1 September 2017 - afternoon

Biotechnological valorization of waste and biomass for the production of energy and biofuels

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Abstract

Fermentable organic wastes, such as the organic fraction of municipal solid waste, agricultural residues and agroindustrial wastes, may be used to generate electrical energy and/or energy carriers, such as methane, biohydrogen, bioethanol, biodiesel and others. Biotechnological processes to this end are particularly environmentally friendly and do not require the use of chemicals. The use of anaerobic digestion for the production of methane from such waste material is discussed. Hydrogen fermentation is then presented as an promising alternative and it is demonstrated how a two-step process may be used to produce both hydrogen and methane, as well as their mixture, hythane, which has superior properties as a gaseous fuel. Microbial fuel cell technology is then discussed as an alternative for the direct production of electricity from dissolved organic matter.

Paper ID: CEST2017_01433

[10] Invited speech

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Organic solid waste biological treatment facilities: comparative analysis of process schemes

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Abstract

The biological treatment of the organic fraction of municipal solid waste represents the most spread strategy to pursue the biological stabilization of this residual stream, under either aerobic or anaerobic conditions.
Anaerobic digestion is an attractive technology for the conversion of organic substrates into methane, but the handling of the residual stream, namely the digestate, can prove to be challenging, especially in those countries where any Regulation has been enforced to discipline its proper use. In order to overcome this drawback, while taking the greatest advantage from the organic solid waste biostabilization in the circular economy view, the proper combination of both aerobic and anaerobic processes can be implemented. At full-scale the combined anaerobic/aerobic treatment entails a high technological complexity, so that the careful monitoring of the overall process is fundamental to ensure its proper development.
This study aims at assessing the process performances of full-scale plants, differently combining the anaerobic process with an aerobic step. To this end, mass flow analysis was used, so as to comparatively discuss the yields of complex biological treatment facilities.

Keywords: anaerobic digestion, biogas, biostabilization, composting, digestate, mass balances

Paper ID: CEST2017_00656

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Chemical pretreatments of organic fraction of municipal solid waste for a sustainable valorization

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Abstract

Organic solid waste gains a lot of consideration in waste management due to both its potential environmental impacts and its suitability to achieve sustainability objectives. One of most widely applied treatment of organic solid waste is the anaerobic digestion, which also promotes renewable energy production. However, specific pretreatments of the substrates are needed to overcome the hydrolytic limiting step and to improve the quality of useful components during the process. Some of these pretreatments allow to convert the substrates in by-products, which could be properly employed in industrial processes. The aim of this work in studying the applicability of organic solvent pretreatment to convert organic solid waste in value-added chemicals.
Differently composed organic samples were prepared and treated by acetic acid under various operating condition. Chemical-physical characteristics, biodegradability and structural changes were investigated to evaluate the efficiency of the pretreatment. The correlations among the resulting data were discussed in order to propose alternative and suitable uses of pretreated organic waste.

Keywords: organic solid waste, organic solvent, pretreatment, resource, value-added chemicals

Paper ID: CEST2017_00702

Hydrogen and Methane Production from Food Residue Biomass Product (FORBI)

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Abstract

This study concerns the production of Hydrogen and Methane from a Food Residue Biomass (FORBI) product, generated from pre-sorted fermentable household waste in a (CSTR) and in a Periodic Anaerobic Baffled Reactor (PABR) respectively. FORBI is generated by drying and shredding the fermentable fraction of household food waste collected door-to-door in the Municipality of Halandri, Greece.Hydrogen production from FORBI through anaerobic fermentation under acidogenic mesophilic conditions was carried out using a 4L CSTR, operated at 12 hrs HRT with an organic loading of 15 g TS/L. Volatile fatty acids, TSS, VSS, COD, dCOD, total and dissolved carbohydrates, pH and hydrogen content were evaluated. The H_2-CSTR was operated for 40 days. During the operation of H_2-CSTR the production of biogas reached up to 0.1026L_{biogas}/g_{FORBI} and the percentage of hydrogen in the gas up to 48.2 %.The conversion of FORBI into methane was carried out through the operation of a 77L PABR operated under mesophilic methanogenic conditions at 10 days HRT and an organic loading of 10 g tCOD/L. TSS, VSS, COD, dissolved COD, pH, VFAs and methane were measured. The mean biogas production rate was 0.158L_{biogas}/g_{FORBI} and the mean methane percentage in the biogas was 70.34%.

Keywords: Methane, Hydrogen, Volatile Fatty Acids, Food Residue Biomass (FORBI) product, Anaerobic Fermentation.

Paper ID: CEST2017_00920

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Bioelectricity production from fermentable household waste in a dual-chamber microbial fuel cell

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Abstract

The use of a Microbial fuel cell (MFC) was studied as an alternative novel solution to convert a Food Residue Biomass (FORBI) product into Bioelectricity. FORBI was produced by drying and shredding the pre-sorted fermentable fraction of household food waste collected door-to-door in the Municipality of Halandri. In this study, the possibility of bioelectricity production from a FORBI extract was investigated in an MFC. Different organic loading rates (OLR) (0.7, 0.9, 1.4, 2.8, 6 g COD/L) were examined. It was observed that the increase of the initial concentration of the final extract resulted in a corresponding increase in the operating time. The best performance of the cell was observed at the highest concentration of the final extract tested (6 g COD/L) corresponding to a maximum power density (normalized to the geometric area of the anodic electrode, which was 21.6 cm^2) of approximately 30 mW/m^2 corresponding to a current density of 88 mA/m^2. The results demonstrate that readily biodegradable substrates such as FORBI can be effectively used for enhanced bioelectricity harvesting in an MFC

Keywords: Microbial fuel cells; Power density; Bioelectricity; fermentable household waste; Food Residue Biomass product.

Paper ID: CEST2017_00922

Effect of thermophilic pre-composting of olive mill wastewaters on reproduction and growth of earthworms *Eisenia andrei*

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Abstract

The aim of the present work was to test the effect of thermophilic pre-composting of olive by-products on reproduction and growth of earthworms *Eisenia andrei.* Three mixtures were composed of olive cake (600 kg), horse manure (300 kg) and wheat straw (100 kg). Olive Mill Wastewater (OMWW), was added different ratio (0%, 25%, and 50%), to prepare three treatment T1, T2 and T3 respectively, then placed in trapezoidal piles with dimensions (1m height and 3×2m base) and pre-composted for two months. Three vermibed were made using 200 kg of mixtures previously pre-composted and inoculated with 2 kg of earthworms. Another three vermibed were made from same non pre-composted mixture to test the effect of thermophilic pre-composting of olive by-product on earthworm's growth and reproduction rate. Earthworm's growth and chemical composition changes of each treatment were measured during vermicomposting process. The growth rate mg ($worm^{-1}day^{-1}$) was better in pre-composted treatment. Indeed pre-composted T_1 (control mixture) present maximum value of growth rate (11.79 mg $worm^{-1}$ day^{-1}), against non-pre-composted T_4 (10.04 mg $worm^{-1}$ day^{-1}), followed by T_2 (10.93 mg $worm^{-1}$ day^{-1}), against non-pre-composted T_5 (7.54 mg $worm^{-1}$ $day^{-}1$), and T_3 (8.57 mg $worm^{-1}day^{-1}$). In fact these results could be attributed to the OMWW's toxicity reduction.

Keywords: Olive pomace; Olive mille wastewaters; Pre-composting; Vermicomposting; *Eisenia andrei.*

Paper ID: CEST2017_01126

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Producing biofuels from urban organic waste

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Abstract

This study explored the possibility to biologically produce hydrogen and methane through the thermophilic single and two stages anaerobic codigestion of waste activated sludge and the organic fraction of municipal solid waste. Specific gas productions in single and double-stage processes working with an hydraulic retention time of 20 days were 493 L/kgTVS and 572 L/kgTVS, respectively. In the two stage process hydrogen and methane productions reached values of 24 LH_2/kgTVS and 272 LCH_4/kgTVS, respectively. Obtained biohythane, after upgrading, is particularly valuable for the automotive sector.

Keywords: waste activate sludge, organic municipal solid waste, thermophilic anaerobic digestion, hydrogen, methane

Paper ID: CEST2017_01158

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

BioGas to BioRefinery. Life Cycle Analysis of advanced utilisation options for anaerobic digestion using the anaerobic Biorefinery concept

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Abstract

The BioGas to BioRefinery project is combining Life Cycle Analysis and Technology Evaluation to advanced utilisation options for anaerobic digestion using the Biorefinery concept. The projects primary aim is to identify optimal utilisation pathways for biogas and liquid effluent and digestate production and use. A further aim is to use the outputs of the research to provide an evidence-base for policy making by developing an evidence-based RoadMap for a biobased or bioeconomy for Northern Ireland. Using data from a regional anaerobic digestion feedstock evaluation, the research is modelling a range of advanced utilisation options for anaerobic digestion for both biogas production and use, and liquid effluent and digestate production and use. A particular focus of the project is potential synergies/symbioses between the common biorefinery building blocks. The usefulness of combining Life-Cycle thinking with the Biorefinery concept with a view to optimising policy development will be discussed, and future research priorities identified to support this important policy area.

Keywords: Biogas, biorefinery, anaerobic digestion, Life-Cycle Analysis

Paper ID: CEST2017_01363

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Comparative analysis of composting source separated biowaste and the organic fraction of the Chania MBT plant

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Abstract

For decades, the management of solid waste was a major problem for the Region of Chania, resulting to a conviction and fine by the European Court of Justice. This resulted into concerted action for the development of a Mechanical Biological Treatment (MBT) plant, using composting as the biological step, in combination with a sanitary landfill, located in Korakia-Akrotiri. The plant begun operation in 2005, serving both as a Materials Recovery Facility (MRF) for the content of the blue bin, used for the collection of commingled recyclables, and a dirty MRF – composting plant, to divert the biodegradable fraction of MSW from landfill, adjusted to the typical collection system in Greece, consisting of two bins, one for commingled recyclables and one for all the rest. This study focuses on estimating the biostability of the organic fraction from the MBT plant of Chania, as well as from the developing Biowaste Source Separation program. Mixtures of these two types of waste with green waste were composted and the process was monitored through typical composting parameters: T, pH, EC, moisture, VS and nitrogen content. Moreover, the quality of the two composts was compared on the basis of heavy metals and selected emerging contaminants.

Keywords: Composting, biowaste, stability, SOUR, emerging contaminants

Paper ID: CEST2017_01400

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Smart Compost Monitoring System using Open Source Technologies

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In this paper, a complete monitoring solution for compost piles or windrows is presented. The system uses sensors to capture data from the field and transmits them to a data server through the GPRS system. A web application is used in order to visualize the data that is stored and also to manage the composting piles/windrows. The major advantage of this solution is it's versatility and cost. The GPRS system offers wide coverage without the use of cables or other low range wireless technologies. Also, using open source software and hardware makes the whole system a low cost solution. Finally, the web application, offers live data visualization from every place with an internet connection.

Keywords:

Paper id: CEST2017_01427

SESSION 27 – ENVIRONMENTAL DATA ANALYSIS AND MODELLING (2)

Friday 1 September 2017 – afternoon

Multilevel analysis for the identification of potential asbestos roofs

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Abstract

In this work a multilevel analysis has been developed for the identification of potential asbestos roof from remote sensing data. Asbestos is a material that was widely used in Italy before 1992 especially for civil and industrial roofs and its degradation is linked to several serious diseases. Recently, the Emilia Romagna region published a document containing guidelines for the evaluation of the conservation status of asbestos roofs and the evaluation of the relative risks. There is the need to have an updated census of asbestos roofs in order to determine their exact location on the territory and facilitate their monitoring. Therefore a methodology for a semi-automated pre-selection of asbestos roofs has been developed in this work using remote sensing data and territorial information. The procedure relies on a territorial multilevel analysis. Photointerpretation techniques, object oriented classification and the analysis of the roofs texture, allow to identify potential asbestos roofs. Tests and assessment of the developed protocol has been done through ground field investigations. The information collected by the classification has been organized in a GIS geodatabase combining the building information already available with the new results obtained from this analysis.

Keywords: asbestos, multilevel analysis, Geographic Information Systems, object oriented classification

Paper ID: CEST2017_00809

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

What is the optimum ensemble range of hydro-climatic simulations for impact modeling studies?

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Abstract

Climate projections are associated with uncertainties both on the global and the regional scale, which are related to the different configurations of the modeling chain. Although a combination of numerous projections is usually needed to quantify the total uncertainty, practical impact modeling investigations can only handle a limited number of scenario combinations. Given the fact that all climate projections are subject to considerable uncertainty, it is crucial to know a representative, with regard to the information content, subset in an available ensemble. Here we propose a framework rooted in the concepts of information theory to identify a representative subset from a larger ensemble of climate projections. The Maximum Information Minimum Redundancy (MIMR) concept is used to identify the representative subset. The analysis is based on an ensemble of 16 climate projections for precipitation and temperature for the entire Sweden. The projections were further used to force the HBV hydrological model and simulate river discharge until the end of the 21st century. We identify the representative subsets for different statistical characteristics for precipitation, temperature and discharge and assess the sensitivity of the identification at different regions, seasons and future periods. Results show that a subset of 20-35% of the total available projections can represent a large fraction of the ensemble range of hydro-climatic changes highlighting the information redundancy in large model ensembles. Finally, the identified subsets are sensitive to the choice of variables, seasons and future periods, whilst the identification should not be solely based on climatic variables but rather consider hydrological information as well.

Keywords: Representative projections, information theory, climate change impacts, maximum information minimum redundancy

Paper ID: CEST2017_00309

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A decision support tool for optimal placement of sewer mining units: Coupling SWMM 5.1 and Monte-Carlo simulation

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Abstract

Rapid urbanization and potential water shortages due to supply side impacts of climatic change have led to the development of innovative water and wastewater reuse strategies. A mid-scale decentralized option that can provide recycled water for numerous uses, including agriculture and urban applications, is that of sewer mining. The idea is to provide reclaimed water by extracting wastewater from the sewers, treating it at the point of demand and, in some cases, returning treatment residuals back to the sewer system. Public perception, inadequate regulatory frameworks, as well as engineering issues, are some of the challenges that pose barriers in adapting such solutions. One of these challenges is hydrogen sulfide build-up, which can cause odor, corrosion and human health-related problems. In order to address the latter issue, we propose a method that couples the advantages of Monte-Carlo simulation with SWMM 5.1 model. The method is able to identify potential locations for sewer mining placement and simultaneously account for the network characteristics and dynamics (i.e., wastewater flow and BOD_5 fluctuations). The overall scheme was applied in a future sewer network in Greece providing useful results and can therefore serve as a guideline in up-scaling sewer mining at a city level.

Keywords: decentralized water treatment; sewer mining; hydrogen sulfide; SWMM simulation model; Monte-Carlo method

Paper ID: CEST2017_00796

Enhancing the resilience of interconnected critical infrastructures to climate hazards

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Abstract

In this work we propose a methodological risk and resilience framework to assess comprehensively multiple climate risks and related natural hazards, such as floods, forest fires, and droughts, for interconnected Critical Infrastructures (CI). As vital components of the normal functioning of modern societies, their resilience encompasses the operational elements, their structural integrity and the capacity to maximize business output under climate stressors. Critical infrastructures are commonly designed, built and maintained based on rigorous standards in order to withstand the climate and weather-related pressures, but shifts in climate characteristics may result in increases of the magnitude and frequency of potential risks, or expose specific CI to new risks not previously considered. A main objective of the proposed methodology is to provide scientific evidence for better understanding of how future climate regimes might affect the interconnected CI during their lifespan and accounting for ageing, and how to assess the cost-effectiveness of different adaptation measures. Additionally, an example in the flooding impact to Torbay in South West UK is presented.

Keywords: Climate Change, Flooding, Critical Infrastructures, Natural Hazards, Risk Assessment

Paper ID: CEST2017_00851

Environmental Determinants of Surface Water Quality Based on Environmetric Methods

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Abstract

A multivariate statistical technique, explaratory factor analysis-FA, has been used to assess the natural and antropogenic impacts on surface water quality in two river basins in Western part of Turkey (Buyuk Menderes and Kucuk Menderes River Basins). The method attempted to explain the correlations between the observations in terms of the underlying factors, which were not directly observable and to reduce a great number of the water quality variables to a smaller number of attributes, grouped in common factors. Furthermore, by using the Confirmatory Factor Analysis-CFA method, the reliability of separated factors and the dimensionality have been determined. Then the path diagram was designed to investigate the structural model. Results revealed that ionic composition, and water oxygenation of waters are factors controlling overall water quality in the region. It can be concluded that factor analysis confirmed by CFA can be used to identify probable pollution sources of surface waters.

Keywords, Confirmatory factor analysis, Factor analysis, Küçük Menderes Basin, Büyük Menderes Basin, Water quality

Paper ID: CEST2017_01390

Dispersion of respirable particles emitted from surface mining operations

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Abstract

Earlier studies on particulate matter (PM) emission from surface mining operations are mainly focussed on estimation of PM emission from different mining activities and quantificaion of the workers' exposure. Another set of studies measured PM around the mine to quantify the exposure level of people residing around the mine. However, these studies did not quantify the the contribution of mining to it. A study has been conducted to quantify the contribution of an active surface mine to the ambient PM level at locations up to a distance of 500 m from the mine. Mass concentrations of PM_{10}, $PM_{2.5}$ and PM_1 are measured at pit boundary, 100m, 200m, 300m, 400m and 500m from the pit boundary, using an aerosol spectrometer. Simultaneously the mining activity taking place inside the mine is recorded. Very high concentrations above 3500 µg m^{-3} are observed when the mine was in full operation thatincludes coal cutting by surface miners and transport by tippers. Coarse fractions, which are primarily produced due to mining activities, were higher than the background level at a distance of 500m from the mine, which indicates a mine can contribute to enhance the ambient PM level even beyond 500m away from it. Significant positive correlations and linear relationships with moderate to good coefficient of determination (R^2) were obtained using Pearson's correlation coefficient and regression analysis respectively between concentrations of different particle sizes.

Keywords: PM_{10}, $PM_{2.5}$, PM_1, Pit boundary

Paper ID: CEST2017_00750

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Wildfire modeling through a mobile application

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Abstract

With increased frequency and intensity of wildfires around the world, new technologies are now emerging that may aid in confronting the disasters and minimize their impacts. Fire protection entities have begun leveraging wildfire behavior spatial modeling, as a tool to provide valid fire spread and intensity estimations used for fuel and vegetation management practices and early warning of potential or on-going wildfires. New mobile applications that integrate Geographic Information Systems (GIS) are also being applied to risk mitigation and disaster response management. In this study, we describe the development of a cross-platform mobile application that combines fire propagation simulations with mobile geospatial technology to create a wildfire decision-aid system for application on active wildfire incidents. Our mobile application (*MTT App*) provides a novel approach to harness new technologies to support real-time suppression efforts and improve firefighter safety.
Keywords: mobile GIS, cross-platform applications, fire behavior, Minimum Travel Time (MTT)

Paper ID: CEST2017_00285

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Designing landscape fuel treatments to mitigate impacts from large wildfires in Greece

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Abstract

The growing problem of catastrophic wildfires in Greece advocates a need to re-examine wildfire risk governance policies. Current fire protection planning is either non-existent or narrowly focused on specific parcels of land, compared to strategic, landscape approaches used in other fire prone regions of the globe. Specifically, fuel breaks are concentrated between developed and wildland areas, while ignoring the larger wildfire problem on the surrounding lands. For instance, about 20% of Lesvos Island, Greece, is covered by dense conifer forests, an important ecological, cultural and aesthetic resource, that are capable of spawning large wildfires. In this study, we used wildfire simulation methods to build a network of fire transmission among forests, developed areas and other land cover types (shrublands, olive cultivation and abandoned lands), and identify source-sink relationships. We then used spatial optimization methods to locate fuel treatments in specific land types to reduce large fire growth. The results demonstrated improved methodologies for fuel management planning that consider the connectivity of wildfire among different land types. They also illustrated that wildfire risk to individual communities is a function of land uses well beyond the current fuel break networks, thus contributing to a larger framework for building fire resilient landscapes and fire adapted communities.

Keywords: Fuel treatment optimization, Cross-boundary risk transmission, Minimum Travel Time simulations, Wildland-urban interface, FlamMap.

Paper ID: CEST2017_00292

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of Sediment-Associated Contamination Risks Using New Multivariate Statistical Indexes

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Abstract

This paper presents the assimilation of heavy metal concentration data from sequential extraction method (SEM) with metal toxicity factors to develop and propose a new sediment quality index called ecological contamination index (ECI), to predict the potential ecological risk associated with sediment contamination. Chemical speciation sediment data of five heavy metals: cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), and lead (Pb) from five coastal aquatic ecosystems of the Equatorial Atlantic Ocean were used in assessment of the degree of heavy metal contamination. Other contamination indicators (degree of contamination, modified degree of contamination) used in characterization and identification of pollution hotspots, indicate considerably contaminated ecological ecosystems. Evaluation based on ECI indicates that sediments of most aquatic ecosystems were considerably to highly contaminated. The results illustrate that the proposed index is reliable, precise, and in good agreement with similar existing indexes for evaluating the severity of sediment-associated contamination by heavy metals. The principal component analysis (PCA) and factor analysis indicate that heavy metals in the benthic sediments originate mostly from anthropogenic sources.

Keywords: Fractionation, heavy metals, sediment, sediment pollution, contamination index.

Paper ID: CEST2017_00129

SESSION 28 – WATER AND WASTEWATER TREATMENT (5)

Saturday 2 September 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of heavy metals from simulated water by using eggshell powder

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Abstract

Characteristics and efficiency of eggshell powder (ESP) were investigated as a low-cost adsorbent in removal of different heavy metal ions from aqueous solution. Initial findings showed ES potential to be applied as an effective sorbent due to high concentrations of carbon and calcium and high porosity and availability of functional groups. Adsorption experiments were studied with varying pH, contact time, and ESP concentration. Maximum percentages of heavy metal ions removal were recorded at optimum pH, contact time and adsorbent concentration. Evaluation of the isotherms and kinetics confirmed that ESP has high value of adsorption capacity. This experiment demonstrated the ability of ESP as an effective, sustainable, and low-cost adsorbent for removal of the heavy metal ions in different wastewaters.

Keywords: Adsorption capacity, Eggshells, Heavy metals, simulated water

Paper ID: CEST2017_00477

Coal combustion ash sorbents for Cd and Zn capture in single-compound and binary systems

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Abstract

The work deals with the adsorption of cadmium and zinc on coal combustion ash (CCA) sorbents, in both single-compound and binary systems. Three CCA sorbents were tested; two of them deriving from the gasification of a raw sample carried out with either steam (SG) or carbon dioxide (DG). Experimental adsorption runs showed a significantly higher adsorption capacity of zinc with respect to cadmium, for all the investigated sorbents. This was ascribed to a higher affinity of sorbent active sites toward Zn and, secondarily, to the smaller dimension of zinc cations (Zn^{2+}) which result less affected by steric hindrance.. Moreover, for both the analytes, a ranking DG>SG>CCA of adsorption capacity can be recognized. This is likely due to the increase in inorganic fraction of SG and DG sorbent with respect to CCA, due to the gasification treatments. Moreover, for DG sorbent, further improvement of the performances could be ascribed to an increase in the concentration of carbonyl surface functional groups, which are considered to be the more active fractions for zinc and cadmium adsorption on the investigated sorbents. Binary adsorption data showed the same ranking among sorbents retrieved in single-compound tests and a higher zinc adsorption capacity. Different competitive effects arose between the adsorbates, likely ascribable to a different affinity towards the sorbents.

Keywords: coal combustion ash; competitive adsorption; cadmium; zinc; gasification.

Paper ID: CEST2017_00481

Groundwater Treatment by Electrodialysis: Gearing Up Towards Green Technology

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Abstract

Experiments on electrodialysis stack to treat groundwater was conducted and evaluated. The stack was operated at optimum experimental conditions at applied voltage of 12V, feed flow velocity of 0.033 l/s and desalination time of 92 minutes. An average cation removal efficiency of 99.15% was obtained while 100% anion removal was recorded for the all the anions except Cl with 99.97% removal efficiency. The oxidation-reduction potential (ORP) was also recorded to increase from -162.2 mV to 908 mV, indicating a shift from a highly reducing to a highly oxidizing reaction that will enhance easier immobilization of toxic metals present in the system. Solution pH was also noted to drop from 7.62 to 4.80 with corresponding decrease in the conductivity of 1388 µS/cm to 36 µS/cm. This indicates that characteristics of product water can be classified that of purified water, suitable for drinking and analytical purposes when process was controlled for such purpose. Arsenic desalination kinetics was found to increase over time at constant applied voltage and feed flow rate with corresponding decrease in current utilization. Lower As feed concentration samples tend to achieve product water concentrations of lower than MCL of 10 ppb earlier than high feed concentration samples.

Keywords: ED, Electrodialysis, groundwater treatment, remediation, green technology

Paper ID: CEST2017_00492

Assessment of Cadmium (II) Removal from Water by Innovative Polyelectrolyte-Coated Fly Ash

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Abstract

Fly ash (FA) is a major industrial waste that adds extra cost for proper disposal. Several studies have recently focused on developing methods to utilize the FA in useful applications. One of the alternative uses of fly ash takes advantage of its adsorptive capacity for the removal of contaminants from water. However, earlier studies showed limited success in this regard indicating the need to improve FA adsorption capacity. This study evaluates the potential capacity of raw fly ash (RFA) and polyelectrolyte-coated fly ash (PE-FA) to remove cadmium (Cd) using layer-by-layer technique. An acid treated FA was coated with 20 layers of cationic poly diallyldimethylammonium chloride (PDADMAC) and anionic polystyrene sulfonate (PSS) solutions. Characterization of the modified FA (PE-FA) was carried out using FE-SEM, and EDX techniques. Adsorbent dosage, pH, and contact time on the adsorption of Cd was studied in batch-mode experiments. Results indicated that in a 50 mL solution, 0.2 g of PE-FA adsorbent has attained a 99% removal of Cd in 15 minutes at agitation rate of 150 rpm and pH 9. While a removal of only 27% Cd was achieved by RFA under the same treatment conditions.

Keywords: Polyelectrolytes; Fly Ash; Adsorption; Cadmium

Paper ID: CEST2017_00568

Metabolism of Oxybenzone in plants

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Abstract

Oxybenzone (OBZ) is a common UV filter in personal care products, which enters aquatic systems mostly directly via recreational activities or indirectly through wastewater treatment plants discharges. It is an emerging contaminant due to its adverse impacts on aquatic ecosystems.To study the degradation capacity of OBZ in phytotreatment, the hairy root culture (*Armoracia rusticana*) and the wetland species *Cyperus alternifolius* were treated with OBZ. Depletion of spiked OBZ from the aqueous medium exceeded 70% after 120 h, and continuous uptake and accumulation in plant tissues was observed. Similar to its fate in mammalian cells OBZ could be activated into the phase I hydroxylated metabolite 2,4-dihydroxybenzophenone.Two subsequently appearing metabolites were identified as oxybenzone-glucoside and oxybenzone-(6-O-malonyl)-glucoside by LC-MS/MS. Formation of these metabolites increased over the experimental period. The identity of the metabolites was further confirmed by enzymatic synthesis, enzymatic and alkaline hydrolysis. To our knowledge this is the first time that OBZ metabolites are shown to occur in higher plant tissues, and that plant defense systems were elevated to counteract stress caused by exposure to OBZ. This study presents the huge potential of plants to eliminate OBZ, and the significance of phytoremediation to cope with environmentally critical UV-filters is discussed.

Keywords: sunscreen, phytoremediation, OBZ, glucoside, detoxification

Paper ID: CEST2017_00602

Adsorption of Arsenic (V) from drinking water onto bone char

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Abstract

The adsorption of As(V) onto the bone char (BC) was investigated in this work as an alternative for removing As(V) from drinking water. This work was aimed at studying the contribution of the hydroxyapatite (HAP) contained in the BC to the adsorption capacity of BC. The adsorption isotherms of As(V) on BC and HAP were determined in a batch adsorber. The effects of temperature and pH on the adsorption capacity were studied in detail. The XRD analysis of BC showed that the main components of BC were HAP [$Ca_{10}(PO_4)_6(OH)_2$] and calcite ($CaCO_3$). Besides, the BC surface was examined by TEM analysis and the sheets of HAP were observed in the BC. The adsorption capacity was raised by decreasing the solution pH due to electrostatic interactions between the arsenate anions and the surface of the adsorbents. The adsorption of As(V) was endothermic because the adsorption capacity increased with temperature. The adsorption capacity of HAP towards As(V) was greater than that of BC, and the capacity of BC was dependent on the HAP contained in the BC. The adsorption of As(V) from drinking water samples was carried out and the results showed that the As(V) could be efficiently removed from drinking water.

Keywords: Adsorption, Arsenic, Bone Char, Hydroxyapatite

Paper ID: CEST2017_00713

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Kinetics of chromate reduction by nano zero valent iron incorporated in a porous matrix

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Abstract

Incorporation of nanozero valent iron (nZVI) in a porous matrix is an innovative technology for the treatment of contaminated waters. Aim of the technology is to exploit the high reactivity of nZVI towards a wide spectrum of contaminants, avoiding important handling problems which arise when bare nZVI suspensions are used. In this study nZVI was incorporated in the matrix of a cation-exchange resin (Amberlyst 15), by applying a green synthesis procedure, and the composite material was used for the removal of Cr(VI) from aqueous solutions. Reduction kinetics was studied by conducting batch tests. The main investigated parameters were the particle size of nZVI loaded resin beads (R-nFe), the concentration of Cr(VI) and the amount of R-nFe per volume of solution.

A model was developed to describe the reduction kinetics, taking into consideration two interrelated processes: (a) the diffusion of contaminant inside the network of pores and (b) the chemical reaction between the contaminant and iron nanoparticles which are homogenously dispersed inside the porous beads. The effective diffusion coefficient, De, and the kinetic constant, k, were initially determined by fitting the model equations to an initial set of experimental data, and then were successfully used to predict the kinetics under different experimental conditions.

Keywords: chromate, iron nanoparticles, Amberlyst 15, reduction kinetics, intraparticle diffusion

Paper ID: CEST2017_00760

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The removal of reactive dyestuff from aqueous solutions using activated carbon prepared from orange (*Citrus sinensis* L.) pulp by chemical activation with $ZnCl_2$

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Abstract

In this study, activated carbon was produced from orange (*Citrus sinensis* L.) pulp by chemical activation with zinc chloride ($ZnCl_2$) and an adsorption capacity of activated carbon for removal of reactive dyestuff (Blue 49) from aqueous solutions was investigated. The surface area of chemically modified activated carbon were 1779.48 m^2g^{-1}. The results indicated that the adsorption of Blue 49 obeys the pseudo-second-order model. The thermodynamic parameters such as $\Delta G°$, $\Delta H°$ and $\Delta S°$ were calculated to estimate the nature of adsorption and these parameters indicate a feasible, spontaneous and endothermic adsorption. The results suggest that the activated carbon prepared from orange pulp has potential in remediation of reactive dyestuff (Blue 49) contaminated waters.

Keywords: Activated carbon, orange pulp, adsorption, characterization, Blue 49.

Paper ID: CEST2017_00774

Development of highly flux antifouling RO Polyethersulfone membrane using woven support

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Abstract

Over the next decades, many regions worldwide will likely face dramatic changes in the availability of water. Desalination of sea water appears as the perfect mean to ensure water supply. To this end, membrane technologies represent a promising technology since they can achieve high levels of purification and are simple technically, energy efficient and typically scalable. However, membrane fouling, characterized by the deposition of solid material onto and into the membrane surface, is still the main problem of this treatment.In the present work, a novel highly flux antifouling membranes were prepared via phase inversion technique using Polyethersulfone (PES) blending with a nano-materials solution of sodium dodecyl sulfate (SDS), Titanium dioxide (TiO_2) and Triethanol amine (TEA), in*N*-Methyl-2-pyrrolidone (NMP) as a solvent. The prepared polymeric solution was cast on woven fabric as supporting material. The SEM results prove that prepared membranes have dense top layer and small finger like structure in the middle, while the bottom layer is porous due to woven support. The prepared membranes exhibit excellent mechanical behavior. Desalination test was carried out using real samples from Mediterranean sea. The membranes performance results indicate that salt rejection reached 96% with high flux 134.9 Kg/m^2h under operating pressure up to 40 bar.

Keywords: antifouling, polyethersulfone membranes, desalination, woven support

Paper ID: CEST2017_01198

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of irrigation with reclaimed water on leaf content and physiological aspects of carnation

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Abstract

This study examined the feasibility of using reclaimed wastewater as irrigation water for the cultivation of carnation plants. The effect of three different qualities of treated wastewater on the growth of this important ornamental plant was investigated in comparison with tap water and tap water enriched with fertiliser. Growth characteristics in plants irrigated with reclaimed wastewaters were equal or higher than those of plants irrigated with tap water. Nitrogen and phosphorus content in leaves increased for plants irrigated with primary, secondary and tertiary treated wastewater in comparison with plants irrigated with tap water while Ca and Mg accumulation in leaves showed no significant difference. Micronutrient (Cu, Fe, Zn) content in leaves increased in plants irrigated with primary and secondary treated wastewaters. Maximum efficiency of PSII (Fv/Fm) and leaf SPAD measurements indicates the absence of photo-inhibition and of chlorophyll loss in plants irrigated with reclaimed wastewaters.

Keywords: *Dianthus caryophullus*, irrigation, water quality, carnations, domestic wastewater

Paper ID: CEST2017_01298

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Cd-contaminated solution treatment by activated and non-activated beech charcoal

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Abstract

Biochar obtained from pyrolysis of vegetable waste has been recognized to possess adsorbent capacity. Furthermore, it represents an economic and environmentally sustainable alternative to commercial adsorbents because, being a waste product, its use allows to avoid industrial activities for adsorbent production as well as to reduce the amount of waste to be disposed of.In this paper, the biochar produced by pyrolysis of beech has been investigated as a potential adsorbent for remediation of cadmium-contaminated groundwater.So far, beech charcoal has been mainly used as a soil amendment and only few experiences have been reported about its use as an adsorbent medium. The present experimental activity started with a series of analyses to obtain the main physical-chemical characteristics of charcoal. Adsorption kinetics and isotherms through batch experiments were then determined. Furthermore, breakthrough curves were obtained through column experiments. The same tests were repeated using the beech charcoal after modification through the addition of specific bacterial strains able to produce a reactive monolayer biofilm. The results showed that bio-activated charcoal has enhanced adsorption capacity for cadmium-contaminated solution.Therefore, charcoal and bio-activated charcoal may be considered valid options as adsorbents for the remediation of solution contaminated by cadmium.

Keywords: Beech charcoal, Biochar, Cadmium, Groundwater, Remediation.

Paper ID: CEST2017_01349

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of membrane filtration via various membrane types on THMFP reduction

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Abstract

Natural waters, groundwaters and surface waters, often contain elevated concentrations of natural organic matter (NOM) due to geological composition or biological decomposition of plant and animal material in the water. The most significant component of natural organic matter are humic substances.

Humic substances are undesirable in water because they cause appearance of color, taste and smell. Because of their molecule structure (long carbon chains and/or rings), humic substances often bind a variety of contaminants (heavy metals, pesticides). Significant problem is the heightened concentrations of humic substances since they form toxic and carcinogenic by-products trihalomethanes (THMs) during the water disinfection with chlorine. Humic substances are complex mixtures of organic compounds with different structure, molecular weight, number and position of functional groups depending on the origin and age of the organic material, the type of water, environmental and climatic conditions which results in a different reactivity with chlorine so called trihalomethane formation potential (THMFP). Membrane processes are efficient methods for ions, colloids and solids removal from water based on their molecular weight and chemical structure. This study investigated the effect of membrane filtration via various membrane types (microfiltration, ultrafiltration, nanofiltration and reverse osmosis membranes) on THMFP reduction. Effect of membrane type on pH, electrical conductivity (EC), alkalinity, water hardness and $KMnO_4$ consumption were also analyzed.

Keywords: water, humic substances, trihalomethane, membrane filtration

Paper ID: CEST2017_00976

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Isolation of microalgae with potential for integrated biomass production and nutrient removal from wastewater

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Abstract

The present study firstly investigates the variations of microalgae in the constructed wetland. Then one of the potential microalgal species was isolated and cultured in autotrophic and mixotrophic growth to compare the performance on biomass production and to evaluate the ability of wastewater treatment and simultaneous biodiesel production. *Scenedesmus* sp. was an abundant strain in the constructed wetland during one year of monitoring. Under both autotrophic and mixotrophic cultivation conditions, an appropriate composition of each source was beneficial for respective biomass production, 8% (v/v) CO_2, and 40% piggery wastewater content. The specific growth rate and lipid productivity obtained with autotrophic growth were slightly higher than those obtained by mixotrophic growth. Both cultivation conditions led to dissimilar fatty acid compositions. Comparing the autotrophic and mixotrophic growth, the mixotrophic cultivation not only produced biomass, but also could assimilate up to 81.5% total nitrogen, 64.6% total phosphorus, and 60.7% chemical oxygen demand (COD) from piggery wastewater, respectively. The high biomass productivity was observed at 16.9:1.1:1 of COD/TN/TP of piggery wastewater.

Keywords: Biomass, *Scenedesmus*, wastewater

Paper id: CEST2017_00512

SESSION 29A – ATMOSPHERIC SCIENCES

Saturday 2 September 2017 – morning

Physical and chemical properties of aerosols in the Mediterranean: Patterns and impacts

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Abstract

The Mediterranean region and Middle East are well known places for high aerosol and ozone concentrations. There three categories of sources of aerosols: desert dust, sea salt and anthropogenic. The characteristic paths and scales of transport was the subject of several studies in the past. Changes in the physical and chemical properties of the aerosols occur along the followed paths. Aerosol levels have several impacts on other gaseous pollutants but the most important are associated with radiation, clouds and precipitation (Direct and indirect effects). In this presentation we discuss the complex direct, semi-direct and indirect links and feedbacks between natural aerosols, radiation budget and the meteorological and chemical state of the atmosphere. The results of a fully coupled atmospheric modeling system (RAMS/ICLAMS) are discussed. The capabilities of this modeling system include the online coupling between chemical and meteorological processes, as well as the explicit treatment of cloud condensation, giant and ice nuclei (CCN, GCCN, IN), and size and humidity dependent optical properties for aerosols. The results from this work show that the presence of mineral dust leads to a linear reduction in solar radiation and nonlinear increase in net downward longwave radiation that is larger during daytime than nighttime. The magnitude of change in the radiation budget is determined by the vertical structure of the dust cloud and mainly its height. The perturbations in the radiation budget affect the air temperature and moisture vertical profile, leading to a cloud base lifting and redistribution of condensates. Sea spraying is a procedure that creates considerable amount of sea salt that acts later as CCN and GCCN with the formation of characteristic cloud formations. The explicit activation of aerosols as CCN and IN causes changes in the spatiotemporal patterns of the precipitation field during and after the event. These influences are caused more by the indirect rather than the direct and semi-direct effects. The changes in the diffuse and direct components of the radiation budget lead to a net negative effect on the photolysis rates that, in turn, alter the pollutants distribution. Ozone concentration, in particular, is affected by dust in a non-monotonous way determined by the availability of ozone precursors. Finally, the anthropogenic aerosols and sea salt are two key contributing factors for near-ground condensation and fog formation in coastal areas.

Paper ID: CEST2017_01432

[11] Invited speech

Synchronous shifts in outgoing longwave radiation and their interpretation

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Abstract

Outgoing long-wave radiation (OLR) has increased substantially over the period 1979 to 2016. In time series averaged for northern and southern mid-latitudes two abrupt, synchronous and statistically significant step-like shifts (1988 and 1997/8) are shown to have occurred with only one shift in the tropics (1997). The timing of these events coincides with similar shifts recently described in a wide range of climate, Earth system and ecological time series. Surface temperature shows a very similar pattern of change to OLR in the northern mid-latitudes, but differs considerably in the southern mid-latitude belt. We demonstrate that low clouds are positively correlated with OLR and the reverse with medium and high clouds confirming that the growth in OLR can be explained via a reduction in cloud cover and atmospheric albedo.

Keywords: climate shifts, outgoing longwave radiation, troposphere, temperature, satellite measurements, clouds, albedo

Paper ID: CEST2017_00684

Estimating the biogenic non-methane hydrocarbon emissions over Attica

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Abstract

Biogenic emissions affect the urban air quality as they are ozone and SOA precursors and should be taken into account when applying photochemical pollution models. The present study presents an estimation of the magnitude of Non-Methane Volatile Organic Compounds emissions (NMVOCs) emitted by vegetation over Attica. The methodology is based on computation performed with the aid of a Geographic Information System (GIS) and theoretical equations in order to develop anemission inventory on a 6x6km^2 spatial resolution and in a temporal resolution of 1hr covering the Greater Athens Area for one year period. For this purpose, a variety of input data was used: improved satellite land-use data, land-use specific emission potentials, foliar biomass densities, temperature and solar radiation data. Hourly, daily and annual isoprene, monoterpenes and other volatile organic compounds (OVOCs) were estimated. Results delineate an annual cycle with increasing values from March to April, while maximum emissions were observed from July to August, followed by a decrease from October to December.

Keywords: Biogenic emissions, Athens, Geographic Information System (GIS).

Paper ID: CEST2017_00691

A staircase signal in the warming of the mid-20th century

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Abstract

The residual dynamics left after adjusting global surface temperature anomalies (1950-2014) for short-term variability from El Niño Southern Oscillation (ENSO) and volcanic eruptions have a staircase pattern. Linear trends for three quasi-stable periods 1950-1987, 1988-1997 and 1998-2014 are near zero with nearly all warming occurring during two step-like shifts in the years 1987/1988 and 1997/1998. We analysed several global datasets: HadCRUT v4.5 – land and sea surface temperature (SST) anomalies; ICOADS v2.5 – SST anomalies measured from ships; NCEP OI v2 – SST measured by satellite instruments; UAH MSU v5.6 and RSS MSU v3.3 – two satellite datasets measuring temperature of the lower troposphere (TLT). The ENSO signal was removed by EOF analysis, and gave comparable results for all datasets. A similar staircase behavior was found in global NCEP/NCAR reanalyses of 300mb meridional wind and outgoing longwave radiation (OLR) in northern and southern midlatitudes. These many different sources confirm the reality of the regime-shift staircase structure of recent warming, which is masked by short-term ENSO variability and the effects of volcanic eruptions.

Keywords: climate; global warming; regime shift; ENSO variability; time series analysis; decadal change

Paper ID: CEST2017_00726

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A Conceptual Model of Abrupt Shifts in the Biosphere-Climate System

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Abstract

Time series analysis of global temperature and ~70 other global and local parameters indicates the presence of abrupt shifts between stationary states. The concept of non-linear systems, which undoubtedly include the "biosphere-climate" system, makes the threshold response to gradually increasing influence factor (the increase in greenhouse gas concentrations) quite expectable. Quasi-stable regimes taking place between the shifts presume the existence of some regulation mechanism which can maintain global temperature near constant in the presence of changing externalforcing.Some authors suggest regulation of surface temperatures by clouds.Understanding the nature of such shifts and stationary regimes between them at qualitative concepts can be achieved by using conceptual small-scale models. In the paper some phenomenological extension of Lorenz-84 Model devoted to low order description of atmospheric circulation accounting possible clouds feedback was considered. It was shown the model itself is able to reduce the effect of forcing changes. Involving clouds feedback increases the resistance of the model to external disturbances.

Keywords: climate shifts, multiple equilibria in climate, staircase-like climate dynamics

Paper ID: CEST2017_01013

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Atmospheric emissions from oil and gas extraction and production in Greece

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Abstract

This paper addresses the atmospheric emissions from oil and gas extraction and production in Greece. The study was carried out in 2014 in the Kavala gulf, which currently is the only location of oil and gas production in Greece and where the exploration activities for hydrocarbons started in the late '60's. This study presents the qualitative and quantitative characteristics of atmospheric emissions, in relation also to the emissions control management system. Currently, atmospheric emissions during extraction and production of hydrocarbons in Greece are very low and do not have any significant effect on air quality and climate change. Particular reference is made to sulphur compounds, since the existence of volcanic rocks results to increased amounts of H_2S. Despite the fact that the produced gas in Prinos reservoir contains about 40% hydrogen sulfide, SO_2 emissions are very low due to the applied technology for transforming hydrogen sulfide to sulfur and the integrated emissions control management system.

Keywords: Oil and gas production, Atmospheric emissions, Greenhouse gases, Gas Flaring, H_2S

Paper ID: CEST2017_01339

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Mapping and evaluation of potential future developments of forests due to climatic changes at the national level with regard to nature protection by example of Germany

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Abstract

According to the principles of the German Strategy for Adaptation to Climate Change nature conservation programmes and instruments should take more account of the findings of climate research, including the relevant uncertainties. In this context, a method for mapping climate-induced changes of natural ecosystem types is presented. It is built on a classification system for natural and near-natural ecosystems in Germany. The modelling approach is based on Classification and Regression Trees and geographic information on climate, soil and vegetation features available with blanket coverage of Germany. This method allows users to produce nationwide maps in a coarse temporal resolution (here: 1961-1990, 1991-2010, 2011-2040, 2041-2070). It is demonstrated how the allocation of the ecosystem types to Habitats Directive Annex I habitat types can be used to estimate potential hazards for the condition of habitat types as a result of climate change.

Keywords: Climate change, ecosystem classification, Germany, monitoring data, potential natural vegetation, reference condition

Paper ID: CEST2017_00854

SO_2 Emissions Removal in a Hollow Fiber Membrane Contactor

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Abstract

SO_2 is the component of greatest concern and is used as an indicator for the larger group of gaseous sulfur oxides (SO_x) which should be reduced in the air. In this paper, DMA (Dimethylamine) solution was used as absorbent under the conditions of 0.1 L min^{-1} gas velocity, 0.1 L min^{-1} liquid velocity, and 290 K operating temperature. The effects of gas and liquid phase properties and module configuration on SO_2 absorption efficiency in the α-Al_2O_3 hollow fiber membrane contactor were investigated. Simulation results show that the changes of gas phase velocity, liquid phase velocity, concentration have great influences on the absorption efficiency of SO_2. Gas and liquid phase flow rate decreases and increases SO_2 absorption efficiency, respectively. Because gas in the membrane module stays for a longer time, more absorption time promotes the gas and liquid reaction. However, the changes of the liquid velocity and the volume fraction of SO_2 in the mixed gas are not significant to SO_2 absorption. In addition, the fluid in the turbulent state provides better SO_2 absorption efficiency than that in the laminar condition.

Keywords: SO_2 emission; air pollution; membrane; dimethylamine

Paper ID: CEST2017_00279

Oxidized forms of polycyclic aromatic hydrocarbons (Oxy-PAHs): determination in suspended particulate matter (SPM)

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Abstract

Smog is a serious problem of many cities in the world. The main component of smog is suspended particulate matter (SPM). Suspended particulate matter is defined as a solid or liquid particles as well natural (for example aerosols of sea salts) as unnatural which are mainly a contamination. SPM is classified in many ways, of which division by size of particles is best known. Two main types of SPM are distinguished: PM10 (particles with size less than 10 micrometers) and PM2.5 (particles with size less than 2.5 micrometers). The health threat caused by SPM is twofold. Dust, as an aerosol of solid particles with very small size, is a threat to the respiratory system. The second most serious threat to the health are substances adsorbed on SPM's surface. SPM is a carrier of many hazardous substances also coming from incomplete combustion of various fuels, more or less contaminated. SPM contains, between else, heavy metals and substances belonging to the broad spectrum of polycyclic aromatic hydrocarbons (PAH). Recently many studies have begun to pay attention to oxidized form of PAHs, especially nitro-PAHs, oxy-PAHs and hydroxy-PAHs, which are considered more harmful than 'original' ones. The state of the art concerning its determination in suspended particulate matter oxidized form of PAHs was the aim of presented paper.

Keywords: PAHs, nitro-PAHs, oxy-PAHs, hydroxy-PAHs, determination

Paper ID: CEST2017_01337

SESSION 29B – EMERGING POLLUTANTS (4)

Saturday 2 September 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Preliminary toxicity assessment of pharmaceutical solutions with and without ferrate treatment

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Abstract

An emerging challenge to the scientific community and water industries is water contamination by various micro-pollutants which are pharmaceuticals, personal care products and endocrine disrupting chemicals. The main sources of these micro pollutants are waste waters from industrial effluent and sewage treatment plants. Recent advances in the knowledge have raised concerns about their effects on the human health and ecosystems. In this study, the efficiency of ferrate to remove low concentration of two pharmaceuticals (Simvastatin and Ivermectin, 10 and 100 μg/L) was investigated. Moreover, Zebra fish animal model was employed to access the acute toxicity before and after treatment with ferrate. Mortality, developmental changes (hatching, heart rate, total abnormalities count) and behaviour changes (swimming and activity) were recorded at all stages. Biochemical responses of Chloramphenicol acetyltransferase (CAT), Tumor necrosis factor (TNF), Interleukin 1 (IL-1) and B-cell lymphoma 2 (Bcl-2) were assessed. The study demonstrated that expression of CAT, TNF, IL-1 and Bcl-2 genes were affected after exposing zebra fish embryos to low concentration pharmaceuticals for 5 days (120 hours post fertilization). Simvastatin significantly increased the expression of anti-oxidant gene (CAT) and decreased the expression of Immune related TNF gene and apoptosis related Bcl-2 gene. Ivermectin showed significant change of expression of CAT and Bcl-2 genes. Ferrate reduced the toxicity of pharmaceuticals by partially removing them during the treatment process.

Keywords: Ferrate, gene study, micro-pollutants, Simvastatin, Ivermectin, toxicity, waste water treatment, zebra fish

Paper ID: CEST2017_00330

Filling the gaps: resources and perspectives on the use of Nuclear Receptor based-assays to improve risk assessment of emerging contaminants

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Abstract

Biological control of key processes, such as development, reproduction, and metabolism, is largely ascribed to a superfamily of ligand-dependent and independent transcription factors named Nuclear Receptors (NRs). Given their ability to accommodate ligands, NRs are prime targets of man-made compounds that mimic or antagonise the action of endogenous ligands. Accordingly, NRs occupy a prominent role in OECD and EPA guidelines for testing and assessment of Endocrine disruptors. Numerous cases of NR-mediated endocrine disruption have been reported, mostly in vertebrates. The best-studied examples include the feminization of teleost fish by Estrogen Receptor (ER) modulators; the imposex phenomenon in gastropods associated with retinoid X receptor (RXR) agonists; and, more recently, the obesogenic effect of different classes of anthropogenic chemicals acting through the Peroxisome Proliferator Activated Receptor (PPAR) and RXR. Although NR assays are already a key instrument in the OECD Conceptual Framework for Testing and Assessment of Endocrine Disruptors, the focus is mostly on vertebrate NRs. Hence, if we aim to improve risk assessment of EDCs and emerging pollutants at an ecosystems scale, and understand their mode of action (MOA), we must establish a framework to include a broad phylogenetic sampling of Metazoans. Here, we address the chief knowledge gaps in the field and set research priorities.

Keywords: EDC, Risk Assessment, Emerging pollutant, Mode of action, Biodiversity

Paper ID: CEST2017_01057

Reactive oxygen species and nucleotide metabolism jointly contribute to HepG2 cytotoxicity induced by Tetrabromobisphenol A

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Abstract

Owing to high lipophilicity and recalcitrance, low volatility and high production, tetrabromobisphenol A (TBBPA) is used as flame retardant worldwide and have been detected in various matrices. Although TBBPA exposure can induce adverse effects on the nervous system, immune system and reproductive system, molecular mechanisms of metabolic toxicity are limited and unclear. Herein, an integrated method including molecular toxicology and mass spectrometry (MS)-based global metabolism was employed to investigate the cytotoxicity of TBBPA on reactive oxygen species (ROS), oxidation/ antioxidation balance and metabolic alterations using HepG2 cell line. Our results elucidated that TBBPA promotes oxidative damage in accordance with the anomalous variations of HepG2 metabolome. TBBPA exposure perturbed the balance statue of oxidation and antioxidation by increasing ROS, 8-oxo-2'-deoxyguanosine (8-oxo-dG) and malondialdehyde (MDA), whereas by decreasing superoxide dismutase (SOD) activity, glutathione peroxidase (GSH-Px) activity and glutathione level. More importantly, five major metabolites (guanine, guanosine, adenine, adenosine and hypoxanthine) were down-regulated significantly in nucleotide metabolism pathway following TBBPA exposure. We also, showed that metabolism plays a key role in regulation of molecular mechanisms and induction of oxidative damage of bisphenol A (BPA) analogue.

Keywords: Metabolomics, DNA oxidative damage, TBBPA, Metabolic toxicity, HepG2.

Paper ID: CEST2017_01153

Selection of coagulants for the removal of chosen micro-pollutants from drinking water

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Abstract

In order to evaluate the efficiency of PAH removal, water was modified with PAH MIX A standard solution. Benzo(a)pyrene, in the amount of 0.02 µg/L, and four recommended PAH, ie. benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, which total concentration amounted to 0.2 µg L^{-1}, were introduced into water. In order to evaluate the efficiency of PCB removal, water was modified with PCB standard mixture, composed of seven indicator congeners: 28, 52, 101, 118, 138, 153 and 180. The concentration of each congener amounted to 0.3 µg/L. With regard to heavy metals, modifications were made by introducing into water a solution containing nickel, cadmium and lead ions, providing their initial concentration in water equal to 0.2 mg L^{-1}. It was demonstrated that the use of $Al_2(SO_4)_3$ allowed to obtain better results of PCB removal from water than in case of using hydrolysed polyaluminium chlorides. The total concentration of PCB decreased by 71%. Whereas the highest efficiency of reduction of the sum of four standardized PAH in water after coagulation (by 84%) was obtained using polyaluminium chloride PAX-19F. Also in case of heavy metal ions removal, best results were obtained using PAX-19F, respectively for Ni, Cd, Pb, concentration was reduced by 21; 44; 78%.

Keywords: polycyclic aromatic hydrocarbons, polychlorinated biphenyls, coagulants, heavy metal ions, water.

Paper ID: CEST2017_00580

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of nitroimidazoles from aqueous solutions by adsorption on single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes (MWCNT)

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Abstract

This work was aimed at investigating the adsorption of metronidazole (MNZ) and dimetridazole, (DTZ) from water onto single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes (MWCNT). The MWCNTs were functionalized by attaching carboxylic groups (MWCNT-COOH) and by treating with an HNO_3 solution (MWCNT-HNO_3). The adsorption equilibrium data were obtained in a batch adsorber and were interpreted by the Freundlich, Langmuir and Radke-Prausnitz (R-P) isotherms. The R-P isotherm best fitted the experimental data since its percentage deviation was always the lowest. At T=25ºC and pH=7, the adsorption capacity of the CNTs decreased in the following order: SWCNT > MWCNT > MWCNT-HNO_3 > MWNT-COOH, and the maximum adsorption capacities of SWCNT towards MNZ and DTZ were 101 and 84 mg/g, respectively. The SWCNT had the highest adsorption capacity because SWCNT presented the largest surface area and was the only CNT with a basic surface. The basic groups activated the π-π dispersive interactions and favored the adsorption of the nitroimidazoles. The adsorption capacity of SWCNT towards MNZ increased considerably by raising the solution pH from 2 to 11, and this trend was not due to electrostatic interactions. The adsorption of both nitroimidazoles on the CNTs was predominantly due to π-π dispersive interactions.

Keywords: adsorption, nitroimidazoles, carbon nanotubes

Paper ID: CEST2017_00733

Assessment of sulfamethoxazole UV-C/H_2O_2 oxidation: Elucidation and stability of transformation products

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Abstract

In this study, the degradation of the sulfonamide antibiotic sulfamethoxazole and the formation of its transformation products (TPs) under UV-C/H2O2 oxidation were investigated in ultrapure water and in secondary treated wastewater samples. The experiments were run in a photochemical apparatus, batch type bench-scale cylindrical reaction vessel with a capacity of 600 mL and a 9 W low-pressure mercury lamp. The formation and stability of the detected TPs were examined with respect to the initial concentration of the parent compound and the oxidant. Post-acquisition suspect and non-target screening of the data, obtained by liquid chromatography quadrupole-time-of-flight mass spectrometry (LC-QTOFMS) analysis, based on accurate mass measurements, isotopic and retention time fitting and fragmentation pattern, led to the structural elucidation of TPs. The complementary use of reversed phase liquid chromatography (RPLC) and hydrophilic interaction liquid chromatography (HILIC) for the identification of polar TPs supported the identification. The TPs were mainly formed, either by the cleavage of sulfamethoxazole structure or by its hydroxylation and were tentatively identified in the treated samples. A transformation pathway of sulfamethoxazole during UV-C/H2O2 oxidation was proposed and presented. Acknowledgments This work has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 675530. Authors gratefully acknowledge Dr. Kathrin Fenner for providing access to Eawag-BBD/PPS. Disclaimer The content of this work reflects only the authors' views and the Research Executive Agency is not responsible for any use that may be made of the information it contains.

Keywords: sulfamethoxazole; transformation products; UV-C/H_2O_2 oxidation; liquid chromatography/quadrupole-time-of-flight mass spectrometry

Paper ID: CEST2017_00861

An assessment of fluoride accumulation in the air, soil, water and vegetation around brick kilns at Tarnol, Islamabad, Pakistan.

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Abstract

Fluoride has been reported as an emerging pollutant espacially around brick kilns in South Asia. The current study was conducted to determine the inorganic fluoride concentration in air, water, soil and vegetation in the vicinity of brick kilns at Tarnol, Islamabad Pakistan. All samples were tested highly positive for fluoride contents in air, soil, water and vegetation near the brick kilns as compared to sites further away. The soil leachable concentration ranged from 2.57mg/kg to 4.08mg/kg, water fluoride level ranged from 0.5mg/L to 1.85mg/L and vegetation fluoride content ranged from 48.29 mg/kg to 20.3 mg/kg. The results from the present study suggest that due to the increase in population of the capital city of Pakistan i.e. Islamabad, the brick kilns numbers will also be increased that will jeopardize the environmental condition for both plants as well as humans.

Keywords: Fluoride, Environment, Brick Kilns, Pakistan

Paper ID: CEST2017_00600

SESSION 30 – HEAVY METALS IN THE ENVIRONMENT (1)

Saturday 2 September 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Do (accumulated) metal levels reflect fresh water community structures? The use of large data

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Abstract

To investigate the effect of metals on the aquatic community level, different approaches can be used. A first approach is the application of species sensitivity distribution (SSD) curves to derive safe concentrations for single metals. From databases concentrations of metals can be derived that protect 95 % of the aquatic organisms (HC5) and compared with quality standards. However, the tested species in the existing databases are not always the most relevant species and endpoints not always the most sensitive. Another approach to investigate the relationship with community structure is to link data bases on metal levels in the environment with biological databases. This was done in the present study by coupling macro invertebrate indices with dissolved metal levels. For a set of metals threshold values could be derived and compared with quality standards. In some case, however, the derived threshold values were higher than the quality standards. This is probably because differences in bioavailability at different sites are not taken into account. Direct measurement of pollutants in biota could tackle these problems. By relating accumulated metal levels in invertebrates or fish with indices that describe the community structure, safe threshold values of accumulated metal levels could be estimated.

Keywords: metals, aquatic communities, body residues

Paper ID: CEST2017_00296

[12] **Invited speech**

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Candidate method identification for heavy metal detection and quantification in water using optochemical strategies

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Abstract

The aim of this research is to identify and assess candidate colorimetric methods for arsenic detection in water. Preliminary assessment of a method's performance was carried out using UV-vis spectroscopy. The method is based on determination of arsenic (III) with potassium iodate in acid medium to liberate iodine, which oxidizes leucomalachite green to malachite green. The samples were analysed at 617 nm. A rapid colour change from colourless to green was observed after the addition of the dye. Beer's law was obeyed in the range of 0.02 – 4 µg mL^{-1}. The detection limit and quantitation limit were found to be 0.139 and 0.466 µg mL^{-1}, respectively. The optimum reaction conditions and other analytical parameters were evaluated. The method's suitability for incorporation into microfluidic detection systems was assessed. Method's performance at low temperatures, small volume, and different reagent ratio effect was evaluated.

Keywords: arsenic, colorimetric detection, spectrometry

Paper ID: CEST2017_00220

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analytical method development for arsenic monitoring in natural waters based on a polymer inclusion membrane system

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Abstract

A simple detection method for As inorganic species contained in natural waters is described based on the use of a polymer inclusion membrane (PIM) system. The membrane is made of a polymer (cellulose triacetate or polyvinyl chloride) and the ionic liquid Aliquat 336 (A336) as a carrier and it is placed in a special device to allow the transport of As from natural water (at μg L^{-1} levels) to a 2 M NaCl solution. The preconcentration is possible due to the different volume ratio between feed and stripping solutions. Parameters related to PIM composition, effect of volumes, and transport kinetics, among others, has been studied. Finally, the method has successfully been applied to the analysis of different natural waters.

Keywords: Arsenic, polymer inclusion membranes, monitoring, natural waters.

Paper ID: CEST2017_00916

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Use of two different approaches to the synthesis of nano zero valent iron for sediment remediation

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Abstract

Heavy metals are one of the main pollutants of river sediments. Stabilization technology proved to be an effective method for solving this problem. Stabilization covers a wide range of remediation techniques that are used to transform waste into forms that will be less problematic for the environment. Stabilization of Great Backi Canal sediment was carried out using nanomaterials, namely nano zero valent iron. Two different approaches for the synthesis of nanomaterials were used, conventional and so-called "green" method. For conventional borohydride method, nZVI was stabilized with native clay as porous material which proved to be very effective because of its specific surface area. For green method oak leaves extract was used, which contains polyphenols and has increased antioxidant capacity representing promising agents for the nZVI synthesis. Assessment of the treatment efficiency was performed using semi-dynamic leaching test ANS 16.1. These results showed that metals were successfully immobilized in the sediment.

Keywords: heavy metals, nZVI, sediment, stabilization

Paper ID: CEST2017_00984

Assessment of Cd and Pb bioavailability in sediments in Phuket Bay, Thailand

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Abstract

Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing concern due to their accumulation and their persistence in the environment that can potentially pose a risk to the ecosystems and human health. The behavior of metals in sediments reflects the historical deposition, sources of contaminants, and information on the impact of human activities on the coastal ecosystem. The transportation of metals is depending mainly on the metal speciation. Therefore, bioavailable fraction is of the interest in this study. The objectives of this study are: i) to determine the pollution levels and the distribution of the selected metals (Cd and Pb) in sediments at the Phuket Bay, Phuket province; ii) to examine the relative bioavailability of heavy metals (Cd and Pb) in the sediments. The spatial distribution of selected heavy metals (Cd and Pb) in the sediments was evaluated for heavy metal contamination. The sediment samples was analyzed using *aqua regia* digestion according to the Standard US EPA Method 3052 (1996) and the first step of BCR sequential extraction proposed by the Standards, Measurements and Testing programme of the European Union (SM&T) to determine the total and bioavailability of Cd and Pb in sediments. The results showed Cd formed a weak complex and easily removed at the initial stages of the extraction accounted for up to 27.8% of the total metal concentration (10.6-53.5 mg kg^{-1}) and up to 11.7% for Pb (8.55-18.1 mg kg^{-1}), respectively. However, the estimate metal levels in the sediments of this study were found relatively lower than other reported studies at other location in Phuket Province and below the Sediment Quality Guidelines of Threshold Effects Concentration (TEC) and Thai soil quality standard for other purposes.

Keywords: Bioavailability, Cadmium, Lead, Phuket, Sediment

Paper ID: CEST2017_00197

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of toxic metals mobility in water-sediment environment of the Lambro Creek, Italy

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Abstract

Metals enter streams through a variety of natural and anthropogenic sources. Source of pollution, localized or diffused, may alter the values of physiochemical parameters, which effect the mobility of metals in an aquatic environment. This paper evaluates the impact of local wastewater treatment plant (WWTP) discharge, as well as diffuse sources of pollution on metals behavior in water, sediment and biota of the Lambro creek, Salerno Province, Southern Italy. Water, sediment and biotic samples were collected in different sites of the creek, during two different periods of the year. Together with the most common physicochemical parameters (pH, conductivity, dissolved oxygen, COD, NO_3-N, etc.), the concentration of potentially toxic metals (Cu, Zn, Pb, Cr and Ni) in different geochemical fractions of sediment and accumulation in biotic tissues were measured. The results showed that the creek was not polluted by metals dominant in urban streams (Cu, Zn and Pb) compared to sediment quality guidelines (SQG) values. The availability of metals in most readily available fraction was found in order of Zn>Cr>Ni>Pb>Cu. Likewise, the distribution coefficient (K_d) values showed the preference of Cu and Cr to bind with sediments while, for Pb and Zn, it indicated the preference to occur in dissolved form.

Keywords: sediment, pollution, metals, mobility, biota

Paper ID: CEST2017_00799

Geospatial mapping, source identification and human health risk assessment of heavy metals in soils of Gyumri (Armenia)

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Abstract

Gyumri was destroyed by a devastating earthquake in 1988. Today the city is in the reconstruction stage, and noticeable traces of earthquake are a significant pollution source of the urban environment by heavy metals (HM). To assess HM pollution levels, to identify their possible sources and evaluate the potential impact to human health soils survey of Gyumri was done. Totally, 443 soil samples were collected, and the contents Fe, Ti, Mn, Co, Cu, As, Zn, Hg, Pb, Cd, Ag, Ba, and Mo have been determined by X-ray fluorescence spectrometry (Olympus Innov-X-5000 (USA)). Geospatial mapping and multivariate geostatistical analysis showed that there exist a significant spatial correlation between pollution sources and hot spots of studied elements. According to the Principal component analysis, four groups were generated explaining 73.4% of the total variance. PC1 including Cu, Zn, Ba, Pb and Mo, PC3: Ag and Cd, and PC4: Cu, Co and As were identified as an anthropogenic group. Risk assessment showed that observed contents of HM pose a non-carcinogenic risk to children health. The riskiest element was Pb which HI>1 in 1.6% of city territory. The results of this study highlight the need for further medico-ecological investigations and development of risk reduction measures.

Keywords: Heavy metals, urban soils, pollution, mapping, geostatistical analysis

Paper ID: CEST2017_00489

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Preliminary analysis of the environmental effects deriving from the application of aerobically stabilized waste on soil

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Abstract

The aim of this work is to evaluate and compare the environmental effects deriving from application on soil of two different types of aerobically stabilized waste. Namely, here we investigate the environmental behavior of a waste produced by aerobic bio-stabilization of mechanically selected municipal waste at a Mechanical–Biological Treatment (MBT) plant and compost produced from an aerobic composting process and from a combination of anaerobic and aerobic bio-degradation processes. After a preliminary characterization of the materials (organic matter content, volatile solids, and heavy metals content), the heavy metal accumulation in soil, caused by long-term application of the organic wastes, was evaluated by implementing a discretized mass balance based on the total content of heavy metals in the solid matrix. In addiction, the results of percolation column tests performed on these materials were used to evaluate the potential impact for the groundwater resource. Results highlight a worst environmental behavior for the MBT wastes in terms of both accumulation in soil and impacts on groundwater.

Keywords: aerobic stabilization, MBT waste, compost, metal accumulation, leaching behavior

Paper ID: CEST2017_00779

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Environmental quality of an urban stream. The case of Pikrodafni stream in Athens

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Abstract

The stream of Pikrodafni, at the SW part of Attica, is a perennial stream with length of 9300m that springs from Hymettus mountain, and its estuary is at the Saronikos Gulf. Pikrodafni flows through urban areas and is affected by various anthropogenic activities.For the evaluation of the environmental quality of the stream water and its influence on the marine environment, water samples were collected from nine sampling sites, every two months, during the period 2012-13. The main physico-chemical parameters of the water were measured in situ whereas the concentrations of major ions, nutrients, heavy metals and organic carbon were determined in the laboratory. Microbiological analyses were also performed.The concentrations of nutrients were high at all sampling sites and sampling periods and their values increased downstream causing nutrient enrichment in the coastal environment. The stream water quality was found to be moderate to bad regarding the studied nutrients.Heavy metals values didn't exceed the permitted legal limits, but the percentage of Cr(VI) was high. With few exceptions, metals in the streamwater were found mainly in dissolved forms.The results from the microbiological analyses indicated that there were high concentrations of pathogenic microorganisms in the water of the stream and decreasing outside the mouth of the stream. At all sampling sites the water had bad quality with regards to the microbiological parameters.

Keywords: nutrients, heavy metals, microbial contamination

Paper ID: CEST2017_00386

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Integrative evaluation of heavy metals concentrations in atmospheric deposition and biomonitors

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Abstract

This paper aims at evaluating heavy metals (HM) concentrations in modelled atmospheric deposition and biomonitors. The model LOTOS-EUROS (LE) yielded data on HM deposition at a spatial resolution of 25 km by 25 km throughout Europe. The European Monitoring and Evaluation Programme (EMEP) provided model calculations on 50 km by 50 km grids. Corresponding data on HM concentration in moss, leaves, needles and soil were derived from the European Moss Survey (EMS), the German Environmental Specimen Bank (ESB) and the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). The modelled HM deposition and respective concentrations in moss (EMS), leaves and needles (ESB, ICP Forests) and soil (ICP Forests) were investigated for their statistical relationships. Regression equations were applied on geostatistical surface estimations of HM concentration in moss and then the residuals were interpolated by use of Kriging interpolation. Both maps were summed up to a map of cadmium (Cd) and lead (Pb) deposition across Germany. Biomonitoring data were stronger correlated to LE than to EMEP. For HM concentrations in moss, highest correlations were found between geostatistical surface estimations of HM concentration in moss and deposition (LE).

Keywords: Deposition modelling; EMEP; Environmental Specimen Bank; European Moss Survey; ICP Forests; LOTOS-EUROS.

Paper ID: CEST2017_00878

Arsenic accumulation in Chlamydomonas reinhardtii cells grown in As-contaminated media

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Abstract

To gain a better insight into the metallome of a biological organism it is important to quantitatively determine metals and/or metalloids in individual cells, the basic biological units of all living organisms. This is needed because biological populations are heterogeneous, so knowledge of the metal distribution in a cell population can complement the average metal concentration. Single-Cell (SC) analysis by means of single-particle inductively coupled plasma mass spectrometry (SP ICP-MS) is in the position to reveal the metal distribution in a cell population. In this work, *Chlamydomonas reinhadtii*, a model unicellular photosynthetic alga, was grown in media polluted with four different arsenic salts, at several non-lethal concentration levels. Growth curves were constructed and the effects of As pollution on the growth rate of the cells were examined. The As and Ca content of individual *Chlamydomonas reinhardtii* cells were quantitated through the use of SC ICP-MS. Comparisons are being made between cell suspensions incubated in different As salts.

Keywords: Chlamydomonas reinhardtii, arsenic, heavy metal pollution, single-cell-ICP-MS

Paper ID: CEST2017_01408

Ulva australis as a tool for monitoring zinc in the Derwent Estuary and implications for environmental assessment

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Abstract

This study investigated temporal and spatial patterns of zinc content in *Ulva australis*. Samples were collected from the Derwent Estuary, Tasmania, Australia, between 2013-2015, at locations where zinc levels were elevated in both sediments and seawater historically. Zinc content was high (~321 $mg \cdot kg^{-1}$) in *U. australis* at all sampling times, with levels consistent with the spatial distribution of metal within the system. Zinc in *Ulva* varied seasonally (5 – 321 $mg \cdot kg^{-1}$) and was highest in the middle-upper estuary, where seawater concentrations were highest, attributed to a nearby zinc smelter. The results suggest that spatial variation of zinc content in *Ulva* reflects the variability in the seawater, which in turn indicates that *U. australis* could be used for monitoring the effects of zinc in estuarine systems more broadly, and that *U. australis* could be a useful addition to existing management strategies in the Derwent and elsewhere.

Key words: Biological indicators, Contamination, Macroalgae, Seasonal variability, Monitoring.

Paper ID: CEST2017_01268

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Copper uptake by *Chrysopogon zizanioides* (L.) Roberty from aqueous solution: Effects of different factors and kinetic study

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Abstract

The high biomass, extensive root network, and fast growth of vetiver grass [*Chrysopogon zizanioides* (L.) Roberty] make it a good candidate for the treatment of heavy metal-polluted soil and water. For this reason, the influence of copper (Cu) concentration, iron (Fe) concentration, and presence of citric acid (CA) as chelating agent on the Cu accumulation in the roots and shoots of vetiver grass were investigated using a 2^3 factorial design. Moreover, Michaelis-Menten equation was utilised to describe the uptake of Cu after 24 hours. Vetiver grass was grown hydroponically using half-strength Hoagland solution adjusted to pH 4 and different conditions for the factorial experiment or varying Cu concentration for the kinetic experiment. Results indicate that the effects of Cu concentration on the Cu uptake of both roots and shoots were highly significant as determined by ANOVA. Meanwhile, there were significant interactions of Cu and Fe concentrations, Cu and presence of CA, and Fe concentrations and presence of CA on root Cu uptake only. For the kinetic study, the Michaelis-Menten equation was found adequate implying a saturable transport system. The calculated Michaelis-Menten constant, K_m, and maximum solute uptake influx, were V_{max}, 24.39 mg L^- and 272.21 mg kg FW^- day^-, respectively.

Keywords: copper, vetiver grass, uptake kinetics, wastewate

Paper ID: CEST2017_00363

The effects of citric acid and varying concentrations of copper and iron on the phytoextraction of copper from aqueous solution by vetiver grass

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Portion of the M.S. thesis of the first author at the Environmental Engineering Program, College of Engineering, University of the Philippines Diliman, Quezon City 1101, Philippines

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Abstract

The effects of the presence of citric acid as chelating agent and varying concentrations of copper and iron on the phytoextraction of copper from aqueous solution by vetiver grass were investigated in a full factorial design. Vetiver slips were allowed to acclimatize in a half-strength Hoagland's Nutrient Solution for 14 days prior to the 7-day hydroponic study where the plants were exposed to different treatments. Plants were harvested, separated into roots and shoots, and prepared for Atomic Absorption Spectrometry analysis. Three-way analysis of variance was used to determine which factors significantly affect biomass change, total copper uptake, and translocation factor. Vetiver grass grown in solutions with citric acid significantly alleviated copper phytotoxicity symptoms resulting to lower decrease in biomass than those plants grown without the chelating agent. Higher copper concentration in solution led to higher total copper uptake, while higher iron concentration in solution significantly decreased copper translocation factors in vetiver grass. Average copper translocation factors were less than 1, i.e., more copper was accumulated in roots than in shoots.

Keywords: Phytoextraction; Vetiver Grass; Copper; Iron; Citric Acid

Paper ID: CEST2017_00526

Influence of citric acid on the uptake, bioconcentration and translocation factors of copper in Chrysopogon zizanioides (L.) Roberty

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Abstract

Phytoremediation is a cost-effective technology in remediating and stabilizing soil, as well as reducing and removing contaminants in surface waters and wastewaters. *Chrysopogon zizanioides* (L.) Roberty (vetiver grass) can tolerate high amount of heavy metals especially in its roots. Hence, the effect of citric acid (CA) as chelating agent on the uptake of copper by vetiver grass was investigated. Vetiver slips were grown in soil for four weeks, harvested and acclimatized for two weeks. The plants were then grown in half-strength Hoagland's nutrient solution with 50 mg L^{-1} copper at pH 4.0 for 3, 7 and 14 days. One treatment contained 5 mmol CA. Uptake, bioconcentration and translocation factors were determined. Bioaccumulation factors for the treatment with and without CA were 10.85 and 28.87, respectively. Translocation factor was not significantly enhanced by the addition of CA. A maximum concentration of 1,443.33 mg Cu kg^{-1} DW was detected in vetiver grown in solution without CA but an insignificant increase in Cu uptake after day 14 was observed. Addition of 5 mmol CA showed no significant difference in Cu uptake. The added CA concentration was not enough to have a significant change in the uptake, bioconcentration and translocation of copper in vetiver.

Keywords: phytoremediation, vetiver grass, copper uptake, bioconcentration, translocation

Paper ID: CEST2017_00434

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Grapevine accumulation of potentially toxic elements from soil: Health risk and implication assessment

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Abstract

This study was performed in a commercial vineyard. Topsoil (0 – 30 cm) and two grapevine species (*Cabernet sauvignon* and *Sauvignon blanc*) samples were collected. The concentrations of Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Na, Ni, P, Pb, S, Sr, V, Zn were determined. Bioavailabilable elements from soil were established applying single extraction methods (CH_3COOH, Na_2EDTA, $CaCl_2$, NH_4NO_3 and deionised water) and pseudo-total digestion. The accumulation of potentially toxic elements in leaves, seed, pulp, and skin of the grapevine was assessed. Health risk for farmers and hazardous index for grape consumers were estimated. The most suitable extractants for isolating concentrations of Ni and Sr bioavailable for leaf were $CaCl_2$ and NH_4NO_3. The concentrations of Cu and Ni bioavailable for seed were extracted by deionised water – 2 h extraction. The most suitable extractant for isolating bioavailable Sr and Zn for skin was Na_2EDTA; for Ni and Sr it was $CaCl_2$; for Fe and V it was deionised water – 16 h extraction. Health risk assessment showed noncarcinogenic risk for farmer's exposure to the soil, and slightly carcinogenic risk was indicated. The hazardous index showed that both grapevine species were safe for consumption.

Keywords: trace elements, bioavailability, single extractions, pseudo-total digestion, (non)carcinogenic risk

Paper ID: CEST2017_00469

Removal of cadmium from airport derived stormwater by disulfide-polymer particles surface embedded on alginate beads

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Abstract

Stormwater runoff water derived from airport areas gives severe cadmium contamination. To remove cadmium from the irregular amount of runoff water, a new sorbent material was introduced. Size-tunable alginate bead were successfully created with surface embedded high cadmium affinity disulfide-polymer particles (DiS-Alginate) suitable for high flow stormwater filters. Sorption and kinetic test were conducted at different concentrations of cadmium and compared with activated carbon. DiS-Alginate exhibited a maximum sorption capacity of 22.3 mg/g and almost 5 times higher sorption affinity than activated carbon. Moreover, the DiS-Alginate sorption mechanism was proven to be chemisorption that indicates rapid sorption kinetics. Therefore, DiS-Alginate appears to be a superior sorbent material for removing cadmium from airport stormwater.

Keywords: Airport runoff, disulfide-polymer, alginate beads, cadmium removal, column filling materials.

Paper ID: CEST2017_01169

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SESSION 31 – HYDROLOGY AND WATER RESOURCES MANAGEMENT (1)

Saturday 2 September 2017 - morning

LafargeHolcim approach to measuring positive impact on water management

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Abstract

LafargeHolcim launched its sustainable development strategy, The 2030 Plan, in 2016 with one overarching objective – generate one third of net sales from more sustainable products and solutions. The plan is anchored on 4 key pillars: climate, circular economy, water and nature, and quality of life of communities and employees.

LafargeHolcim commitment on Water comprises two parts: 1) To improve water efficiency by 30% in cement by 2030; and 2) To achieve positive water index in water-scarce areas where LafargeHolcim operates by 2030. The latter aims to create a more efficient, equitable, and sustainable water resources management in water-stressed areas by "returning back more water to the community and nature than LafargeHolcim consumes" and promote a sustainable use of water resources, through community and watershed projects.

A "water scarce" area is determined by employing the World Business Council for Sustainable Development (WBCSD) Global Water Tool: any area with an annual total renewable supply per person of less than 1,000 cubic meters is classified as water scarce. Using a methodology reviewed by the Swiss Development Agency, the Positive Water Index for each site will be assessed through a Water Credit/ Water Debit approach. This approach will consider both quantitative and qualitative dimensions. Building on previous experiences, different categories of projects enhancing water sustainability will be deployed. These include:

1. watershed protection and restoration: recharge of natural water sources; construction of check dams to intercept run-offs; and reforestation
2. water access and sanitation: improvement of access to safe water through well; construction and development of sanitation solutions
3. water for productive use: use of treated wastewater for water-efficient irrigation and agricultural practices

The LafargeHolcim WPIM methodology was successfully piloted on two projects, including groundwater recharge and efficient agriculture by Ambuja Cement Ltd, in India.

Paper ID: CEST2017_01441

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A peaks over threshold approach for hydrological drought severity assessment

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Abstract

Information on hydrological drought characteristics is very important for the design and operation of hydrotechnical projects (e.g. water reservoirs, water transfer works etc.). In this study, streamflow drought characteristics of the river at Yermasoyia catchment, Cyprus, were analyzed based on 30 year daily runoff data, using the threshold level method. Fixed and variable thresholds (seasonal, monthly and daily) were employed for this purpose. The 50th percentile values of the flow duration curve were used as suitable thresholds for the semi-arid catchment of the study area. Drought severities, as estimated by the four thresholds, were used to perform statistical frequency analysis in order to estimate appropriate design levels and derive Severity-Duration-Frequency (SDF) curves. Peaks-Over-Threshold analysis (POT) was used for this purpose and the application showed that monthly and daily varying thresholds have similar patterns estimating more severe drought events as the return period increases. The other two thresholds are not able to incorporate the effect of drought duration appropriately; therefore, the estimated severities are lower and the return period has almost no effect.

Keywords: Streamflow droughts, Threshold level method, Peaks over threshold, Severity-Duration-Frequency curves, Cyprus

Paper ID: CEST2017_01364

The PEARL-toolbox: supporting the decision making process in selecting flood resilience strategies

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Abstract

Dilemmas of a what/if nature is a common challenge affecting decision makers that are responsible for managing socio-technical systems of increased complexity. In order for the scientific community to answer questions about the effects of decisions, it has to address issues of defining levels of acceptable risk and safety under uncertainty. And even when the scientific community has answers regarding the outcome of the decisions, transferring this knowledge is challenging requiring a lot of effort and resources in order to support the decision makers, in a simple and yet informative way. This research is focused on the work carried out for assisting decision makers involved in flood risk management. In this regard, a methodology supported by a toolbox was developed guiding the decision makers along the selection of suitable flood resilience strategies and measures. The toolbox includes a library of optimisation and multi-criteria decision analysis algorithms that identify optimal flood mitigation strategies, as well as an agent based model that allows the exploration of the response of the system, under different extreme flood event scenarios, socio-economic conditions and flood resilience strategies. In this work, the toolbox and its user friendly online interface are presented, developed to allow decision makers to use the proposed tools thus transferring actual scientific knowledge to the involved parties.

Keywords: decision support system, agent based modelling, flood resilience strategies, optimisation and MCDA algorithms, science-policy interface

Paper ID: CEST2017_00571

Comparison of 1D-1D and 1D-2D urban flood models

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Abstract

The present study aims to compare two different modelling approaches in the assessment of urban flooding. A real case study is used, which is a small urban catchment located in the center of Athens, Greece (Ano Patisia, Kypseli). In the first modelling approach (1D-1D), the combined sewer system and the surface system are coupled using the Storm Water Management Model (SWMM), which simulates flow both in the storm sewer system and on the surface (streets). SWMM solves the 1D Shallow Water Equations (1D-SWE) in both sewer and surface systems as a set of links and nodes. In the second modelling approach (1D-2D), the surface and sewer system are coupled using MIKE URBAN and MIKE FLOOD. The coupled model solves the 2D-SWE in the surface system and the 1D-SWE in the sewer system. The results show the importance of considering the interaction of sewer and surface system when modelling urban drainage networks. The 1D-2D coupled models can be a very useful tool in simulating flood extent and flood inundation in urban areas. The comparison provides an insight into the limitations of 1D-1D models in simulating flood extent and flood inundation, problems that can be overcome by using 1D-2D coupled models.

Keywords: Urban flooding, 1D-1D model, 1D-2D model, SWMM, MIKE URBAN-MIKE FLOOD

Paper ID: CEST2017_00708

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Stochastic simulation of periodic processes with arbitrary marginal distributions

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Abstract

Stochastic simulation of hydrological processes has a key role in water resources planning and management due to its ability to incorporate hydrological uncertainty within decision-making. Due to seasonality, the statistical characteristics of such processes are considered periodic functions, thus implying the use of cyclo-stationary stochastic models, typically using a common statistical distribution. Yet, this may not be representative of the statistical structure of such processes across all seasons. In this context, we introduce a novel model suitable for the simulation of periodic processes with arbitrary marginal distributions, called Stochastic Periodic AutoRegressive To Anything (SPARTA). Apart from capturing the periodic correlation structure of the underlying processes, its major advantages are a) the accurate preservation of seasonally-varying marginal distributions; b) the explicit generation of non-negative values; and c) the parsimonious model structure. Finally, the performance of the model is demonstrated through a theoretical (artificial) case study.

Keywords: Stochastic simulation, periodic processes, hydrological processes, arbitrary marginal distributions

Paper ID: CEST2017_00797

Phytoplankton Composition and Water Quality of Kamil Abduş Lagoon (Tuzla Lake), Istanbul-Turkey

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Abstract

In this study, water quality and pollution status of Kamil Abduş Lagoon (Tuzla Lake), which is one of the special lagoons of Istanbul Metropolitan, were analyzed. For this purpose, phytoplankton composition, some physicochemical parameters and nutrient concentrations of the lake were investigated. Samples were collected at 3 sampling sites between February 2016 and January 2017. A total of 31 taxa, belonging to Bacillariophyta (12), Charophyta (1), Chlorophyta (4), Cryptophyta (1), Cyanobacteria (4), Euglenozoa (5) and Miozoa (4) were identified. Both of freshwater and marine species were recorded in the study area. The presence of mesotrophic and eutrophic species of phytoplankton indicated that the trophic structure of the lake is eutrophic. Also it is supported by high concentrations of chlorophyll-*a* and nutrients. Due to the lagoon is under treat by pollution it is need to be urgently protected.

Keywords: Phytoplankton, water pollution, physicochemical parameters, nutrients, Kamil Abduş Lagoon.

Paper ID: CEST2017_00823

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Artificial low stream flow time series generation of Palaia Kavala Stream, Kavala City, NE Greece

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Abstract

The present study generates synthetic low stream flow time series of an entire calendar year considering the stream flow data recorded during two certain interval periods of the years 2016 and 2017. We examined the goodness of fit tests of six theoretical probability distributions to low stream flow data acquired at the exit of the Perigiali stream, Kavala city, NE Greece watershed, during part of May, June, July, part of August, part of December 2016 and part of January 2017, using either a combination of a 3-inches U.S.G.S. modified portable Parshall flume in conjunction with a 3-inches Montana portable flume and a combination of a 3-inches conventional portable Parshall flume in conjunction with a 3-inches Montana portable flume and calculated the corresponding probability distributions parameters. The six specific probability distributions used in this study were the following: (1) Gumbel min (Minimum Extreme Value Type 1) distribution, (2) 3-Parameter Log-Normal distribution, (3) Pearson Type 5 distribution, (4) Pearson Type 6 distribution, (5) Two-Parameter Weibull distribution, (6) Kumaraswamy distribution and (7) Wakeby distribution. The Kolmogorov-Smirnov, Anderson-Darling and Chi-Squared, GOF tests were employed to show how well the probability distributions fitted the recorded data and the results were demonstrated through interactive tables providing us the ability to effectively decide which model best fits the observed data.

Keywords: time series, discrepancy ratio, goodness-of-fit tests low flow data, conventional and modified Parshall flumes

Paper ID: CEST2017_00842

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Hydrologic issues in demarcation studies of watercourses in Greece

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Abstract

In this work various hydrologic issues related to demarcation studies of watercourses in Greece, currently conducted according to law 4258/2014, are discussed. Detailed specifications were published in February 2017. The demarcation lines have to surround the flooding area, the existing banks and any technical works associated with the watercourse. According to the new law, demarcation lines have to be defined for conditions with and without regulation works. This presents particular problems in inhabited areas and relates also to the flood risk assessment required by the 2007/60/EU Floods Directive. The Special Secretariat for Water, Ministry of the Environment and Energy, is responsible for the implementation of the Floods Directive. Within this framework the Secretariat published (2016) idf relations for all areas of Greece, a significant step for hydrology studies. Determining peak flows for ungaged areas is difficult and involves high uncertainty. Although, advanced computer capabilities are used for detailed hydrologic modeling, a substantial revision of flood engineering procedures is required, as many of the empirical relations used are based on limited field data developed decades ago. Additional guidelines and specifications for hydraulic computations, especially for the case "without works" and legal framework are also needed.

Keywords: demarcation, flood, ungaged areas, flood directive, Greece

Paper ID: CEST2017_00869

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Uranium in groundwater and environmental impact in arid climate

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Abstract

Data on radionuclides concentration in groundwater are essential for both quality assurance and better understanding of recharge sources. In the investigation presented here, results of ^{238}U and ^{235}U analysis in groundwater across some parts of the United Arab Emirates (UAE) are discussed. The data are evaluated with respect to distribution in different aquifers, sources and effect of climate conditions. The data indicate a wide range of concentration (^{235}U= (0.12–508) ng L^{-1} and ^{238}U (26–69237) ng L^{-1}), but most of the groundwater samples have values below the permissible limit set by the WHO for drinking-water. Carbonate rock aquifers contain the highest concentration of radionuclides concentration, whereas clastic aquifers show the lowest values. Sources of the radionuclides in the groundwater are mainly attributed to natural interaction of groundwater within the rocks and sediments, but anthropogenic addition, particularly from use of fertilizers may also be a secondary source. The arid climate of the UAE may have enhanced accumulation of the isotopes in the aquifers due to limited water recharge.

Keywords: Uranium-238, Uranium-235, aquifer, arid region, United Arab Emirates.

Paper ID: CEST2017_01259

The water-land-food-energy-climate Nexus for a resource efficient Europe

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Abstract

A novel methodology for addressing policy inconsistencies and knowledge gaps that hinder the transition to a greater resource efficiency Europe is proposed. We focus on the integration of all different sectors that interact and influence each other, namely the "water- energy- food- land use- climate nexus" and we develop tools for identifying and quantifying their complex interlinkages under the influence of climate change. In order to achieve this, we employ a series of sophisticated models (referred to as "thematic models"), each of which addresses a different nexus dimension, or a combination of a few, while none addresses all nexus dimensions in an integrative manner. We use dynamic systems modeling and other complexity science techniques in order to "merge" different thematic model outputs in a single coherent result, which is presented to the user in an easy-to-comprehend Serious Game environment. This way, the effect of policies that are designed to affect one field (nexus dimension) on others can be quantified and simulated, thus informing policy-makers for the unintended consequences of their policies, reducing uncertainties, covering knowledge gaps and leading to a resource efficient Europe faster.

Keywords: Policy Instruments, Nexus, Serious Game, Climate Change, Governance

Paper ID: CEST2017_00768

Spatiotemporal river water physicochemical profile and pollution hazard mapping in the wider area of Spercheios River catchment (Central Greece)

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Abstract

Human induced activities impose significant pollution threats in river catchments worldwide. The Spercheios river outflows in the Maliakos Gulf and is located at Central Greece and protected under the Natura 2000 European network. The catchment land uses comprise mainly intensive agricultural areas with significant pollution pressures from fertilizers, small factories and domestic wastewater. This study aims to identify and evaluate the impacts of land uses and human activities on the water quality of the river by spatially monitoring the fluctuations of physicochemical properties along the river. Physicochemical data from 10/2014 up to 07/2016 - acquired from three automatic-telemetric monitoring stations in Alamana (natural riverbed), Anthili (artificial riverbed) and Ipati (main river branch) - and chemical data from sampling stations adjacent to the telemetric, were used. Physicochemical data were statistically analysed in hourly, seasonal and annual basis, chemical data were used to evaluate the water physicochemical status of the stations and subsequently all of them were related to the pollution hazard/pressure map of the Spercheios catchment. The results revealed the significant effects of human pressures in the river water quality, especially downstream, and the outputs have been used to propose best practices for the integrated management of the Spercheios river catchment.

Keywords: Spercheios river, physico-chemical properties, catchment, hazard map

Paper ID: CEST2017_00260

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Seasonal hydrological forecasting in Europe: Analysis of skill and its key driving factors

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Abstract

Recent advances in understanding and forecasting of climate have led into skillful meteorological predictions, which can consequently increase the confidence of hydrological prognosis. There is currently a need to understand the large European river systems and make practical use of seasonal hydrological forecasts. Here, we analyze the seasonal predictive skill along Europe's hydro-climatic gradient using the pan-European E-HYPE multi-basin hydrological model. Both model state initialization and provision of climatology are based on forcing input derived from the WFDEI product. An ensemble of re-forecast forcing data (daily mean precipitation and temperature) from ECMWF System 4 are firstly bias corrected using a modified version of the DBS method, and further used to drive E-HYPE. The predictive skill of streamflow based on ECMWF and climatology for the European basins is assessed on monthly timescales. Seasonal re-forecasts are evaluated geographically and temporally with respect to their accuracy against perfect forecasts of streamflow. We analyze the skill across 35408 subbasins, which represent various climatologies, soil-types, land uses, altitudes and basin scales within Europe. We finally use the Classification and Regression Trees analysis to link the gain in the seasonal skill to physiographic-hydro-climatic characteristics and meteorological skill, in order to suggest possible improvements.

Keywords: Seasonal hydrological forecasting, E-HYPE, ensemble forecasts, pan-European scale

Paper ID: CEST2017_00308

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Snowmelt runoff modelling of an Himalayan sub-tributary of the Ganges River in India: Comparison of modelling approaches

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Abstract

Modelling of snowmelt runoff at the catchment scale is important for water resources management and flood protection. Mathematical representations of basin response to precipitation and snowmelt still remain a major challenge to hydrological research. Here, two models (SRM & ANN) are applied and compared for snowmelt runoff simulation of the Sharda river basin, which is a large (15280 km^2) trans-boundary central Himalayan River basin located within the Ganges River basin with 34% of its area being in Nepal. Observed data of daily precipitation, temperature and discharge as well as daily precipitation data from the WATCH dataset for the upper reaches of the catchment are used for model simulation. Snow cover data are derived from the MODIS dataset. Results show that the ANN technique outperforms conceptual modelling (SRM); however, due to the former's black-box nature, ANNs are useful only for short-term forecasting despite their high simulation accuracy. On the other hand, the conceptual models (SRM) even with lower accuracies than ANN are suitable for impact studies of environmental changes (landuse, climate etc.) as well reservoir operating policies.

Keywords: Hydrological modelling, Mountainous basins, Snow melt, MODIS, India

Paper ID: CEST2017_00841

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Head losses induced by filter cartridges in drinking water networks

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Abstract

In the framework of liquid treatment processes, with the aim of ensuring public health security for drinking water or to prevent economic damage, when safeguarding important production processes, major investments have been devoted to research, study and design of innovative products able to respond to market demands, that offer nowadays several solutions. The present work focuses, specifically, on the filtration of drinking water with filter cartridge systems, with the aim to investigate the effect of their introduction into a hydraulic system in terms of head losses. The problem is particularly important when the cartridge is installed in hydraulic plants characterized by low pressures, in which its insertion can make the pressure levels fall below the minimum limit recommended to ensure the smooth operation of domestic devices. Specifically, the behavior of seven different commercial filter cartridges was analyzed through an experimental analysis conducted in a pilot circuit at the Laboratory of Environmental and Maritime Hydraulics (LIDAM), University of Salerno. Experiments have been performed here in different operating conditions, detecting pressure data in different points through piezometric gauges. The analysis provided some information useful in the choice of the proper cartridge in low-pressure distribution systems.

Keywords: drinking water networks, filter cartridges, head losses, laboratory experiments

Paper ID: CEST2017_00576

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Statistical Comparison of nonlinear rainfall-runoff models for simulation in Africa North-West semi-arid areas

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Abstract

Determining the relationship between rainfall and runoff for a watershed is one of the most important problems and challenging task faced by hydrologists and engineers. Conceptual hydrological models represent most suitable tools for this purpose in case of data scarcity. In this work we set up a comparative study between two conceptual nonlinear models, the GR2M and the ABCD, applied to semi-arid catchments located in north-west of Algeria. Monthly rainfall, temperature and stream flow data are available for the period 1971-2010. Overall, in calibration, the two models perform similarly, whereas the results show that the GR2M model performed better than the ABCD in the validation phase. Such circumstance could be caused by different motivations. On one side the different number of model parameters that make the ABCD the less parsimonious approach, with four parameters to be calibrated. On the other side the inability of the ABCD model to capture and describe the groundwater processes, important for the cases study. Moreover the validation phase embeds a large drought period, started in late 1980s, which makes difficult model adaptation to different hydrological regimes.

Keywords: Statistical comparison, non-linearity, GR2M, ABCD.

Paper ID: CEST2017_00694

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Reliability of the Stream Visual Assessment Protocol as a River Quality Evaluation Tool for Aborlan River, Philippines

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Abstract

River water quality monitoring is crucial in the conservation and maintenance of natural resources. However, most procedures demand extensive requirements, high costs, and complex data which render continuous monitoring difficult to maintain. Simpler methods which assesses visually apparent characteristics to convey the general quality of the river ecology were therefore developed. This study applied a modified version of the Stream Visual Assessment Protocol (SVAP) developed by the United States Department of Agriculture (USDA), a procedure which utilizes direct observations to state the general quality of a river and its riparian zone, to the Aborlan River in the Philippines. Its reliability as predictors of physicochemical parameters of the river were tested using correlation analysis. Results showed that SVAP is significantly correlated with temperature and TSS, and can therefore act as rapid predictors of the physicochemical values. Results of the study also indicated that local knowledge is significant in estimating the values of TSS and temperature.

Keywords: Public participation, River water quality, Sensorial Evaluation, Water quality Monitoring.

Paper ID: CEST2017_00812

Assessing the hydrologic alteration of rivers in Europe

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Abstract

This paper presents a European-scale analysis of hydrologic data at the resolution of the Functional Elementary Catchment (FEC). Simulated daily time-series of river flows from the PCR-GLOBWB model were used based on a hypothetic near-natural scenario where water abstractions from water bodies do not exist and the actual anthropogenic scenario with water abstractions occurring. Many hydrologic indicators describing the rivers' hydrologic regime were calculated with the Indicators of Hydrologic Alteration (IHA) methodology and software package and their deviations between the two scenarios were used as proxy metrics of rivers' hydrologic alteration or hydrologic stress. The results were indicated by mapping the hydrologic alteration on Europe's geographical FEC-level background. Indicators, mostly connected with low flow conditions, showed that Southern Europe is more hydrologically stressed due to abstractions than the rest of Europe. This work gives a general view of hydrologic stress in Europe allowing the identification of possible significant hydrologic stress on a local basis. However, to be able to determine minimum ecological flows that can ensure good ecological status, good pan-European datasets on ecological response are required.

Keywords: Functional Elementary Catchment, Hydrologic Stress, Indicators of Hydrologic Alteration, PCR-GLOBWB model.

Paper ID: CEST2017_01036

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Water pricing: are "polluters" paying the environmental costs of flow regulation?

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Abstract

River ecosystems are severely affected by dams and reservoirs. The Water Framework Directive states that polluters should be financially responsible for the caused environmental damage. Nevertheless, the environmental costs associated to flow regulation often are not fully paid by water users. This study presents an approach to value the environmental costs of flow regulation based on the "polluter pays" principle, i.e., the amount to be paid should be proportional to the caused environmental impact. The procedure includes three major steps: (i) assessing the admissible range of regulated flow variability based on flow data during the pre-dam period, (ii) estimating the daily environmental impact of regulated flows according to the resulting hydrological change in terms of the intensity, duration and frequency of the impact, and (iii) calculating the environmental costs of flow regulation subject to spatiotemporal characteristics. This paper applies the proposed methodology in the Luna River, Spain. The advantages over other water cost valuation methodologies are discussed. The approach enlarges the current recognition of water environmental costs and represents a simple and practical management tool for achieving the objectives of the Water Framework Directive.

Keywords: Flow regulation, Environmental costs, Dams, Water, Water Framework Directive

Paper ID: CEST2017_00789

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterizing groundwater west of Nile Delta using electric resistivity

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Abstract

Six vertical electrical sounding points (VES) were measured northern western desert. The analysis of the given well log data was used to estimate the groundwater level in the study area. The study area covers about 100 feddans, located at 80 km northwest Giza city. The Digital Elevation Model (DEM) of the investigated area was extracted from the Shuttle Radar Topography Mission (SRTM) satellite image. Thieves were interpreted with assessment of Digital Elevation Model (DEM) to determine the subsurface layers and the true resistivity, lithology and thickness variations of such layers. The obtained result is the subdivision of the shallow section into three units of sediments arranged as: top surface layer "A" of dry sand and gravels with mud overlaps; the second layer "B" of sand and mud layer. This layer composed of saturated sand which was considered as the water-bearing zone of the investigated interval, its thickness ranges between 80m and more than basement rocks. The depth to the basement surface has an average value of 104.7 m at the eastern side and 114.1m at the western side of the study area.

Keywords: Vertical Electrical Sounding (VES), Geo-electrical survey, groundwater, west Nile Delta.

Paper ID: CEST2017_01350

SESSION 32 – MARINE ENVIRONMENT AND COASTAL MANAGEMENT

Saturday 2 September 2017 - morning

Erosion and sediment transport processes along Eresos coastal zone (Lesvos, Greece)

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Abstract

This paper demonstrates the results of a 5 year monitoring program for the study of coastal erosion in the highly touristic beach of Eresos in Lesvos island. The beach is exposed mainly to S and SW winds. Frequent topographic (RTK-GPS), bathymetric (single-beam echo-sounder), morphological (side scan sonar) and sedimentological studies in shallow waters (<11.0 m) in conjunction with scuba diving observations, meteorological information and a hydrodynamic experiment, evidence an extremely energetic across and longshore transport of the sandy seafloor sediments. Two longshore bar / trough systems at ~0.5 and ~3.0 m depth are found to move substantially during storms, whereas the sonar mosaics show ripples and ribbon-like bedforms, the latter distributed at the west half part of the inshore area deeper than the 5.0 m water depth and oriented perpendicular to the shoreline. High frequency wave/current measurements show near-bed flows up to 35 cm/s, directed SSW that matches with the direction of the ribbon-shape features. The abovementioned findings verify the active sediment transport and the spatio-temporal complexity of the micro-morphology in the Eresos coastal area.

Keywords: beach erosion, morphodynamics, spatio-temporal changes, hydrodynamics, Eresos beach

Paper ID: CEST2017_00710

The potential of marine aggregate deposits off a highly eroded coastal area in Lesvos Isl. (Greece) - Implications for coastal management

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Abstract

This paper presents the results of a marine geophysical and sedimentological study carried out offshore of Eresos beach (Lesvos, NE Aegean) to investigate the potential of the area in exploitable Marine Aggregate (MA) deposits that could be used for the nourishment of the eroding beach. High-resolution data were acquired using an echo-sounder, a chirp subbottom profiler (SBP) and surface sediment samples. The SBP data analysis indicated the presence of a wedge-shaped deposit probably consisting of medium-coarse-grained sediments, being up to 8.0 m in thickness. Grain size analysis of the surficial sediments samples revealed a sandy deposit (90-100 % sand) down to water depths of 65 m, with the dominant fraction being fine sand. Mineralogical analysis revealed that these sediments are similar to the nearby beach sands, with albite being the dominant mineral and quartz the most significant secondary mineral particularly at shallower waters. A rough estimation on the basis of the geophysical evidence indicated a deposit volume of about $3x10^6$ m^3 at water depths between ~30 and 60 m. It appears that the area is a promising site for MAs suitable for beach nourishment, but more geological and environmental studies are needed in order to estimate the quality and volume of the reserve more accurately and determine the environmental impacts of the extraction.

Keywords: marine aggregates, geophysical prospecting, granulometry, mineralogy, NE Aegean Sea

Paper ID: CEST2017_00706

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Recording of and technical responses to coastal erosion of touristic Aegean island beaches – The ERABEACH project

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Abstract

Beaches, which form the most significant natural resource of the Aegean Archipelago, are under increasing erosion risk due to projected mean sea level rise (MSLR) and changes in the magnitude/frequency of extreme sea levels (ESLS). In the framework of the ERABEACH project, the erosion risk of all beaches of 6 Aegean islands (Lesvos, Chios, Thira, Kalymnos, Chalki and Agathonisi) under different scenarios of SLR has been modeled, in order to select critical and vulnerable beaches in each island for further study. Then, different innovative approaches were developed/tested at different pilot beaches to establish the present and model the future erosion risk and design effective and cost-efficient technical responses. Our results advance our knowledge on the diagnosis/prognosis of the beach erosion and flood risk at island settings, provide detailed assessments of the erosion risk and designs of effective technical responses under SLR to the partner municipalities, improve our understanding of the interactions between beaches and their back-basins and develop our capability to monitor (in high frequency) beach erosion using cost-efficient optical systems. The ERABEACH project provides a structured approach to assess and respond to the current and future island beach erosion, according to the emerging international/European legal framework.

Keywords: beach erosion, coastal protection measures, sea level rise, management protocols, Aegean Archipelago

Paper ID: CEST2017_00707

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Monitoring erosion risk in Kamari beach (Santorini)

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Abstract

The objective of the present contribution is to present the results of a study undertaken in the framework of the ERABEACH Project (http://erabeach.aegean.gr/) at Kamari beach (Santorini), one of the most touristic beaches of the Aegean Archipelago. The study combined *state-of-the-art* approaches to monitor beach erosion at different spatio-temporal scales, i.e. (a) analysis and inter-comparison of a 4-year time-series of high resolution summer satellite imagery, (b) collection/analysis of high frequency observations of the shoreline position using a novel optical (video) monitoring system and (c) detailed field topographic/bathymetric, sedimentological and meteorological information collected during repeated ground surveys. Our results suggest that Kamari beach has suffered significant erosion during (at least) the past 4 years. The most vulnerable areas of the beach appear to be its middle and, probably, its northern section. At the same time the beach appears to associated with very significant spatio-temporal variability; differences between the minimum (most inshore) and the maximum (most offshore) shoreline positions varied between 13 and 28 m during the 6-month period of the ground video monitoring. The significant erosion trends observed in the area are likely to be the result of a combination of natural and anthropogenic processes, including potential changes in the nearshore wave characteristics, the construction/presence of a backshore coastal wall/road along the beach that enhances beach erosion during energetic events and diminishing land sediment supply. It appears that technical adaptation measures are urgently required to mitigate erosion, particularly as this is likely to be exacerbated by the projected climatic changes.

Keywords: beach erosion, remote sensing monitoring, Thira, touristic beaches

Paper ID: CEST2017_00705

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Source Apportionment of Polycyclic Aromatic Hydrocarbons (PAHs) in sediments from Chalong Bay, Phuket, Thailand

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Abstract

The potential sources of 16 PAHs in surface sediments from highly tourism activities of Chalong bay, Phuket province, Thailand were apportioned. Twenty-eight of sediment samples were collected by using van Veen grab Sampler from Chalong bay, Phuket. Quantitative analysis of the 16 PAHs which categorized according to the US-EPA was analyzed by Gas Chromatography-Mass Spectrometry (GC/MS). Moreover, the multi-technique such as diagnostic ratios and principle component analysis (PCA) were applied to apportion the potential source of PAHs in the study area. The results showed that total concentration of PAHs (ΣPAHs) of sediments in Chalong bay ranged from 0.391 to 138 ng/g dry weight, with an average of 56.2±49.2 ng/g dry weight. While, the Diagnostic ratios plot was used to identify the potential sources of PAHs that caused by the anthropogenic in the study area. It was found that 80% of PAHs in sediments have originated from pyrolytic sources whereas the rest is originated from petrogenic sources. The accumulation of PAHs in sediments at Chalong bay were influenced by various potential sources of PAHs such as petroleum spills, combustion of fossil fuels, automobile exhausts, wastewater discharge from the domestic community and street runoff. The multivariate statistical treatment implicated the same potential sources of PAHs that are agreed with PAHs Diagnostic ratios.

Keywords: Polycyclic Aromatic Hydrocarbon; Chemical fingerprinting; Thailand; Principal component analysis; Anthropogenic Coastal Sediment

Paper ID: CEST2017_01137

The Introduction of Biofuels in Marine Sector

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Abstract

Sulphur and emissions related limits which are imposed on marine fuels drive the maritime industry to look on alternative fuels. The maximum sulphur content of the fuel has already decreased in the ECAs SOx (Sulphur Emission Control Areas) from 1.5% to 1% from 1 July 2010, and to 0.1% from 1 January 2015. Globally, the highest permitted sulphur content of fuel will be reduced, as from 1 January 2020 to 0.5%. Increasing demand of low sulphur fuel is anticipated, leading to a substantial mitigation of marine fuels from residual to distillate ones.

Biodiesel or else Fatty Acid Methyl Esters (FAME), and mixtures of it with conventional petroleum fuels, constitute alternative energy source for the maritime industry. The International Standard EN ISO 8217 specifies the requirements of petroleum fuels for use in marine diesel engines. According to the previous version of EN ISO 8217:2012 distillate fuels should comply with the "de minimis level" of approximately 0.1% v/v FAME. Nevertheless with the latest revision of EN ISO 8217 standard in 2017, the incorporation of FAME up to 7% v/v is allowed in specific marine distillate grades (DF). Marine distillates can also include hydrocarbons from synthetic or renewable sources, similar to the composition of petroleum distillate fuels.

Keywords: Marine Fuel, Distillate Fuel, SECAs, DF grades

Paper ID: CEST2017_01294

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effects of different operating conditions on sediment slurry sequencing batch reactors treating marine port sediments contaminated by PAHs

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Abstract

Due to intensive anthropic activities, marine port sediments are often contaminated by organic pollutants like polycyclic aromatic hydrocarbons (PAHs), which represent a significant environmental threat. In this study, two sediment slurry sequencing batch reactors (SS-SBRs) were used to biologically degrade a mixture of PAHs (namely fluorene, phenanthrene, fluoranthene and pyrene) from marine sediments dredged from Cagliari (Italy) and El Kantaoui (Tunisia) ports. To enhance PAHs removal by biostimulation, nutrients were added in both sediments, acetate was used as co-substrate (El Kantaoui, SS-SBR1), and saponins were used as surfactants (Cagliari, SS-SBR2). Moreover, different levels of contamination (up to 200 mg_{PAHtot}/kg_{dw} in SS-SBR1; up to 400 mg_{PAHtot}/kg_{dw} in SS-SBR2) and solid to liquid ratios (S/L, up to 0.2 in SS-SBR1; up to 0.1 in SS-SBR2) were applied. As to SS-SBR1, the highest average removal efficiencies (99-100% and 98-100% for 3- and 4-ring PAHs, respectively) were achieved when the level of contamination and S/L were set at 200 mg_{PAHtot}/kg_{dw} and 0.1, 150 mg_{PAHtot}/kg_{dw} and 0.13, and 150 mg_{PAHtot}/kg_{dw} and 0.20, respectively; as to SS-SBR2, very high average removal efficiencies (99÷100% and 98÷100% for 3- and 4-ring PAHs, respectively) were observed during the whole experimental campaign. Such results are promising and provide a useful background for testing other important operating parameters (*e.g.*, the volumetric exchange ratio).

Keywords: biostimulation, marine sediments, polycyclic aromatic hydrocarbons, SBR, sediment slurry

Paper ID: CEST2017_01330

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Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Application of Aphrodite3D coastal simulation Software to generate high-resolution nearshore current circulation and seabed evolution

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Abstract

Prediction of current flow and sediment transport is important in coastal engineering especially in applications related to coastal protection and erosion control Projects. Furthermore they become significant in various other engineering applications related to wastewater management, pollution control, coastal infrastructure design, scour protection, dredging, beach restoration etc. In most cases prediction of coastal morphology and shoreline evolution is necessary in Environmental Impact Assessments for human interventions along the coast. The purpose of this paper is to present wave-generated current flow and coastal morphology patterns based on 2D model simulations with coupled depth-averaged continuity and momentum equations. High-resolution simulations on coastal hydrodynamics are generated with Aphrodite3D Software to produce representative results in an arbitrary coastal shoreline and seabed morphology. Only the two-dimensional module is presented. The model uses orthogonal grid with a small grid spacing to efficiently simulate the horizontal flow field and sediment transport in two dimensions. Different options in seabed slope and cross-shore morphology are examined. Short-term shoreline and seabed changes can be predicted from this model. Medium-term morphology can be predicted running the model's equations using coarser grid with corresponding larger time-steps..

Keywords: Coastal Simulation, numerical model, coastal erosion, coastal morphology, sediment transport

Paper ID: CEST2017_01397

New screening tool for obtaining concentration statistics of pollution generated by rivers in estuaries

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Abstract

Rivers present one of the crucial pathways for the waterborne transport and therefore estuaries are critical coastal areas for a pollution hazard that might lead to eutrophication and general water quality deterioration. When addressing these problems, the decision makers and coastal area managers often need additional skills and expert knowledge, so they engage consultants to develop models and provide potential solutions. The actual implementation of a solution in practice is hampered with different stakeholders' interest and objectives. However, if the relevant institutions were provided with a screening tool, enabling them with a certain level of solution ownership, potentially more involvement would occur. This research utilizes analytical model based on ensemble averaging and near field approximations of the fundamental advective-diffusion equation for the case of continuous, steady, conservative substance transport where stream flow mean velocity is dominant. Such approach significantly reduces the costs and time needed to obtain enough measured data needed for common statistics analysis or more complex numerical model. Developed methodology is built into a simple software named CPoRT (Coastal Pollution Risk Tool) within recently conducted research project funded by European Social Fund. CPoRT is a free application which may be used by any stakeholder interested in an estuary pollution problem.

Keywords: estuaries, concentration statistics, screening tool, stakeholders' involvement

Paper ID: CEST2017_00772

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Long-term shoreline displacements and coastal morphodynamic pattern of north Rhodes Island, Greece

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Abstract

An important key element required to develop a reliable and effective Integrated Coastal Zone Management (ICZM) Plan is the in-depth understanding of long-term morphodynamic patterns affecting a coast. The present study investigates the morphological evolution of the north coast of Rhodes Island, Greece resulting from erosion and accretion processes. Long-term shoreline changes were determined from multi-temporal aerial and satellite images (1960-2016) georeferenced and analyzed under a GIS platform (ArcGIS v10.2, ESRI). In addition, the rate-of-change statistics of 24 historic shorelines were calculated using the Digital Shoreline Analysis System (DSAS, USGS). Subsequently, wave and hydrodynamic conditions affecting sediment transport in the coastal area were analyzed by using a dynamic modelling system (MIKE 21/3 Coupled Model FM, DHI). Shoreline displacement occurs mainly at the spit-like northern tip of the study area (Cape of Mylon). This spit-like morphology changes seasonally, due to variations in the annual wave regime. Since 1960, the overall surface area of the backshore has slightly increased with a rate of 36 m^2/y, though in shorter period times large variations has been identified, such as a reduction of 1256 m^2/y between 1960 and 1971 and an increase of 8046 m^2/y between 1990 and 1991.

Keywords: Littoral processes, Sediment transport modelling, GIS analysis

Paper ID: CEST2017_00497

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Integrated design of coastal structures and adaptation to climate change hazards

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Abstract

The main objective of this study is to propose an integrated methodology for the design of breakwaters for coastal defence, considering the wave climate change and its impact on the littoral transport in the area sheltered by the breakwater. The joint probability density function of significant wave height and mean wave period, used here, reprentative of the wave climate for a sufficiently long period of years, is estimated from wind data of frequencies of wind velocity combined with fetch length. This methodology has been proved to provide sufficiently accurate results. Besides, a probabilistic design methodology is presented, which uses the aforementioned long-term joint probability distribution of significant wave height and mean wave period and computes the probability of damage levels during the structure's lifetime. This advanced design method is applied to the most prominent subject in the design of coastal structures, i.e. the calculation of the required armour stones in rubble mound breakwaters. For the assessment of the hydrodynamic and morphological impact of the structure, Xbeach model has been applied, based on the probabilistic framework of wave climate. This methodology was implemented by using actual data of a specific location in the northern Aegean; Greece.

Keywords: Probabilistic design, Breakwater, Damage, Armour layer, Morphological change

Paper ID: CEST2017_00880

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Heavy metal mobility from marine sediments due to erosion and resuspension

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Abstract

This study examines the effects of specific natural attenuation processes such as erosion, resuspension and diffusion, on leaching of metals from natural marine sediments and spiked sediments, to the water column. The role of pH of the water column on the concentration of dissolved metals is investigated by submitting sediments to a modified elutriation test, using leachants with different pH. Sediment samples were collected from several stations in the inner port of Piraeus, Greece. The Gust Microcosm apparatus was used mainly for the experiments. Increasing shear stress caused resuspension of solids from sediment to the water column, and metal concentrations in the water column was found to closely follow the concentration of suspended solids. When natural sediments where subjected to the resuspension tests, no significant quantities of dissolved metals were released to the water column. Furthermore, metal mobility at different pH values was found to be very low as a result of the buffered final pH of the leachant, after the completion of every leaching procedure.

Keywords: sediments, metals, mobility, erosion, attenuation

Paper ID: CEST2017_00894

The application of GIS in Tourism Carrying Capacity Assessment for the Island of Rhodes, Greece

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Abstract

Tourism industry is fundamental for any national economy and its development is crucial for economic growth and social progress worldwide. In Greece, tourist arrivals averaged 1,070,942 persons per year from 2007 until 2016 while tourism revenues averaged 884 € million per year from 1997 until 2016.
In this paper, "Tourism Carrying Capacity" or TCC is assessed for Rhodes Island, Greece. The TCC indicates the maximum number of people that may visit a destination simultaneously, without degrading the physical, economic and social environment and decreasing visitors' satisfaction. Rhodes Island is one of the most popular international Greek tourism destinations. The arrivals from January of 2014 until June of 2016 were 1,902,660, while permanent population is 115.000 inhabitants and seasonal exceeds 200,000. The first signs of saturation were noticed after 2000. The calculation of a unique numerical value for the TCC is not representative as a set of sustainable tourism indicators should be used according to the PAP/RAC methodology. So, GIS is used for results presentation since it offers a valuable tool to support decision-making for sustainable tourism planning and development. Spatial analysis will provide a framework of policies. The outcome will be GIS based plans aiming at sustainable tourism development.

Keywords: Carrying Capacity Assessment, Island of Rhodes, GIS

Paper ID: CEST2017_00494

Could marine life cure cancer? perspectives and challenges

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Abstract

Life started and evolved in water. Marine life is the key to the global function of the ecosystems and food chain. Could marine life also be the solution to human health problems, especially cancer? Marine life contains and produces a vast variety of substances that have beneficial properties for human health. Many of them can be used as functional food ingredients due to their antihypertensive, antioxidant, anti-microbial, anti-coagulant or anti-diabetic properties and many have the potential to be used as pharmaceuticals, especially for cancer, due to their antitumor properties. The recent advances in the analysis and identification methods of chemical substances in trace levels in the marine environment have provided the opportunity of better understanding of their formation mechanisms, fate and properties. Nowadays great research efforts are being devoted to the determination of their pharmacological potentials. Some of them are considered as prospective cancer therapeutics and have been subjected to clinical trials with promising results. The aim of this work is to review existing information on origin and properties of marine life substances with pharmaceutical action and the potential to be used as cancer therapy drugs. Recent results, analytical problems, future perspectives and challenges are discussed.

Keywords: marine life, natural pharmaceuticals, drugs, cancer, analytical methods

Paper ID: CEST2017_00588

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Green versus sustainable: The case of shipping

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Abstract

The environmental effects of shipping have historically been addressed at the IMO level by focusing on specific pollutants and developing policy instruments which led to greener technologies and operations. An emblematic example is the diminishing of oil pollution by ships due to the Annex I of MARPOL 73/78 with innovations such as double hulls and crude oil tank washing. Current environmental issues include energy efficiency, atmospheric pollution, and the introduction of alien species by ships in the marine environment. However, there are concerns according to which regulations aimed at solving of some problem can exacerbate another. For example, the introduction of low sulfur fuel oil to combat SO_2 pollution would result in increased CO_2 emissions and a modal shift to land transport (trucks). Ideally the effort to achieve green shipping must consider the economic and social consequences of each measure. Recently, an initiative for sustainable shipping has emerged, a comprehensive approach aiming at maintaining the economic growth of shipping while ensuring social welfare and environmental protection. In this context, the aim of this paper is to explore the classic term of sustainability in the context of shipping. The synergies and antagonisms between different environmental policies and social and economic issues in shipping are discussed.

Keywords: IMO, energy efficiency, atmospheric pollution, social welfare, economic growth

Paper ID: CEST2017_00648

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Using phytoremediation technologies as a nature-based solution to improve and recover impacted estuarine environments

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Abstract

Research carried out by group is focus on the development of biotechnology tools for ecosystems recover, taking into consideration the several anthropogenic impacts and the ecosystem functionality. Results obtained in the past 12 years have clearly shown the potentialities of applying native salt marsh plants for the remediation of pollutants (namely metals hydrocarbons and pollutants of emerging concern) in moderately impacted estuarine environments, which can contribute for its recovery. Present results show phytoremediation as a suitable cleaning technology and enable the generalization of these techniques to everyday life.

Keywords: phytoremediation; salt marshes; metals; hydrocarbons; pollutants of emerging concern

Paper ID: CEST2017_00440

SESSION 33A – SMART CITIES FOR A SUSTAINABLE DEVELOPMENT

Saturday 2 September 2017 – morning

Environmental technologies for the sustainable development of smart cities

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Abstract

Cities are first and foremost built for people and must be managed to guarantee a suitable quality of life. More than 50% of the world's population lives in cities. By 2050, this figure will rise to nearly 75%. The big challenger is to sustainably provide and manage energy, buildings, transportation, security, health, food, water and wastes in the urban-ecosystem dimension.

In today's world, people are able to produce large amounts of valuable data, thus contributing to develop smart cities. Smart cities consist of human-made structures or environments that are, in some capacity, monitored, metered, networked and controlled. A smart, sustainable city is an innovative city that uses information and communication technologies and other means to improve quality of life, efficiency of urban operation, and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.

The improvement of livability and sustainability are main issues of a smart city. In this context environmental technologies are the hot solution. The development of novel technologies is strongly required to monitoring in realtime the key parameters directly on site at different parts of the urban-ecosystem. However to make the technology smart, for each environmental issue a robust algorithm for the data analyses and interpretation is necessary to make the right action/decision needs for the control of the quality of the environment. In the next future we can also image that these decision could be made by an artificial intelligence that can control all enviromental tecnologyes in the city.

Design of smart cities is one of the most growing issue to be resolved for both current and next generations and environmental technologies designed at urban level will be the core. At this day, as almost every smart building, infrastructure and city is a prototype, these communities are in the early stage of development and require specific attention and expertise as we advance. This work will uncover the newest worldwide trends and developments that are driving smart city innovation for a sustainable development.

[13] **Invited speech**

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Bridging Socio-Hydrology with Cyber-Physical Systems: Synergies and Opportunities

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Abstract

The emerging field of Socio-Hydrology seeks to explore the integrated human-hydrology systems and understand the co-evolving dynamics, feedbacks and behaviours across multiple time and space scales. This paper discusses the ways Socio-Hydrology contributes to the advancements of Cyber-Physical Systems (CPS) for Integrated Water Resources Management mainly focusing on prediction, one of the industry's forecasting pillars. The review of the rationale, methods and applications of Socio-Hydrology is followed by the analysis of an architectural approach of a state-of-the-art CPS. The discussion identifies research gaps and opportunities, especially in regards with the challenging UK water policy landscape, which requires the design of systemic approaches for resilient systems. Further to exploring the potential synergies between Socio-Hydrology and CPS, the paper examines the role that transdisciplinary research and its underpinning methodologies play in the creation of novel approaches.

Keywords: transdisciplinary, cyber-physical systems, socio-hydrology, Industrie 4.0

Paper ID: CEST2017_00369

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A "green campus": methodology and indicators

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Abstract

In the last decades the concept of sustainability has been applied to evaluate the performance of different systems, with reference to the social, economic and environmental dimensions. The great interest towards sustainability has raised the need for its quantification, so that several indicators, indices and ratings have been proposed in scientific literature. Real systems, resulting from the aggregation of elementary units, are very complex, so that the use of conventional indicators could prove poorly efficient in assessing their overall sustainability. The present study aims at evaluate the environmental performance of a complex structure through an integrated methodology, in order to reduce pressures and environmental impacts of the various activities of its functional units, thus improving the overall sustainability of the system. The assessment of sustainability performance requires setting up a system of indicators, to be used in the developed methodology, pursuing the minimization of both energy and resource consumption, while providing a supporting tool for the decisional processes towards an overall eco-efficiency improvement. For experimental purposes the University campus of Salerno, in South Italy, was chosen as complex system and the operational aspects dealing with solid waste management, water consumption, energy efficiency and air quality were analyzed.

Keywords: sustainability, environmental indicators, methodology, assessment, green campus

Paper ID: CEST2017_01082

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

An optimization algorithm for the selection of investment projects in smart cities

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Abstract

Cities and territories are being called upon to face the strategic challenges involved by sustainable development, based on the complexity of the interactive perspectives, in line with stakeholders' interests and constraints about the limited financial available resources. In this context, the integrated approaches for decision making relating in particular to urban planning and design in accordance with guidelines for Smart Cities, provide for a resolution of different scenarios having a complex nature thus helping to define programming procedures designed to return a model of a smart city based on the best use of the funds. The paper proposes a multi-criteria economic analysis model for a selection of investment projects that considers not only financial but also social, cultural and environmental parameters in order to examine the real sustainability of initiatives to be taken in urban areas. The model is defined in a mathematical programming language (AMPL) with the optimization algorithms typical of Discrete Linear Programming and it is tested on case studies.

Keywords: Economic Evaluation; Optimization Algorithms; Multicriteria Models; Sustainability; Smart City.

Paper ID: CEST2017_01365

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Traffic Congestion Analysis of the Central Business District of San Pablo City, Laguna, Phillipines.

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Abstract

Planning sustainable management and ease of transport requires the identification of certain transport problems that most urban cities suffer from—one of which is traffic congestion. Traffic congestion is one of the major transportation problems in the Philippines. This had been the impending case in the bottleneck areas in San Pablo City, wherein perceptive observation and transport reviews showed the major roads, especially *Jose Rizal Avenue* and *Marcos Paulino Avenue*, have traffic congestion issues. The study assessed traffic congestion on the three study sites, namely: *M.L.Quezon-Colago Avenue Intersection*, *Hermanos Belen St-M.Paulino St Intersection.* and *M.Paulino St-M.Leonor St. Intersection*. Through the use of traffic parameters such as Volume Capacity Ratio, Level of Service, and Travel Time Index, it was found out that there was a presence of traffic congestion on the study sites; results showed that the traffic congestion was caused by the number of tricycles in the area, and the location's land use. The study concludes the presence of traffic congestion, and recommends the review and proper implementation of traffic policies, and the construction of transport facilities.

Keywords: Traffic Congestion, Volume Capacity Ratio, Level of Service, Travel Time Index, Transportation

Paper ID: CEST2017_01152

Towards Sustainable Urban Transport in small seaside cities with tourist interest: The case study of Nafpaktos city.

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Abstract

Nafpaktos is located in the southeastern part of Nafpaktia geographical unit. This seaside town constitutes a dynamically developing tourist destination. Rapid urbanization and the existing transportation network are the main causes for degraded environment, poor service level, congestion and other factors that affect the quality of the citizens' life. Adding to these, tourist regions like Nafpaktos, have to cope with abrupt seasonal changes in transportation demand, which result to congested streets, due to the overall car-centric culture. This paper aims to suggest policy interventions that can guide the development of urban transportation in a sustainable manner. In this context, major outputs from this research consist of new public transport routes, rearrangements and modifications to the existing street network, promotion of actions to increase cycling and actions to increase the area of green open spaces. The main purpose of this study is to maintain the city's cultural identity along with its conversion to a smart city, in mobility terms. After analyzing the greater area of Nafpaktos and simulating the marked changes, the expected outcomes contain the reduction of car use (up to 20-25%), the increase of annual passenger numbers in public transport and the raise of the proportion of green spaces per inhabitant exceeding $9m^2$ (minimum standard by the World Health Organization – WHO).

Keywords: Accessibility, Green spaces, Mobility, Small-sized and seaside cities, Smart City, Sustainability assessment, Sustainable urban and transportation development**.**

Paper ID: CEST2017_00381

The effect of cryogenic treatment of ores on the comminution process and analyze the saving of energy

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Abstract

Mineral processing is the process of separating valuable minerals from gangue. The process is estimated to account for 6 % of global energy consumption and is little as 3% efficient. With the increased focus on environmentally friendly practices, the optimization of comminution is of vital importance. Comminution essentially involves two processes- crushing and grinding. World's most industrialized countries suggested that this process is consuming the greater amount of energy. One of the suggestions was to develop a pre-treatment process to weaken mechanical properties of rocks before subjecting them to comminution. Haphazardous wastage of energy has attracted the attention of researchers and industries world over in the wake of worldwide augmenting energy demand, frequent ups and downs of energy price and enhancement in global warming. In order to achieve covetous goal of bringing down energy consumption of comminution, present project proposes to develop a process which enables reducing mechanical properties of solid material thus helping in their easy breakage. Being aware of wide spread application of comminution not only in mining and mineral industries but also in other industries, this development would save energy significantly. This method is based on the fact that mechanical properties of material changes significantly with temperature.

Keywords: Comminution, Cryogenic, Energy, Global warming

Paper ID: CEST2017_00744

The concept of Urban Metabolism in Insular Communities and it's relation to Sustainability

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Abstract

This paper is focuses on the understating of how one are metabolism through tourist development without any specific plaining from the begging. As a case study the City of Agia Napa was chosen which presented unique characteristics the last 45 years as was and still the main player for Tourism Development in Cyprus as can guest more than 30% of the total tourism that visit Cyprus while at the same time offer millions of € in the Government. The last 45 years Agia Napa developed very fast a huge Hospitality Industry giving limited attention to the correct development. Considering the fact that in 1980s most tourists were looked for cheap destinations, with good food, nightlife, beaches and safe environment Ayia Napa became an attraction. Green areas were dramatically reduced, essentially lost the orientation point which was the Medieval Monastery as in the nearby areas were developed and expand restaurants, pubs, nightclubs, discos, etc. There was essentially an integrated design that does not respect the environment and the society. The only objectives in the past were to cover quickly the needs and the requirement for the tourist with the maximum economical profit. Main objective is to understand the metabolism of the city in the framework of Sustainable Development.

Keywords: city metabolism; tourist and environment; sustainable development; strategic plan, smart cities

Paper ID: CEST2017_00780

SESSION 33B – EFFICIENT CONVERSION OF BIOMASS AND WASTE INTO VALUABLE PRODUCTS (1)

Saturday 2 September 2017 – morning

Effect of Plasmid Addition on the Production of 1-Butanol from CO_2 in Isolated *S. Elongatus* from the Sea Sediment of Konak - Izmir

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Abstract

For a sustainable future it is essential to close the global carbon cycle. Oxidised forms of carbon, in particular CO_2, can be used to synthesise energy-rich organic molecules. Engineered cyanobacteria have attracted attention as catalysts for the direct conversion of CO_2 into reduced fuel compounds.1-Butanol is a promising gasoline replacement compared to the more commonly used ethanol due to several advantages. Specifically, 1-butanol is less corrosive and has a higher energy density than ethanol. In this study, *Synechococcus elongatus* was isolated from the sea sediment in Konak and the effects of CO_2 isolated from the same region on the production of 1-butanol was investigated. Addition of plasmid slightly increased the CO_2 utilisation rates. The effects of environmental factors (NO_3-N, SO_4-S, NaCl, H_2, O_2) on the ratio of 1-butanol production to CO_2 removal were investigated. Under optimized conditions *S.elongatus* metabolized the CO_2 according to Monod kinetic (K_s = 1.5 mg L^{-1} and μ = 0.21 day^{-1}). Under high NO_3-N, SO_4-S, NaCl, and O_2 concentrations 1-butanol produced with un-competitive inhibition with a high K_i value of 2.3 mg L^{-1} indicating the low inhibition in *S.elongatus* with plasmid. The competitive inhibition constant (K_i) is low (0.70 mg L^{-1}) exhibiting the high competitive inhibition at high concentration for the operational conditions given above.

Keywords: 1-butanol, carbondioxide, cyanobacteria, monod, plasmid.

Paper ID: CEST2017_00643

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Phenolic pigment extraction from orange peels: Kinetic modeling

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Abstract

Fruit and vegetable wastes cause loss of many beneficial substances such as dietary fiber, antioxidants, pectin, fatty acids and vitamins which are important for nutrition. The citrus wastes are very important antioxidant sources because of their flavonoids and phenolic acid contents. Pigments exist intensely in shells that are not consumed as food. In this study, the kinetic model of phenolic pigment production by Soxhlet extraction from waste orange peel supplied from fruit juice production factory was determined and the kinetic constants, which will be reference for large-scale systems, were determined. In the pigment extraction from dried pulpless orange peel with ethanol at 79 ^{o}C with particles smaller than 0.5 mm and at 40:1 liquid/solid ratio (L/kg), the highest phenolic pigment yield was found as 57.3 % (0.57 g phenolic pigment/g dry peel). Work in this context is expected to shed light on industrial applications and contribute to the development of food industry.

Keywords: Waste orange peel, Phenolic pigment, Soxhlet extraction, Kinetic modeling

Paper ID: CEST2017_00798

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of co-digestion ratio and enzyme treatment on biogas production from grass silage and chicken litter

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Abstract

Biomethane production potential was evaluated by anaerobic co-digestion of grass silage and chicken litter in batch experiments. The aim of this study was to identify optimum enzyme treatment and co-digestion ratio for these substrates. Preliminary batch assays for biomethane potential determination were performed using a co-digestion ratio of 2:1 (grass silage: chicken litter) treated with various concentrations of enzyme. The highest specific methane yield of 59.28 ml CH_4/ g was observed for 0.1% (w/v) enzyme treatment.

Keywords: anaerobic co-digestion, biomethane potential, grass silage, chicken litter, enzyme treatment

Paper ID: CEST2017_01143

Air gasification of paper, cardboard and plastic waste

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Abstract

The research presents the results of paper, cardboard and plastics waste mixture air gasification. The experiments were carry out in a lab-scale rotary kiln reactor. The main operating process parameters were: feeding rate 1 kg/h, operating temperatures 800 °C and 900 °C using air as gasifying agent, Equivalent Ratio (ER) ranging between 0.2-0.3. The gas yields increases with the increasing of temperature and gasifying agent (ER=0.3), reaching up to 1.99 m^3N/kg at 800 °C, and 2.1 m^3N/kg, at 900 °C respectively. The syngas composition was analyzed with both Testo instrument and GS-MS. Considering the operating conditions, the main composition of the combustible gas was: N_2 (48-56%), CO_2 (13-16%),CO (11-14%), CH_4(5-8%), H_2 (9-10%). The solid yields, decrease with the increase of temperature and ER, varying between 14-17% from the initial feedstock. The minimum energy conversion efficiency is achieved at ER=0.25 while the maximum one is achieved at ER=0.3 for both temperatures.

Keywords: energy, gasification, paper, plastic, waste.

Paper ID: CEST2017_00935

Poultry Litter Gasification in a Fluidized Bed Reactor: Effects of Equivalence Ratio, Temperature and Limestone Addition on Tar Yield and Composition

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Abstract

Air gasification of poultry litter was experimentally studied in a laboratory scale bubbling fluidized bed gasifier. Gasification tests were conducted at atmospheric pressure using silica sand as the bed material. This paper investigates the effect of equivalence ratio (ER) in the range of 0.18 - 0.41, temperature between 700 and 800 °C as well as the addition of limestone blended with the poultry litter, on tar yield and composition. The optimum conditions with regards to the tar (minimum total tar yield ≈ 3.2 $g_{total\ tar}\ kg^{-1}_{poultry\ litter\ (d.a.f.)}$) as well as product gas properties were achieved at 800 °C and ER = 0.3 using 8 % w/w of limestone blended with poultry litter. By varying ER poultry litter blended with limestone showed a reduction in total tar yield whereas poultry litter not blended with limestone showed increasing yield over the tested ER range. Moreover, in the presence of limestone, polycyclic aromatic hydrocarbons (PAHs) showed a tendency to reduce over the ER range tested. Increasing the temperature was shown to be effective to reduce the total tar yield but the amounts of PAHs increased. Due to the high nitrogen content of the poultry litter (≈ 6.5 % w/w (d.a.f.)) the chemical composition of the tar is distinctive compared with conventional lignocellulosic fuels. Nitrogen-containing hydrocarbons such as pyridine, 2-methylpyridine, 2-methyl-1H-pyrrole, and benzonitrile were identified in significant amounts. It was demonstrated that poultry litter can be gasified by blending it with limestone, yielding a product gas with low tar content as well as diminishing the risk of agglomeration caused by the mineral composition of poultry litter ash (high K and P content).

Keywords: Gasification, poultry litter, limestone, tar, solid phase adsorption

Paper ID: CEST2017_01094

A new circular economy concept: Textile waste for chemical and textile industries feedstock

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Abstract

The RESYNTEX project aims at designing, developing and demonstrating a new industrial symbiosis between textile waste and the chemical industry. The new original symbiosis is based on the chemical/enzymatic transformation of textile waste in a form that facilitates the easy take up as feedstock by the chemical industry in order to produce high added value chemicals. The parallel production of various high added value products ensures competitive production costs for the chemical market. As a result, economic advantages can be provided besides prevention of industrial environmental problems. The project will consider and demonstrate the whole value chain starting from the citizen behaviour change and the textile collection of unwearable textiles, improving and automatizing the industrial sorting, demonstrating the production of the transformed textile components and the symbiosis with the obtained chemical products and finally analysing the best economic models and policy actions for a successful introduction in EU markets.

Keywords: textile waste, recycling, chemical depolymerisation, enzymatic transformation, circular economy.

Paper ID: CEST2017_01196

SESSION 34 – ELECTRIC AND ELECTRONIC WASTE

Saturday 2 September 2017 - morning

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Apprehension of material distribution of complex components in end-of-life electrical and electronic equipment

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Abstract

During the pre-treatment process of WEEE, certain types of electronic components are released, which due to their diversity in shape, size, and material composition, cannot be attributed to one particular material fraction, e.g. ferrous metals, aluminium or similar, and are sorted out as mixed material stream. These components can generally be classified under an umbrella term as "complex components" and include Printed Circuit Boards, Power Supply Units, Hard Disk, etc. Although complex components are interesting from both economic and environmental point of view, the results of material composition analyses in the scientific literature tend to be highly scattered so that their practicality for further use is significantly diminished. Within the scope of this research, complex components have been analysed through a series simple analytical methods, e.g. nickel test, aluminium/magnesium test, etc., and ICP-OES in order to provide a new approach for the material analysis of complex components. The research provides an assessment of more than 40 different papers published in high impact scientific journals and results of material composition analysis of more than 60 components classified into seven types of complex components. Conclusively, a guideline for material analysis of complex components arising from end-of-life electrical and electronic equipment has been developed.

Keywords: ICP-OES, complex components, waste analysis, recycling, precious metals

Paper ID: CEST2017_00430

Efficient recycling of zinc from alkaline spent batteries using environmental-friendly strategies: a contribution to the circular economy

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Abstract

In the context of the circular economy, the production of new batteries, based on recycled materials from spent batteries, is the most energy efficient strategy, maximizes the reuse of the recycled materials and contributes to "closing the loop" of the alkaline batteries lifecycle**.** Thus, the main aim of this work was to evaluate the possibility of using ultrasound and microwaves to assist the (acid or alkaline) leaching of Zn in high yield from spent alkaline batteries and to compare the results with those obtained using the conventional leaching procedure. Both (microwave- and ultrasound-assisted leaching) strategies increased ($\geq$ 92 and $\geq$ 80% for acid and alkaline leaching, respectively) the extraction of Zn compared with the best results of conventional leaching [1.5 mol/L H_2SO_4, 3 hours: 90% of Zn; 6 mol/L NaOH, 3 hours: 42% of Zn] at 80°C. Moreover, they also proved to be more environmentally-friendly approaches for the extraction of Zn from spent alkaline residues since a concentrated (acid: ≥18.7 g/L Zn; alkaline: about 16.5 g/L Zn) Zn solution with adequate purity for subsequent Zn recovery was obtained using significantly decreased leaching times ($\leq$ 23 minutes) and concentrations (1 mol/L H_2SO_4 or 4 mol/L NaOH) of chemicals.

Keywords: spent alkaline batteries, microwave-assisted leaching, ultrasound-assisted leaching, zinc recovery

Paper ID: CEST2017_00531

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

WEEE collection and CRM recovery trials: piloting a holistic approach for Scotland

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Abstract

Re-Tek UK and its partners, Enscape Consulting and the University of West of Scotland commenced trials for the collection and recovery of critical raw materials from waste electrical and electronic (WEEE) products in July 2016. Sponsored by WRAP CRM (Life funded) the trials are aimed at boosting the recovery of critical raw materials (CRMs) from household waste electrical and electronic products (WEEE) and Information Communications Technology (ICT) in particular, after functioning equipment is separated out for re-use.The new collection models provide residents with the opportunity to drop-off unwanted electrical and electronic appliances at a time and place that suits them, through a collaborative approach which encourages local authorities, educational establishments, businesses, and Social Enterprises etc to act as hub sites. Hubs are designed to minimize product damage and encourage drop-off, rather than hoarding.
Extraction methods developed after the collection phase of the trial will advance the opportunity to recover Cobalt, Gold and Silver from ICT products, with the potential to inform how a more sustainable supply chain could be developed in Scotland. These are based on bioleaching and electrochemical recovery using novel carbon based electrode systems, with an assessment of pilot performance and scale up challenges. We report on progress to contribute to an EU Life project covering pilot studies across Europe to provide definitive data on practical solutions to WEEE and CRM recovery.

Keywords: critical raw materials, bioleaching, electrochemical recovery, electronic equipment collection, hub sites, cobalt, silver, gold

Paper ID: CEST2017_00821

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessing the Urban Mining Potential in the City of Huddersfield, UK

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Abstract

With the increasing demand of metals from industrial facilities and the construction sector, the abundance of discarded metals within the infrastructure of a typical city may be considered as an attractive source for metal recovery. The term "urban mining" refers to the process of recovering metals from secondary metal stocks in urban locations, which provide an alternative resource to conventional mountainous mines. An integrated urban mining potential assessment comprises of two steps: (a) mapping and size estimation of a certain metal reserve and (b) evaluation of the economic feasibility of its recovery, by determining the necessary extraction process. The infrastructure systems (or infrasystems) in the city of Huddersfield, and UK in general, are to a great extent buried underground and surface cables are usually immediately removed after being decommissioned. Thus, the major infrasystems (and the corresponding metals) in the studied region are (a) AC/DC power (Cu/Al), (b) telecommunication (Cu), (c) natural gas (Fe) and (d) water mains (Cu/Fe). In the current study, we focus on the assessment of urban iron mining potential, through mapping the spatial distribution of hibernating iron deposits in Huddersfield, identifying potential hotspots in the city and assessing alternative options for their recovery.

Keywords: Urban Mining, Huddersfield, Iron, Gas Network

Paper ID: CEST2017_00908

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Resource availability in photovoltaics - Case Study: Tellurium

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Abstract

The most established thin-film technology with a 70% share of the thin-film market in Photovoltaics is based on Cadmium Telluride. However, the use of tellurium, a metal with a limited production per year, may constitute a bottleneck for the increasing deployment of this technology. Four scenarios, following the tendencies depicted by Energy [R]evolution study, were calculated using the software STAN to assess the material flow balance of Tellurium. The most ambitious scenario shows a peak of demand 464t/year by 2025. Compared with an annual Tellurium production of 400t in 2016 and a present requirement of only 26% share of the yearly production, this result appears to be high. The benefit of Tellurium recycling shows a high impact on the demand, especially when large amounts of modules start to reach the end of life. However, uncertainties throughout the scenarios are present and need to be considered.

Keywords: PV module, critical metals, material flow analysis, tellurium, STAN

Paper ID: CEST2017_01063

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Simulation and economic analysis of a hydrometallurgical approach developed for the treatment of waste printed circuit boards

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Abstract

This paper presents the main achievements of a hydrometallurgical process to recover base and precious metals from waste printed circuit boards. The technology comprise a first leaching process performed in a two-step counter current way with sulfuric acid and hydrogen peroxide for base metals solubilization and a consecutive cross leaching process with thiourea, ferric sulfate and sulfuric acid to extract precious metals. Furthermore, the reach solutions are subjected to cementation procedure with zinc powder to recover the elements of interests in their metallic form. The enriched solution with zinc after base metals recovery is considered as a by-product of the process as this has the properties suitable for its using in agriculture industry as fertilizing agent. The spent solution achieved after cementation of precious metals is partially recycled within the process and the other part is treated by Fenton process and then neutralized with lime. Considering the achieved results at laboratory level, the entirely procedure was simulated using SuperPro Design software to determine the process economy for an industrial plant.

Keywords: Waste Printed Circuit Board, Hydrometallurgical Process, Process Analysis, Super Pro Design

Paper ID: CEST2017_01249

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Challenges and perspectives on a database management system for the sustainable recovery of critical metals from waste electrical and electronic equipment

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Abstract

Sustainable recovery of critical metals (CM) from Waste Electrical and Electronic Equipment (WEEE) in the European Union (EU) requires information for detailed analysis, monitoring and decision making. Related knowledge is currently insufficient or disseminated through the network of stakeholders. This paper assesses the requirements of an adequate Database Management System (DBMS) with participation of different actors involved in the recovery of critical metals, and analyses the difficulties and the possibilities found for its implementation. The requirements of this DBMS and the interaction of the different actors are presented, with the aim of supplying standardized information for management and research. Barriers are studied through a survey to identify obstacles for its elaboration. Limitations for its development are addressed and practical solutions for its elaboration are presented.

Keywords: Database, Recovery, Critical Metals, Waste Electrical and Electronic Equipment

Paper ID: CEST2017_01325

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment processes for e-waste in an informal context

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Abstract

The e-waste recycling chain in China, India and some other developing countries in Africa (e.g. South Africa, Kenya, Ghana) mainly rely on the informal sector and consists of collection, manual dismantling, metal recovery and open dumping of residual factions. Additionally, components are recovered for repair and refurbishment. China and India have formed large organized informal sector while in Africa, those activities have been doing by individuals.
The paper gives an overview on typical treatment processes for e-waste in China, India and Ghana. This includes manual dismantling, melting to release components, desoldering, open burning and other processes such as acid leaching and amalgamation. Further critical emissions and impacts are explained.
These informal practices lead to direct or indirect severe effects to human health and the environment due to the presence of toxic metals and organic compounds. Studies show the high concentration of metals (such as lead, nickel, copper, cadmium), polybrominated diphenyl ethers, polychlorinated dibenzo-p-dioxins and dibenzofurans, polycyclic aromatic hydrocarbon in dust, sediment, wastewater from recycling workshops or in soil, water from open pool close to recycling facilities in China and India. In Africa, high levels of contaminants (heavy metals such as copper, lead, zinc) from e-waste are found in sediment of common fishing ground lagoon. Metal concentration in soil, ash and sediment from several burning sites exceed over 100 times compared to typical background soil levels.

Keywords: e-waste, informal recycling, environmental impacts, health risks

Paper ID: CEST2017_01347

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Hydrometallurgical recovery of critical metals from WEEE shredding dust

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Abstract

The recycling of metals from Waste Electrical and Electronic Equipment (WEEE) can be regarded as a relevant economic opportunity as the industry of electronic devices is a large consumer of both base and special metals. Significant portions of precious metals and rare earth elements contained in WEEE are however lost in recycling treatments, especially through dust stream originating from shredding and other separation steps involved in mechanical processes. The management of this dust fraction concerns both economic and environmental issues as it is currently disposed of in landfill. If the occurrence of hazardous substances is a matter of environmental concern, on the other hand the presence in dust of reasonable concentrations of valuable metals makes this matrix a potential attractive source of secondary materials. Nevertheless, research studies on refining treatments for critical metal recovery from WEEE shredding dust have not been reported yet. The present study aimed at investigating the potential application of refining processes to dust materials originating from a full scale WEEE treatment plant. For this purpose, a chemical leaching process was carried out and the optimization of the operating parameters was discussed. The leaching capacity of selected metals was evaluated and a hydrometallurgical approach was proposed for valuable and critical metal recovery from dust waste.

Keywords: electronic waste, chemical leaching, dust material, precious metals, rare earth elements

Paper ID: CEST2017_00771

Estimation of waste mobile phones in the Philippines using neural networks

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Abstract

Waste mobile phones are one of the subgroups of WEEE defined as discarded electronic products. This study estimated current and projected quantities of waste mobile phones in the Philippines using feed forward neural network. The neural network architecture used had three (3) layers: input layer, hidden layer and output layer. Seven (7) input factors were used during the learning phase of the network namely (i) population, (ii) literacy rate, (iii) mobile connections, (iv) mobile subscribers, (v) gross domestic product (GDP), (vi) GDP per capita and (vii) US dollar to peso exchange rate. The structure was designed with 5 hidden layers which consisted of; six (6) neurons for layer 1, five (5) neurons for layer 2, four (4) neurons for layer 3, three (3) neurons for layer 4 and two (2) neurons for layer 5. The neural network was designed to calculate first for the sales of mobile phones before estimating waste mobile phone generation. Visual Gene Developer 1.7 Software was used which showed an error of ±0.00001. Estimates and predicted values were found to be in good agreement with a calculated accuracy of 99%. This study can be used by policy makers as strategy, and as guideline and baseline data for establishing a proper management system for WEEE. The developed neural network performed better than the traditional linear extrapolation method for forecasting of data.

Keywords: WEEE, Neural Networks, generation rates

Paper ID: CEST2017_01056

Biomining – Biotechnological Systems (Bioleaching and Biosorption) for the Extraction and Recovery of Metals from Secondary Sources

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Abstract

Biomining is the common term used to define processes that utilize biological systems to facilitate the extraction of metals from ores. Nowadays, a biomining concept can be defined as a two stage combined biological systems (1st stage bioleaching and 2nd stage biosorption) in order to perform the extraction and recovery of the metals from secondary sources such as industrial and mining waste, waste electrical and electronic equipment (WEEE), bottom ash and end of life vehicles. Overwhelming demand and limited sources of metals have resulted in searching new sources so that attentions have been shifted from mining process towards recycling of secondary resources for the recovery of metals. There are several metallurgical processes for metal recovery from the secondary sources such as pyrometallurgical processing, hydrometallurgical and bio/hydrometal-lurgical processing. Biomining processes are estimated to be relatively low-cost, environmentally friendly and suitable for both large scale as well as small scale applications under the bio/hydrometallurgical processing. Thus, the process involves physical separation (pre-treatment) and biomining (bioleaching and biosorption) and hydrometallurgical processes for recovery of base metals, rare earth elements (REEs) and precious metals from e-waste was evaluated.

Keywords: Biomining, Biosorption, Bioleaching, Critical Metals, WEEE

Paper ID: CEST2017_01068

Applied WEEE pre-treatment methods: Opportunities to maximizing the recovery of critical metals

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Abstract

WEEE is a fast-growing waste stream that includes potentially hazardous substances, but also valuable secondary raw materials, which can be recovered by using of adequate recycling and recovery treatment solutions. In the last years, the research interest has moved from the conventional recycling (recovery of ferrous and non-ferrous metals, plastic, glass and other "mass relevant" fractions presented in WEEE), to the innovational recycling, aimed to recover trace elements, such as critical metals (CMs) and rare earth metals (REMs). Currently, the majority of CMs and REMs are lost during the pre-treatment processes. In this paper, an overview of the most relevant e-waste categories and products in terms of CMs and REMs presence, a description of currently applied pre-treatment methods and fate of the observed group of metals during pre-processing phase, as well as general recommendation in order to avoid losses of CMs and REMs within the WEEE treatment chain, are elaborated.

Keywords: WEEE, Critical Metals (CMs), Rare Earth Metals (REMs), Waste Pre-treatment

Paper ID: CEST2017_01343

Preliminary estimation of WEEE generation in Greece based on the population balance model

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Abstract

The recast European Union Directive on Waste of Electrical and Electronic Equipment (WEEE) requires Member – States to collect 65% of the Electrical and Electronic Equipment (EEE) or the 85% of WEEE generated, by 2019. However, still there is not an established, universally accepted method for the calculation of the quantity of WEEE produced.Most available estimates make use of models based on the EEE put on the market and the lifespan distribution of different categories of EEE, i.e. the statistical distribution of the time required for EEE items in each category to become waste. However, this lifespan distribution will vary over space and time, as differences in purchasing power and consumption habits will result in differences in the replacement time of the various EEE goods. This preliminary study makes a first attempt to define the lifespan statistics for Greek households, thus refining the results of such population balance models, through the use of a questionnaire study. More specifically, the aim of this study is to estimate the amount WEEE that are and will be generated in Greek households within the next two decades. The estimation is based on the EEE put on the market, a detailed questionnaire-based study, and the lifespan distribution of EEE. This paper presents the preliminary results of approximately 50 questionnaires. In the next step, the study will be expanded to more than 1,000 Greek households.

Keywords: WEEE, lifespan distribution, Greek households

Paper ID: CEST2017_01381

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Comparison between German (Hamburg) and Italian (Turin) WEEE management systems

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Abstract

In the world about 30-50 Mt/y of WEEE is disposed and often improperly managed, leading to potential negative environmental impacts and to a loss of secondary raw resources. The aim of this paper is the assessment of WEEE management systems in Germany and Italy, as representative examples of EU countries. A specific comparison was made between Hamburg (1.7 M inhabitants) and Turin (2.3 M inhabitants) metropolitan areas. The analysis highlighted analogies (collection targets, national coordination centers and producer responsibility) and differences (e-waste classification and collection systems). Improvements in the collection phase are necessary in both countries in order to fulfill Directive 2012/19/EU targets. While large e-waste showed the highest collection rate, about IT, small household and consumer equipment e-waste strategic actions are necessary, particularly in Italy. The adoption in Germany of containers for the collection of small WEEE in shopping centers and residential areas generated good results; therefore they could be exported in Italy as well.

Keywords: WEEE, collection, urban mining, metal recovery

PAPER ID: CEST2017_01388

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biorecovery of metals from waste electrical and electronic equipment (WEEE) and its techno-economic and sustainability assessment

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Abstract

Global waste electrical and electronic equipment WEEE generation reached 41.8 million tons in 2014, and forecasted to rise to 50 million tons in 2018 (Baldé et al., 2015). In addition to the prevalence of toxic compounds, WEEE also contains valuable metals such as copper (Cu), gold (Au), aluminum (Al) and nickel (Ni). Discarded electric and electronic devices and particularly printed circuit boards (PCB) are a very promising secondary source of metals. Recovery of metals is conventionally carried out by pyrometallurgical and hydrometallurgical methods, which have their own drawbacks and limitations. To this end, we present the proof-of-concept of a novel technology to biologically treat and recover metals from WEEE. In this work, discarded PCB is characterized, a novel metal biorecovery technology is given, and its future techno-economic and environmental sustainability analysis is analyzed.

Paper ID: CEST2017_01354

SESSION 36 – EMERGING POLLUTANTS (5)

Saturday 2 September 2017 - afternoon

Effect of electrochemical processes applied to membrane bioreactors on the removal of antibiotics from wastewater

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Abstract

In the recent decades, the use of antibiotics is of great concern due to their continuous input and persistence in aquatic ecosystems even at low concentrations. The lack of appropriate treatment systems in conventional wastewater treatment plant, the unsuitable disposal of unused or expired antibiotics and their incomplete metabolization in humans severely affect the quality of surface and groundwater. The present work aims to study the combination of electrochemical processes with membrane bioreactors (electro MBR/eMBR) for the removal of antibiotics from synthetic municipal wastewater. Amoxicillin (AMX) was chosen and spiked, at a concentration of 10 μg/L into the influent wastewater, as representative of highly consumed antibiotic that is frequently detected in the aquatic environment. In order to reach the set objectives, an intermittent electric field of 0.5 and 1.15 mA/cm^2 was applied between two cylindrical perforated aluminum anode and stainless steel cathode, immersed around a membrane module in a laboratory scale eMBR. For comparison purposes, the reactor was also operated as a conventional membrane bioreactor. The results illustrate that the application of electrochemical processes to membrane bioreactors was able to increase the antibiotic removal with respect to the conventional MBR.

Keywords: amoxicillin (AMX); emerging contaminants (ECs); electrochemical processes; electro MBR; current density

Paper ID: CEST2017_00886

Removal and transformation of citalopram and 4 of its biotransformation products during ozonation

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Abstract

The continuous discharge of pharmaceuticals in effluents from production facilities, hospitals, and private households, improper disposal of unused drugs, and the direct discharge of veterinary medicines all lead to contamination of environmental waters. Many pharmaceuticals are not entirely removed even through wastewater or drinking water treatment processes, thus, they are consequently detected at various concentrations (from ng to μg per liter) in effluent samples of wastewater treatment plants (WWTPs) and drinking water supplies. Citalopram (CTR), a selective serotonin re-uptake inhibitor, is a compound of interest due to its worldwide high consumption for the treatment of depression. Several studies carried out worldwide reported the occurrence of CTR in different environmental matrices, including influent and effluent wastewaters, sewage sludge, surface waters and biota. The treatment sequence applied in WWTPs encompasses the following steps: a primary gravity settling, a secondary biological treatment and finally a tertiary step, including advanced oxidation processes for disinfection and removal of micropollutants. Treatment with ozone appears to be one of the most promising disinfection technologies for the removal of these compounds. Although the removal of many pollutants may be significant, often total mineralization is not achieved. Since the reactivity of ozone towards organic compounds is high, transformation products (TPs), with unknown physicochemical properties and toxicity, may be produced. So far, studies concerning the transformation of emerging contaminants during a disinfection method (ozonation, chlorination, UV treatment), have been focused on the probable transformation of known contaminants and less frequently on their known human metabolites. Since recent literature has revealed the formation of biotransformation products of emerging contaminants during secondary biological treatment, their probable transformation during tertiary treatment should not be overlooked. The aim of this study is to investigate the removal and transformation of CTR and four of its biotransformation products during ozonation.

Keywords: ozonation, citalopram, emerging pollutants, transformation products, trend analysis

Paper ID: CEST2017_01272

Removal of pharmaceutical compounds by electrochemical processes in real wastewater

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Abstract

This study investigated the viability of treating pharmaceuticals from real municipal wastewater using electrochemical process i.e. intermittent electrocoagulation. Batch experiments were performed using a laboratory scale electrochemical reactor with aluminum and stainless steel as anode and cathode, respectively. Diclofenac (DCF), carbamazepine (CBZ) and amoxicillin (AMX) were selected as representative of highly consumed pharmaceuticals under different drug categories (anti-inflammatory, antiepileptic and antibiotic) that are frequently detected in water resources. The effects of continuous and intermittent (5 min ON/ 20 min OFF) application of direct current (DC) field on the abatement of pharmaceutical compounds were determined and found to favor the latter in terms of treatment efficiency at varying current densities (CD = 0.3, 0.5 and 1.15 mA/cm^2). The removal efficiencies of conventional pollutants namely chemical oxygen demand (COD), dissolved organic carbon (DOC), aromatic and humic substances (in terms of UV_{254}), ammonia nitrogen (NH_4-N) and orthophosphate (PO_4-P) were also obtained and found to be directly proportional to current density and reaction time.

Keywords: diclofenac (DCF); carbamazepine (CBZ); amoxicillin (AMX); emerging contaminants (ECs); electrocoagulation

Paper ID: CEST2017_01356

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biodegradation of pharmaceuticals in a pilot-scale staged Moving Bed Biofilm Reactors (MBBRs)

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Abstract

The amount of pharmaceuticals that hospital wastewater can contribute directly into a sewage is significantly high while conventional activated sludge (CAS) sewage wastewater treatment plants (WWTPs) provides insufficient removal of these pharmaceuticals. Therefore, a pilot-scale MBBR was built at Skejby hospital with the aim to investigate the possibility to reduce the pharmaceuticals load in the wastewater. A batch and a continuous flow experiment were conducted to assess the pilot plant. In general, antibiotics (azithromycin, ciprofloxacin, clarithromycin and trimethoprim), sulfonamides (sulfadiazine, sulfamethizole and sulfamethoxazole) and X-ray contrast media (diatrizoic acid, iohexol, iomeprol, iopamidol and iopromide) showed higher degradation rate constants (k_{bio}) and removal than other treatment systems including a CAS treatment system. In particular, removal of more than 50% has been determined as compared to treatment systems utilizing activated sludge. Besides, diclofenac was measured to have a total removal of up to 80% over the treatment train.

Keywords: Biodegradation; diclofenac; hospital wastewater; pilot-scale MBBR

Paper ID: CEST2017_01392

SESSION 37 – HEAVY METALS IN THE ENVIRONMENT (2)

Saturday 2 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Accumulation of cadmium and its effects on physiological characteristics in *Arundo donax* L.

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Abstract

A wetland simulated experiment was employed to investigate the accumulation of Cadmium (Cd) in *Arundo donax* L., and the effects of Cd addition on its growth and photosynthesis characteristics. Results showed that the morphological characteristics, the leaves and roots biomass didn't show statistically significant differences. The order of Cd accumulation is stem < roots < leaves. There were no differences on relative chlorophyll content, quantum yield of PSII electron transport (Yield) and maximum quantum efficiency of photosystem II (Fv/Fm) (except 0.125 mg/L), photosynthetic rate (Pn), while significant differences on initial chlorophyll fluorescence (Fv/Fo). The activity of superoxide dismutase (SOD) was stimulated by Cd treatments. Although the activities of peroxidase (POD) and catalase (CAT) were decreased at 2.5 mg/L, and at 0.05 and 0.125 mg/L, respectively, the activity of CAT was increased at 2.5 mg/L and POD increased at 0.05 and 0.125 mg/L, indicating the decrease in CAT and POD was compensated by the induction of POD and CAT activity, respectively. The results suggested that the oxidative stress may involve in the mechanism of Cd toxicity and *A. donax* showed a strong tolerance to the increased Cd pollution, which may have a potential use for phytoremediation purposes in wetland environment.

Keywords: *Arundo donax*, antioxidant enzymes, chlorophyll fluorescence, gas exchange parameters.

Paper ID: CEST2017_01136

Biomonitoring Studies of Environmental Pollution in Egypt Using Crayfish and Mosquito-fish with Emphasis on Bacteriological, Parasitological and Heavy Metal Assay

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Abstract

The present study was conducted to biomonitor the water quality in Abu-Rawash, Giza, Egypt by comparing the health status of two different aquatic organisms, red swamp crayfish (*Procambarusclarkii*) and mosquito-fish (*Gambusiaaffinis*).Bacteriological, parasitological and histo-pathological studies were performed.Physiochemical parameters (pH, Electrical conductivity, phosphate, ammonia and nitrate) and some heavy metals [copper (Cu), zinc (Zn), cadmium (Cd), nickel (Ni), and lead (Pb)] were analyzed in water samples. Heavy metal concentrations were also examined in different crayfish tissues (muscle, exoskeleton and hepatopancreas) and mosquito-fish. Some pathogenic and nonpathogenic bacterial species were isolated from both crayfish and mosquito-fish represented by *A. hydrophila*, *Ps. Fluorescens*, *Vibrio parahaemolyticus*, *E. coli*, Citrobacter spp., Enterobacter spp., staph and micrococcus. No parasites were found out in crayfish, while mosquito-fish showed high gill infection with encysted metacercariea. High levels of heavy metals were detected in water, they follow the order of Ni>Pb>Cd, while Zn and Cu were in normal values. Ni showed the highest bioaccumulation factor in both crayfish and mosquito-fishtissues, while Zn was in high concentration in the muscles of crayfish. Crayfish and mosquito-fish are two different biomonitoring aquatic species that give an early warning of the water pollution to take the responsible steps and avoid water pollution for saving our aquatic environment.

Keywords: Crayfish, Mosquito-fish, Biomonitoring, Bacteria, Parasites, Heavy metals.

Paper ID: CEST2017_01357

Application of some clay minerals to eliminate the hazards of heavy metals in contaminated soils

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Abstract

Soil pollution by heavy metals has serious hazards on microorganism plants, human being and ecological environment. Many approaches have been introduced to overcome the problem of contaminated soils by heavy metals as cadmium, copper and nickel. A laboratory experiment conducted using zeolite and bentonite, three rates on contaminated soils (sandy and clay) with 200ppm of each element. The adsorption and release of element by time (1-14 days) have been recorded. The rate constants of Hoerl's and Elovich kinetic models were determined to compare the effect of adding zeolite and bentonite in three rates on sandy and clay soils. The obtained results indicated that the reaction occurs very fast after adding the remediation material and continuous steady by time. The low rate of the material was very effective in increasing the adsorption of the heavy metals. The release of elements as a result of adding both zeolite and bentonite had the order $Cd^{2+} > Cu^{2+} > Ni^{2+}$. The role of zeolite is more pronouncing in enhancing the adsorption of the heavy metals more than bentonite due its specific molecular structure and high surface area. Therefore it recommended to be applied as a remediation material in polluted soils by heavy metals.

Key words: zeolite, bentonite, heavy metals, contaminated soils.

Paper ID: CEST2017_00052

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Accumulation and Translocation of heavy metals from soils to vegetables by sewage effluent application in territory of Rawalpindi

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Abstract

Application of sewage effluent for growing vegetables in peri-urben areas of big cities has become a common practice. A survey was conducted during 2008-2009 from 15 different sites of Rawalpindi, Pakistan to assess accumulation of heavy metals in soil and edible parts of vegetables by application of sewage effluents. Samples were collected randomly from sewage effluents, nearby soil and vegetables, and were analyzed for Zn, Ni, Mn, Pb, Fe, Cu, Co, Cr and Cd contents. Results revealed exceeding concentration of Ni (43%), Mn (71%), Pb (29%), Cu (29%) and Cr (43%) in sewage effluent. Fields (surface and in sub-surface soil) receiving sewage effluent were higher in metals contents than safe limits except Cd, Ni, Co and Pb. Vegetables (coriander, spinach, garlic, tomato and chili) grown in these field were found 100% contaminated and accumulation of heavy metals was higher than the WHO/FAO recommended permissible limits.

Keywords: Heavy metals, sewage effluent, contaminated soil, vegetables, peri-urban area

Paper ID: CEST2017_00399

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geo-spatial variability assessment of water pollutants concentration in Mariut Lake, Egypt

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Abstract

In recent decades, the need to better understand the spatial and temporal variabilities of pollutants within aquatic systems was increased. Mariut Lake is one of the most heavily populated urban areas in Egypt and in the world. A total of 22 samples were collected and analyzed for determining the concentrations of chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), cadmium (Cd) and lead (Pb) in winter time 2014. Inverse distance weighting analyst tools were used to explore, analyze the spatial distribution and mapping of the heavy metal concentrations.
The results revealed that all of heavy metals concentrations matched with the allowable limits to be discharged in marine environment as prescribed in Egyptian law except of Ni metal which exceeded the allowable limits. The results illustrated that the highest concentration of Mn and Fe were distributed in the upper north eastern parts of the studied stations, this may be due to human's activities and industrial area. While the eastern region has high concentrations of Pb, Ni, Cr and Co due to El-Kalaa drain discharges. However, the western part of the study area has high concentration of Zn and Cu due to El-Ommum drain discharges.

Keywords: Heavy metal, Mariut Lake, Geo-Spatial.

Paper ID: CEST2017_495

SESSION 38 – SOLID WASTE MANAGEMENT (3)

Saturday 2 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geotechnical properties of products of alternative fuel combustion and their co-firing with hard coal in the context of waste management

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Abstract

Efforts directed to reduction of GHG emissions lead to the introduction to the coal-based power industry of new firing/co-firing technologies and alternative fuels. This resulted in the formation of combustion products with new properties that may affect the reuse of these wastes or/and pose hazard to the environment. One of the powerplant fly ash (FA) reuse options is its application as dense mixture with water for backfilling mine workings or in engineering constructions. In this comparative study, geotechnical properties of four groups of FA were evaluated: (I) from hard coal combustion in conventional pulverized coal boilers, as disposed coal ash (C-PCA) and freshly generated FA without (C-PFA) and with SNCR installations for NO_x reduction (NC-PFA); (II) from co-firing of coal with biomass in pulverized coal boilers (BC-PFA); (III) from coal (C-FFA) or biomass combustion in fluidized-bed boilers (B-FFA); (IV) from co-firing of process gases with coal in pulverized coal boilers (GC-PFA). The transportability, bonding, solidification properties and resistance to axial compression and re-wetting of dense mixtures were evaluated by volumetric density, fluidity, water retention capacity, bonding time, solidification time, resistance to axial compression and slakening parameters. Calcareous C-FFA > B-FFA appeared to display the best geotechnical properties. Other materials can be aligned in order BC-PFA>GC-PFA>NC-PFA>C-PFA>C-PCA, though showing much weaker geotechnical properties than FFA.

Keywords: coal/biomass combustion fly ash; pulverized coal/fluidized-bed combustion; mine workings backfilling; fly ash dense mixtures, geotechnical properties

Paper ID: CEST2017_00665

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Using a waste audit and a knowledge assessment survey to investigate plateauing MSW recycling rates in Australia

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Abstract

It has been widely acknowledged that MSW recycling rates are beginning to plateau below their full potential. This study investigated a local government area in Australia experiencing plateauing MSW recycling rates, to understand how waste system recovery capabilities and separation behaviour determine recycling plateau level. Data was collected from a waste audit and a household survey. Materials and products assessed in the waste audit and household survey were divided into a variety of categories; ease of identification (easy, moderate, hard), material type (glass, plastic), and waste type (recyclable, general waste). The recycling full potential was determined by the capability of the waste system to recover materials, and the gap below full potential was governed by the separating ability of the populace. It was found that approximately 75 percent of dry recyclables were being captured by the MSW system. The 25 percent of recyclables lost was due to misidentification of recyclables as general waste. This was more likely to occur for materials classed as moderate or hard to identify. It was apparent that some materials caused greater confusion than others.

Keywords: recycling, plateau, waste audit, survey

Paper ID: CEST2017_00818

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Influence of particle size on leaching characteristic of fly ash

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Abstract

The effect of particle size on the physical, chemical, mineral and rheological properties of coal ash has been studied. In this study, the leaching of heavy metals like, Fe, Ni, Cr, Cu, Pb and Cd from fly ash and its leaching behavior at different pH conditions were studied in order to predict potential environmental pollution. The leaching test of heavy metals from fly ash was investigated in order to predict the environmental effect from the ash disposal on the ground water quality.

Keywords: Physico-chemical properties, Mineral characterization, fly ash, Fly ash.

Paper ID: CEST2017_01243

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Solid waste management in Canadian First Nations communities

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Abstract

Historically, the management of solid waste in First Nations communities in Canada had gained limited attention in terms of scientific research and governmental policies. Open-site dumping and open-air burning are commonly implemented in many First Nations communities and barriers towards environmentally sound and friendly solid waste management techniques including the remoteness, year-round inaccessibility of roads, lack of funding, and unclear jurisdictions. This improper practice could lead to environmental issues because of the generation of leachate and the emission of toxic compounds from the garbage dumpsite, and thus exposing the residents to pollutants such as heavy metals, persistent organic pollutant (POPs), volatile organic compounds, dioxins, and furans. This is particularly the case with the increasing consumption of industrial products and improper disposal of hazardous waste like scrap tires, used batteries, and end-of-life vehicles. It is true that the Canadian government publicly and financially made certain efforts and contributions towards the elimination of environmental issues in First Nations; however, more attention is required for some remote and isolated small-scale communities. This paper examines the existing challenges faced by the First Nations communities, particularly the environmental hazards from improper practices of solid waste disposal, and the current policy as well as funding aimed to improve the situation.

Keywords: First Nations; Solid waste management; Open dumping; Open-air burning; Government policy and funding

Paper ID: CEST2017_01291

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

How best can we utilize our solid tannery waste?

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Abstract

The enormous amount of solid tannery waste that is generated in Bangladesh has been being used as the major component of poultry/fish feed since long. Recent studies on the presence of chromium in solid waste, in poultry/fish feed, and even in chicken, eggs and fish suggest that in the interest of public health solid tannery waste should be avoided while producing poultry/fish feed. The present paper examines the toxicity of Cr(III) and Cr(VI) separately and their maximum allowable dose levels. Two approaches have been considered for using solid tannery waste in poultry/fish feed. In the first one, the tanned part of the waste should undergo elaborate chemical treatment to reduce the amount of chromium to a minimum. In the other approach a proposal has been made to decrease the formation of highly toxic Cr(VI) by taking proper steps at different stages of production of leather and feed. It is assumed that the amount of Cr(III) that enters chicken, eggs and fish through the feed would cause no health risk to consumers. The second approach may be appropriate for Bangladesh. The dumping of solid waste in landfills is not practicable and not in conformity with the present-day idea of industrial symbiosis.

Keywords: Public Health, Solid Waste, Tannery, Chromium Toxicity, Animal feed.

Paper ID: CEST2017_00428

SESSION 39 – EFFICIENT CONVERSION OF BIOMASS AND WASTE INTO VALUABLE PRODUCTS (2)

Saturday 2 September 2017 - afternoon

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Bio-processing of agricultural residues to bio-fuels using *Neurospora discreta*

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Abstract

The use of lignocellulosic agricultural residues for production of biofuels can address two pressing concerns of waste treatment and energy crisis simultaneously. However, the lignin present in these residues poses a challenge due to its recalcitrance, resulting in low overall yields despite using multi-step processes employing strong chemicals or high energy input to degrade the lignin. 'Complete bioprocessing' of agricultural residues using microorganisms is in its nascent stages of development and offers a promising alternative to existing processes. In our lab, we have found that a locally isolated fungus, *Neurospora discreta* can be used for such a process as it has the enzymatic machinery required for complete degradation of lignocellulosic biomass and producing not only ethanol but also carotenoids which can serve as a value-added product. A proof of concept study for complete bioprocessing of two types of agricultural residues using *N. discreta* is discussed here.

Keywords: Biofuels, lignocellulosic biomass, complete bioprocessing, *Neurospora discreta*

Paper ID: CEST2017_00822

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Recycling of SO_2: Its conversion into elemental sulfur

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Abstract

The environmental pollution by the industry and thermal power plants with adverse gas emissions is considered to be one of the most important ecological issues nowadays. The project is aimed at the SO_2 utilization and its conversion into elemental sulfur. The hunting of SO_2 with the existing mechanisms is based on the chemical conversion of the oxide into solid compound. The new approach of the alteration of inorganic compounds is preseneted in the project bypassing the traditional ways of chemical alteration realization. It gives an opportunity to utilize SO_2 by recovering the elemental sulfur from its oxide. The innovation is based on the realization of the sulfur dioxide conversion coupled process by the effect of the hydrogen oxidation branched chain reaction. As revealed in the researches, the hydrogen-oxygen mixtures containing SO_2 implement regular flaming mode in which SO_2 is converting into elemental sulfur (low temperature burning) in the low pressure and temperature and flow conditions. It's obvious that in these conditions (T = 450-510 °C, P≤ 200 Torr) molecular hydrogen separately does not interact with the sulfur dioxide. In the result the coupled full chain process is fulfilled, when inorganic compounds as well as primary reagents are complied into intensive chemical conversion.

Keywords: environmental pollution, recycling, emissions, utilization, elemental sulfur, conversion, chain reaction

Paper ID: CEST2017_01219

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Syngas Production via Ethanol Dry Reforming: Effect of Promoter Type on Al_2O_3-supported Co Catalysts

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Abstract

Lanthanide-promoted (ceria and lanthana) and unpromoted 10%Co/Al_2O_3 catalysts were synthesized via co-impregnation technique and evaluated for ethanol dry reforming in a quartz fixed-bed reactor at $P_{CO2} = P_{C2H5OH} = 20$ kPa and reaction temperature of 973 K under atmospheric pressure. Both Co_3O_4 and $CoAl_2O_4$ phases were formed on the surface of promoted and unpromoted catalysts. The reduction of Co_3O_4 to CoO phase was facilitated by CeO_2 or La_2O_3 addition. C_2H_5OH conversion improved significantly up to about 1.2 and 1.9 times with the addition of CeO_2 and La_2O_3 promoters, respectively. La-promoted catalyst appeared to be the best catalyst in terms of H_2 and CO yields as well as C_2H_5OH conversion followed by Ce-promoted and unpromoted catalysts.

Keywords: Ethanol dry reforming, Co-based catalysts, Hydrogen, Syngas

Paper ID: CEST2017_00522

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of Alternative MSW Treatment Technologies with the aim of Energy Recovery in the Municipality of Vari-Voula-Vouliagmeni

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Abstract

The design and implementation of flexible plants with thermal or biological waste treatment methods are significantly important in conjunction with European and National environmental legislations. Alternative Municipal Solid Waste (MSW) management is directly linked to the reduction of the biodegradable fraction and total waste mass disposed to landfill sites. This paper focuses on the techno-economic analysis of a small scale waste management project through an integrated mechanical-biological treatment scheme which includes the technology of anaerobic digestion (AD) for combined heat and power (CHP) production. Additionally, the main technical and design parameters of the digesters are also reviewed. The goal is to investigate the economic viability of the integration MSW concept by comparing it to the current practice of waste disposal.

Keywords: municipal solid waste, mechanical biological treatment, waste treatment products, dry anaerobic digestion, composting

Paper ID: CEST2017_01346

PART B - POSTER PRESENTATIONS

WATER AND WASTEWATER TREATMENT

Thursday 31 August 2017

Potential of *Azolla pinnata* for removal of cadmium from wastewater by phytoremediation

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Abstract

In this study, Azolla pinnata is a free- floating plant was obtained from Agric. Microbial Dept., Soils, Water and Environment Research Institute (SWERI), Agric. Res. Center (ARC), Giza, Egypt and used to investigate its bioindicative value by evaluating its ability to accumulate different concentrations of Cd^{+2} (0, 0.1, 0.2, 0.3, 0.4 and 0.5 ppm) in the form of Cd $(NO_3)_2.4H_2O$. The effect of different concentrations of Cd^{+2} on biomass production of this plant, doubling time and metal accumulation was studied. In such concern, growth of A. pinnata was determined during 25 days of incubation under greenhouse conditions. From the results of this study, it can be concluded that A. pinnata could be used as a reliable way for biomonitoring of cadmium and in pollution assessment. Overall, A. pinnata is an effective, eco-friendly and low-cost treatment technology.

Keywords: Azolla pinnata, Phytoremediation, Wastewater, Cadmium

Paper ID: CEST2017_00055

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Nitrite dosage strategy on N_2O production for denitrifying phosphorus accumulating organisms acclimated with different electron acceptors

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Abstract

Simultaneous nitrogen and phosphorus removal by denitrifying polyphosphate accumulating organisms (DNPAOs) is a promising process for wastewater treatment. However, high potential of nitrous oxide (N_2O) emission may occur in this process, which would limit its sustainable application. Effect of nitrite dosage strategy on N_2O production for DNPAOs acclimated with different electron acceptors was examined. N_2O emission by the enriched DNPAOs was mainly affected by electron acceptor rather than intracellular organic carbon, and a high emission potential occurred with nitrite as the electron acceptor. By applying pulse dosage of nitrite, N_2O emission was reduced significantly. In addition, a high N_2O emission potential was observed for DNPAOs acclimated with nitrite than nitrate, indicating that the acclimation history had a high effect on system performance. Under all conditions, adequate anoxic duration should be maintained to denitrify the dissolved N_2O, which was another mitigating strategy for N_2O emission.

Keywords: Denitrifying phosphorus removal; DNPAOs; N_2O; Electron acceptor

Paper ID: CEST2017_00273

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Factors influencing water conservation & the reliability of human interdependence paradigm scale in Pakistan: A quantitative analysis

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Abstract

A study was conducted to examine the relationship of variables from the Norm Activation Model and water conservation behaviors as well as to assess the reliability of the Human Interdependence Paradigm in a Pakistani context. Since water scarcity has become a major environmental threat to the existence of humankind in the 21st century, there is a dire need to look at ways to promote water conservation behaviors and to perpetuate a conservation culture within societal levels. In this study participants from various walks of life, will be asked to fill out a questionnaire that will consist of items incorporating items such as Personal Norms, Awareness of Consequences and Ascription of responsibility as well as items of the Human Interdependence Paradigm scale. The results will be utilized to gain a broader perspective about the Pakistani culture in terms of conservation behaviors and adherence to various environmental worldviews on a subliminal level.

Keywords: Water Conservation Behaviors, Norm Activation Model, Pro-environmental behavior, New Human Interdependence Paradigm, Karachi

Paper ID: CEST2017_00297

Microbiological safety and quality of water intended for human consumption.

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Abstract

The following article's objective is to analyze the microbiological safety and quality of water for consumption, illustrated with an example of water for Częstochowa city located in Silesia region, Poland. Underground water is collected and treated for the needs of the residents of the city. Sanitary safety is a major priority in water treatment process, whose main aim is assuring water biostability. Biological stability of water is confirmed by the content of BDOC (biodegradable dissolved organic carbon) and AOC (assimilable organic carbon). The research results show that BDOC and AOC content in water was 42 - 56 µm/L and 4 - 9 µm/L, respectively. Therefore all examined waters met requirements for biostability in terms of BDOC and AOC content. In terms of microbiological properties, it was determined that bacteriological quality of all examined waters met applicable national standards. The value of colony forming units ranged from 10 CFU/ml to 34 CFU/ml. In terms of quality properties, the values of the physicochemical markers of the quality of water which was introduced into water system, were in consonance with requirements set for water intended for human consumption.

Keywords: water quality, BDOC, AOC, treatment of water, microbiological safety

Paper ID: CEST2017_00299

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Study of bacterial population dynamics in sequence batch reactors under different operating conditions in the presence of a metabolic uncoupler, 3,3',4',5-tetrachlorosalicylanilide (TCS)

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Abstract

The process of uncoupled metabolism has been studied since the ´90s for the reduction of sludge production. Under normal growth conditions, the catabolism and anabolism of bacteria are coupled, however under uncoupled conditions (brought on by chemical uncouplers), the catabolism is undisturbed leading to unchanged substrate consumption, while the ATP synthesis and anabolism slow down causing reduction in biomass yield. The 3,3',4',5-tetrachlorosalicylanilide (TCS) has been widely adopted as an environmentally-benign uncoupler to reduce yield of activated sludge. However, its potential impact, in the microbial community of SBR activated sludge, is unknown yet. Four parallel sequence batch reactors (SBR) with and without TCS addition were operated under different conditions, two F/M ratios, to research the microbial population dynamics by uncouplers. The 16S rRNA gene amplicon sequencing (NGS) was performed to reveal the microbial community. During the 41 days operation, the TCS of the SBR was 1 mg/L. Specific comparisons down to the family, class and genus level were done from Illumina-MiSeq amplicons. This study provides a general view of the composition of microbial communities in activated sludge of SBR operated under different conditions with TCS

Keywords: NGS, TCS, Metabolic uncoupler, Microbial communities, sludge reduction

Paper ID: CEST2017_00358

Measurement of ATP, cell viability and enzymatic activities in sequence batch reactors after addition of a metabolic uncoupler, 3,3',4',5-tetrachlorosalicylanilide (TCS)

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Abstract

A substantial part of the operating costs of activated sludge process is associated with the management and treatment of the excess sludge generated during the treatment process. Among the in-situ excess sludge reduction technologies, the metabolic uncoupler addition method is promising because it can be easily fed to the aeration tank of a wastewater treatment plants. Metabolic uncouplers disrupting proton gradient could directly decrease adenosine triphosphate (ATP) production and reduce the total energy for biomass synthesis. Thereby, monitoring the ATP variation could be beneficial to directly identify the occurrence of metabolic uncoupling in microorganisms and provide a deep understanding of the uncoupling metabolism. The more commonly tested uncouplers include 3,3',4',5-tetrachlorosalicylanilide (TCS). In this work the ATP and microbial hydrolytic enzymatic activities were measured to study the influence of TCS addition on the biomass and on the process performance. Four parallel sequence batch reactors (SBR) were evaluated under different operating conditions, two F/M ratios, during 41 days with and without TCS addition. During the 41 days operation, the TCS amount added to the SBR was 1 mg/L. ATP values showed that TCS addition has decreased the ATP generation and biomass in the reactors where TCS was added.

Keywords: ATP, redox activity, enzymatic activities, TCS metabolic uncoupler

Paper ID: CEST2017_00359

Evaluation of Long-term Changes in Wastewater Application in Different Depths of Soil

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Abstract

Water scarcity and the need for water for food production and environmental protection in the world have forced human beings to seek new water sources. Nowadays, application of unconventional water resources (wastewater) has been proposed in the countries facing shortage of water resources. However, limited studies have assessed this issue. The present study evaluated changes in elements of the soil irrigated with wastewater. For this purpose, an experiment was conducted as a randomized complete block design with three replications. Soil samples were collected from the studied regions at two depths of 0-30 cm and 30-60 cm. Studied parameters included sodium, total calcium and magnesium, acidity and electrical conductivity of the soil. Three studied regions (no irrigation, irrigation with treated wastewater, irrigation with river waters) were considered. The results showed an increase in sodium, calcium and magnesium and pH of the effluent from Zahedan Wastewater Treatment Plant compared to control. However, electrical conductivity decreased in the soil irrigated with wastewater. It can be concluded that wastewater increases some soil properties, which contributes to soil restoration.

Key words: soil, wastewater, total calcium and magnesium, Zahedan

Paper ID: CEST2017_00429

Environmental application of biogenic magnetite nanoparticles to remediate chromium(III/VI)-contaminated water

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Abstract

The physicochemical characteristics of biogenic minerals, such as their high specific surface area and high reactivity, as well as the presence of a bacterial carrier matrix make them interesting for various applications, for instance as catalysts, adsorbents, oxidants or reductants. The objective of this study was to examine the efficiency of biogenic magnetite nanoparticles (BMNs) produced by metal-reducing bacteria in removing chromium. Interactions between ionic Cr(III/VI) and BMNs were examined under different solution pH (pH 2 to pH 12) using different dose of BMNs (0 to 6 g/L). Chemically synthesized magnetite nanoparticles (CMNs) were used in experiments for comparison. Results showed that BMNs had higher Cr(VI) removal efficiency (100%) than CMNs (82%) with reaction time of 2 weeks. The lower the pH of Cr-contaminated solution and the longer the reaction time, the higher the Cr(VI) removal efficiency. The Cr(VI) removal efficiency by BMNs in Cr-contaminated groundwater was about 94% after reaction time of 2 weeks. BMNs coated with organic matter were more effective to lead adsorption of Cr(III) with electrostatic interaction (82%) and to prevent oxidation of Fe(II) within the magnetite structure than CMNs (13%). These results indicate that BMNs could be used to decontaminate ionic chromium in environmental remediation technologies.

Keywords: Chromium, Remediation, Groundwater, Magnetite, Nanoparticle

Paper ID: CEST2017_00470

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Arsenic adsorption and desorption cycles for groundwater remediation

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Abstract

Arsenic is a critical pollutant for groundwater, severely reducing the quality of water for human utilization and aquatic life, even at low concentrations. Adsorption is one of the most suitable technologies to reduce arsenic content within acceptable levels. Several studies rely on the usage of activated carbons to remove arsenic from water, but they rarely deal with the reutilization of spent carbons. This is a critical issue because the economy of adsorption processes strongly depends on the capacity of cyclically use the sorbent without replacing it after exhaustion.In a former paper, we showed that NaCl solutions effectively regenerate arsenic-spent carbons and produce saline solutions from which arsenic can be effectively precipitated. In this work, we report new experimental studies aimed to support the design of an adsorber based on a set of columns operated in either adsorption, desorption or water rinsing mode. In particular, experiments were performed on a model groundwater contaminated with 3 mg/L As(V), in order to understand how the use of the same activated carbon in consecutive adsorption-regeneration cycles modify its adsorption capacity over time. The experiments indicated that activated carbon can be proficiently used in multiple cycles, preserving more than 90% of its original adsorption capacity.

Keywords: Arsenic; activated carbon; desorption; regeneration, adsorption cycles.

Paper ID: CEST2017_00480

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Comparison of CAS, MBR, SBR, and biolak treatment systems in removal of BOD and COD from municipal wastewater—Case study: Ekbatan wastewater treatment plant

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Abstract

Progressive importance of wastewater treatment and water reclamation due to the limited nature of freshwater resources and growing demand for clean water makes a practical assessment of different treatment technologies essential to engineers. This study aims to provide an evaluation of the performance of activated sludge, membrane bioreactor, sequencing batch reactor, and Biolak treatment systems in removing BOD_5 and COD from municipal wastewater. An independent pilot for each treatment system was constructed and set up at Ekbatan wastewater treatment plant in Tehran. An extensive set of tests were performed on the effluent of the pilots under controlled operating conditions to evaluate the performance of each process. The study was conducted over a period of one year. It was found that while the CAS and Biolak pilots reached results in accordance with treatment standards, the highest water quality was achieved by the MBR and SBR pilots. Furthermore, the SBR and MBR pilots reached the maximum BOD_5 and COD removal efficiencies, respectively. Finally, it was concluded that high efficiency in conjunction with qualitative advantages such as low land occupation and easy retrofit of old plants makes SBR and MBR technologies among the most viable options for municipal wastewater treatment.

Keywords: Biolak process, Biological wastewater treatment, Conventional activated sludge, Membrane bioreactor, Sequencing batch reactor

Paper ID: CEST2017_00559

"Old" and new categories of DBPs in aqueous matrices: Analytical methods and toxicity testing

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Abstract

The by-products formed during disinfection of water and wastewater (DBPs) have been a subject of priority research since 1974 when trihalomethanes (THMs) were detected for the first time in chlorinated water by Rook. Since then, many other categories of such toxic byproducts have been identified by utilizing of advanced analytical techniques. More than 600 compounds are known today and the list is increasing. Some of them, like haloacetic acids (HAAs), have been regulated. Others, such as N-nitrosodimethylamine (NDMA), are still being investigated. New categories such as halobenzoquinones and other aromatic DBPs have been recently detected in chlorinated water, wastewater and saline water. In the present review paper, the advances in analytical methods and the main new findings are highlighted. The toxicity testing for the various categories is also presented, as some new DBPs were found to be much more toxic than the "old" ones.

Keywords: New DBPs, analytical methods, toxicity, aqueous matrices

Paper ID: CEST2017_00587

Use of halloysite-TiO_2 nanocomposites for the decomposition of tebuconazole fungicide in water

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Abstract

In this study we present halloysite clay mineral combined with TiO_2, as promising new class of nanomaterials that can be used as an effective, cost efficient and environmental friendly methodology for the decomposition of Tebuconazole, $C_{16}H_{22}ClN_3O$, [(RS)-1-p-chlorophenyl-4,4-dimethyl-3-(1H-1,2,4-triazol-1-ylmethyl)-pentan-3-ol], TEB-fungicide, in water. For this purpose halloysite-TiO_2 nanoparticles were fabricated using the sol-gel methodology combined with hydrothermal treatment of the samples in mild conditions. The halloysite-TiO_2 nanocomposites are characterized by X-Ray diffraction (XRD), scanning electron microscopy (SEM), and N_2 sorption-desorption isotherms analysis by BET for determine specific surface area (SSA). The total pore volume of the halloysite 40% - TiO_2 60% prepared nanocomposite and its specific surface area is 0.35 cm^3/g and 188 m^2/g respectively. This nanocomposite showed a photocatalytic efficiency of 39.5% to TEB decomposition after 240 minutes of UV irradiation. The best photo-degradation efficiency, 47.4% of TEB was achieved with the halloysite 10% - TiO_2 90% nanomaterial, instead of 33.2% decomposition efficiency using commercial TiO_2 (Degussa P25). In this case, the halloysite 10% - TiO_2 90% nanocomposite showed the highest specific surface area of 222 m^2/g. The degradation of TEB in all the samples studied did not change after 150 minutes of UV exposure.

Keywords: Fungicide, Photocatalysis, Tebuconazole, Halloysite, TiO_2 nanocomposites

Paper ID: CEST2017_00598

Petrochemical Industry: Wastewater treatment for water reuse

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Abstract

In water and wastewater treatment, the integration of processes is currently employed. Generally, two or three conventional processes are combined with one membrane technology, to maximize the possibilities of water reclamation and reuse. At the present work, a pilot study integrating Electrodialysis Reversal (EDR) and Reverse Osmosis (RO) processes to the treatment of a petrochemical wastewater aiming the water reuse was performed. Before the treatment by EDR-RO, the wastewater had been previously treated by conventional processes (sedimentation + activated sludge + stabilization ponds) on-site in the petrochemical wastewater treatment plant. The RO pilot plant has a spiral-wound polyamide membrane, Dow Filmtec™ BW30-4040, with membrane area of 7.2 m², while the ED pilot plant has 75 ion-selective membrane pairs having a total area of 14.4 m^2 and platinum-coated titanium electrodes. The integrated process EDR-RO provided the recovery of high quality water with conductivity around 6 $\mu S.cm^{-1}$. The removal rates for contaminant were higher than 90% for most parameters monitored. The characteristics of the produced water were compared to the water commonly used at the cooling towers at the industry. The results showed that integrated process EDR-RO can be an alternative for process water production.

Keywords: Wastewater, Hybrid Process, Reverse Osmosis, Electrodialysis Reversal, Reuse

Paper ID: CEST2017_00711

Evaluation of antibiotics removal from wastewater by nanofiltration

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Abstract

Pharmaceuticals constitute a wide group of human and veterinary medicinal compounds largely used worldwide. Antibiotics are one of the most important pharmaceuticals found in the water, being amoxicillin one of the most commercially used due to its high antibacterial activity and large spectrum against a great variety of microorganisms. These chemicals find their way into the water via wastewater from drug manufacturing plants, hospitals, and private households. Thus, it is highly important to employ an adequate treatment for wastewater containing antibiotics. Unfortunately, although their low efficiency in removing antibiotics from wastewaters, conventional biological treatment is still the most often used treatment for this purpose. On the other hand, considering their inherent characteristics, membrane separation processes, as nanofiltration, may be performed for removing the antibiotics presented in wastewaters. At the present work, the performance of nanofiltration in removing antibiotics from wastewaters was assessed. Two nanofiltration membranes, two antibiotics (amoxicillin and norfloxacin) at different concentrations and pH of wastewater were evaluated. The results pointed out that the pH did not influence permeability, and rejections for both antibiotics were always higher than 97% in all experiments showing the viability of nanofiltration for antibiotics' removal and water reuse.

Keywords: Nanofiltration, Antibiotics Removal, Wastewater.

Paper ID: CEST2017_00725

Synergistic extraction of copper Cu(II) using di(2-ethyl hexyl) phosphoric acid (D2EHPA) and tri-n-octyl phosphine oxide (TOPO)

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Abstract

This work consists of a water purification technique that involves $Cu2^{+}$, H_3O^{+} and_ Cl^{-} ions. It is well known that extraction of Cu2+ from chlorhydric acid is quite difficult regarding to the presence of many Cu (II) species in the aqueous media. The copper is enquired to form different aqueous species such as hydroxyl: $Cu\ OH^{+}$, $Cu(OH)_2$ (aq), $Cu(OH)_3^{-}$ and $Cu(OH)_4^{-2}$ further the formation of aqueous complexes having chloride bonds. In this study we considered various forms of Cu(II) present in the chlorhydric acid solution: $CuCl^{+}$, $CuCl_2$; $CuCl_3^{-}$ $CuCl_4^{-2}$ in the aqueous phase were taken into account in the analysis of the extractions. The optimum synergetic parameter giving the ions extraction efficiency was determined for diluted copper solutions. The chemical parameters have allowed us to obtain the variables giving the optimum synergistic extraction efficiency for diluted solutions of copper. The fundamental parameters influencing the extraction synergism by mixing of two extractants, di(2-ethyl hexyl) phosphoric acid and tri-n-octyl phosphine oxid of copper(II) from chlorhydric acid solutions have been examined. The synergistic extraction by the mixture: Extractant cation exchanger (D2EHPA)/ Extractant solvating (TOPO) dissolved in kerosene were investigated.

Key words: Synergistic, extraction, copper, treatment, environment.

Paper ID: CEST2017_00729

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Arsenium and selenium removal from aqueous solutions using eco-materials

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Abstract

Environmental engineering deals with several fields, most important of them is represented by water resource protection. It is well known, that natural waters and especially groundwater contain dissolved substances, most of them unharmful for earth life, but also some potentially harmful for human and animal life. Ground waters containing dissolved arsenic and/or selenium are not suitable for human and animal life. Some prerequisite microelements for human life as Selenium becomes toxic when higher quantities are ingested. In comparison, arsenic has acute toxic effect over human and animal life even when low quantities are ingested. In both cases, the maximum amount was limited by OMS at 10 µg L-1. A new technique was used to produce an iron oxide doped graphite ecofriendly composite material for arsenic and selenium retention from water solutions. Synthesized material was characterized using SEM, EDX, DRX and DTA. Adsorption capacity and adsorption mechanism were established through equilibrium studies. Maximum adsorption capacity was 400 µg As(V) and 625 µg Se(VI) per gram of adsorbent.

Keywords: adsorption, arsenic, eco-material, selenium, toxicity

Paper ID: CEST2017_00731

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Sustainable water management in university: From fountain to campus

Ikiz A.S.

Abstract

All of the university campuses in Turkey utilize local city water resources besides a unique example in Turkey. Muğla Sitki Koçman University has its own water system independent from the city resources where local governance providing. Muğla is located in western cost of Turkey and has university founded in 1992. In 2001 university constructed a water line from 52 km away to campus from Sandras Mountain with its own efforts. The high quality drinking water is well enough to drink and use for campus utilization. From 1200 m high mountain level to 600 m. campus water flows from its own body without any other energy usage such as water pumps. Biologically treated body of water is tap drinkable in campus. In this humble paper I will provide the unique information of this aqua project in Muğla.

Keywords:

Paper ID: CEST2017_00732

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Degradation of the bendiocarb insecticide, using an adsorption and bio-desorption continuous process

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Abstract

In this work, the behavior of a multi-channel biofilm reactor (MCBR) was studied to attain an adsorption and bio-desorption system for the removal of pesticides. The MCBR operates with three airlift channels, and two channels packed with granular activated carbon (GAC) and fragments of volcanic stone (tezontle). The adsorption coefficient *Qo* of bendiocarb, contained in the commercial insecticide "Ficam W" was determined on GAC. The high value of *Qo* favors high adsorption rates of bendiocarb, which was efficiently degraded by the immobilized community in the bioreactor, together with other Ficam W ingredients. It was evidenced that both processes, adsorption, and biodegradation, operated in the reactor since the bendiocarb removal rates and efficiencies were significantly higher in the MCBR than in batch cultures where the activated carbon was not present. The selected community efficiently degraded 92% of bendiocarb in batch cultivation and was able to remove most of the benzodioxol, which is an intermediary of the degradation of bendiocarb. From the microbial community grown in MCBR, thirteen cultivable microorganisms were isolated and identified. They belong to the genera: *Pseudoxanthomonas, Ochrobactrum, Bosea, Pseudomonas, Agromyces, Bacillus, Ralstonia, Brevundimonas, Aminobacter, Paracoccus, Brevibacterium, Kakuria, and Gordonia.*

Keywords: Bendiocarb, Insecticide, Adsorption, Bio-desorption, Biodegradation

Paper ID: CEST2017_00742

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Wastewater reuse for irrigation by coagulation and ultrafiltration

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Abstract

This study presents the application of coagulation and ultrafiltration as a combined treatment of rendering plant wastewater. The coagulation was optimized in a wide range of coagulant ($FeCl_3$) dosage (10-80 mg L^{-1}) and pH (4.5-7.5) according to the response surface methodology (RSM) to achieve a minimal turbidity and total carbon with a pH close to 7. The coagulation at optimal conditions was used as the pretreatment to ultrafiltration. The ultrafiltration was performed at 5 bar with 6 commercially available membranes (GK, PT, GM, PU, PW, and MW) that have a wide range of molecular weight cut-off (3-50 kDa). The main water parameters were measured after each treatment step (biological treatment, coagulation, and ultrafiltration) as well as the flux decline during ultrafiltration. The parameters were compared to the regulations and guidelines regarding water reuse for irrigation. After the ultrafiltration, the membranes were washed with an alkaline cleaning agent (Nalco PC 99) for recovering membrane flux. According to the obtained values of measured parameters and flux decline, the best ultrafiltration membrane for wastewater reuse was selected.

Keywords: wastewater, water reuse, irrigation, coagulation, ultrafiltration

Paper ID: CEST2017_00767

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Adsorption of metribuzin from aqueous solutions using activated carbon prepared from olive-waste cake

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Abstract

The aim of the present work is the valorization of activated carbon prepared from industrial solid waste in the adsorption of metribuzin pesticide. The present study constitutes of two principal parts. The first part includes chemical activation of raw material and structural characterization of the activated carbon. In the second part, different parameters likely to have an influence on the adsorption capacity of metribuzin such as adsorbent dosage, initial solution pH and initial Metribuzin concentration were investigated. The experimental data were analyzed by the Freundlich, Langmuir, Dubinin-Radushkevich and Temkin isotherm models. The surface area of chemically modified activated carbon was 1418 m^2 g^{-1}. The experimental data indicated that the adsorption isotherms are well described by the Langmuir isotherm equation and the calculated adsorption capacity was 144.93 mg g^{-1} at 318 K. The results indicated that the activated carbon prepared from olive-waste cake is very effective for the adsorption of metribuzin from aqueous solutions.

Keywords: Activated carbon, olive-waste cake, adsorption, pesticide.

Paper ID: CEST2017_00777

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment of cow-farm wastewaters using *Platanus sp*.

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Abstract

The modern epoch is characterized by increasing concerns regarding the potentially negative effects for the environment, as a result of human activities. The spectacular progress of industry and technologies as well as the improving of life standards contributed to the introduction of an increasing number of pollutants in the aquatic environment. The ability of plants to remove contaminants from the environment has been researched over the last decades and has found a number of applications. This work presents preliminary findings on the removal-degradation of cows'-farm wastewaters. This work focused on the use of plants and more specifically in plant stems. This method is an attractive treatment option because it is simple to construct and operate, it has low cost and it uses only solar energy. Furthermore, it seems to be effective in the removal or degradation of those wastewaters. However, further research is necessary to establish a synergistic method (including biological treatment methods) which will practically enable complete removal or degradation that compounds from waters or soil.

Keywords: bioremediation, *Platanus* sp., degradation, toxicity.

Paper ID: CEST2017_00807

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterization and production of extracellular polymeric substances (EPS) by *Bacillus pseudomycoides* U10

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Abstract

Extracellular polymeric substances (EPSs) are important for industrial and medical relevance with significant commercial value. Different strategies are applied to reduce cost of production such as using cheaper substrates, improving product yield by optimizing fermentation conditions, or developing higher yielding strains via mutagenesis, and/or genetic and metabolic manipulations, and optimizing downstream processing. We aimed to determine the effect of whey, different pH values, temperature and incubation time on bacterial EPS production by *Bacillus pseudomycoides* U10. Maximum EPS production was obtained when 1 g/L whey was added to the growth medium. The optimum pH level was 7.0 and the highest EPS production was observed at 37 ºC. According to X-ray diffraction, thermogravimetric EPSs have poorly crystalline nature and exhibit two step degradations, corresponding to weight loss of moisture and/or carboxyl group and pyrolysis of EPS, without distinctive changes in different media conditions. SAXS data indicate the layer thickness of the bacterial EPS is from 12.04 to 14.07 Å for whey and dissolved LB conditions, respectively. It was found that EPS structures changed with whey addition, such as, higher d-values, lower weight losses which seemed to be related to increasing durability and/or stability.

Keywords: *Bacillus pseudomycoides*, EPS, Whey, XRD, SAXS, SEM

Paper ID: CEST2017_00830

Modeling Approach Of adsorptive removal of arsenic from aqueous solution

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Abstract

Arsenic presence in underground waters is a well-known problem around the world. Last centuries new remediation technologies have been developed for effective arsenic elimination. Nowadays, several physico-chemical remediation techniques are used, such as: adsorption, ionic exchange, coagulation, precipitation, membrane filtration. Adsorption is frequently utilized due to its easy setup and economical cost. Availability of a large number of classical and nonconventional adsorbents as well, transforms adsorption in an attractive remediation technique. Due to arsenic affinity for iron adsorbent, iron content represent a significant parameter. As adsorption on carbon based materials with graphitic structure is presented in this paper. Influence of contact time and also pH onto As adsorption were studied. Based on experimental data was modeled the influence of contact time over adsorption capacity in order to determine the optimum contact time for maximum adsorption capacity.

Keywords: arsenic, adsorption, composites, mechanism

Paper ID: CEST2017_00913

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Reduction of nitrogen content in landfill leachate using microalgae

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Abstract

Landfill leachate contains large amounts of biodegradable or refractory to biodegradation organic materials, where organic and inorganic salts, ammonia-nitrogen, heavy metals and chlorinated consist important groups. Leachate from run out municipal landfills has a lower BOD5 but still high contents of N-NH4+. Usually, the ammonium concentration could be reduced by nitrification processes followed by biological denitrification, but for leachate from run out landfills this step requires the addition of organic molecules (e.g. methanol or acetic acid) as carbon source. To overcome this drawback, the authors suggested the use of mixotrophic microalgae to reduce the nitrogen content from landfill leachate before and after nitrification processes. In fact, microalgae could potentially offer many advantages in leachate treatment, being able to use inorganic nutrients for their heterotrophic growth without an aerobic environment. Microalgae cultures were performed with different quantities of landfill leachate after microfiltration pretreatment in order to have different nitrogen concentrations in water. Additional runs were performed in landfill leachate after biological nitrification pretreatment. Runs were compared with those carried out in classic Bold Basal Medium taken as a control. During the growth, biomass was observed microscopically and the ammonium, nitrate, nitrite contents were determined.

Keywords: landfill leachate, Nitrification treatment, *Chlorella vulgaris*, Lipid content.

Paper ID: CEST2017_00925

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Preparation and Characterization of pillared clays

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Abstract

Pillared clays are a new class of materials, in which large surface and pore volumes can be obtained according to the type of pillars. These solids have enormous potential for application in adsorption and catalytic processes. In the present study, two different pillared clays were studied. At first, alpha-sepiolite wastes were collected and Al-pillared sepiolite synthesis was carried out using these wastes. Another pillared clay (Al- pillared montmorillonite) was a commercial product. The morphology and surface functional groups of the materials have been analysed with the aid of x-ray diffraction (XRD) and Fourier Transform Infrared (FT-IR) spectroscopy. The specific surface area of the pillared clays was determined by nitrogen adsorption. The specific surface area of the pillared clays was determined by nitrogen adsorption using an automatic adsorption instrument. The BET surface area of pillared clays was determined by the application of the Brunauer-Emmett-Teller (BET) analysis, software available with instrument.

Keywords: Sepiolite; Montmorillonite; Pillared-clay; Waste utilization

Paper ID: CEST2017_00949

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation of ecotoxicity of carbon nanomaterials with polyoxometalates

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Abstract

Recent research has shown the potential of nanomaterials in the environmental field, because their high specific surface area provides improved efficiency to several processes. Although their application in soil remediation and water treatment seems promising, information about their possible toxic effects in the aquatic ecosystems is still sparse. The toxicity of three polyoxometalates ($[PMo_{12}O_{40}]^{3-}$(PMo_{12}), $[PMo_{11}VO_{40}]^{4-}$ ($PMo_{11}V$), $[PMo_{10}V_2O_{40}]^{5-}$($PMo_{10}V_2$)), graphene flakes (GF) and the three polyoxometalates immobilized on GF (PMo_{12}@GF, $PMo_{11}V$@GF, $PMo_{10}V_2$@GF), which were developed to be used as catalysts on photo-oxidation processes, was evaluated towards the alga *Pseudokirchneriela subcapittata*, a recommended species for ecotoxicity tests. The experimental evaluation was carried out according to the inhibition test for algae (EC Regulation 440/2008, which was based on the OCDE Guideline 201). This is based on determining the effect in growth inhibition of the algae culture (*P. subcapitata*) exposed to the nanomaterial according to the exposure concentration of material, compared with a control culture. Determination of *in vivo* chlorophyll content by fluorescence, which is a fast and sensitive method, was used to estimate cell density. The most toxic material was the one with higher content of vanadium ($PMo_{10}V_2$@GF), for which 6.5 mg/L is the effective concentration that causes inhibition to 50% of the alga population.

Keywords: Ecotoxicity, growth inhibition, polyoxometalates, *Pseudokirchneriella subcapitata*

Paper ID: CEST2017_01032

Homogeneous reductive mediator generation using a water-containing ionic liquid medium by paired electrolysis for environmental pollutant degradation

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Abstract

The aim of present work was to minimize the cell potential to generate a homogeneous mediator by constant current electrolysis towards air pollutant removal. Initial water content analysis with a 1-butyl-3 methyl imidazolium trifluoromethane sulfonate [BMIM CF_3SO_3] ionic liquid revealed a minimum cell potential of 6 V at 18 M water. Three types of mediator precursors, $Ce(III)(SO_4)_2$, $[Co(II)(CN)_5]^{3-}$, and V(III)(acetylacetonate), were used to generate a reductive mediator by galvanostatic mode using paired electrolysis. The potentiometric titration with H_2O_2 enabled reuse of the spent ionic liquid after mediator quantification. The electrolytic reduction of V(III)(acetylacetonate) metal complex in 18 M water-containing BMIM CF_3SO_3 under optimized conditions revealed 65% of V(II)(acetylacetonate) formation. A well-defined change in the reduction efficiency of V(III)(acetylacetonate) from 18 % to 6% upon the addition of 20 mM dichloromethane demonstrated that dichloromethane reduction follows the mediated electrochemical reaction (MER). The developed system allows the use of galvanostatic mode to generate a mediator in an ionic liquid and the removal of VOCs in an effective manner.

Keywords: Water contained ionic liquid, paired electrolysis, galvanostatic mode, mediator generation, VOCs

Paper ID: CEST2017_01037

Ecotoxicity evaluation of pure peracetic acid (PAA) after eliminating hydrogen peroxide from commercial PAA

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Abstract

In recent years, disinfection of inflowing Combined sewer overflows (CSO) water in the CSO discharge structures has been studied using Peracetic acid (PAA) to minimize the impact from the discharge of untreated CSO to the surface waters. Degradation of hydrogen peroxide was slower than PAA when it was used to disinfect CSO. All previous toxicity studies was based on commercial PAA mixture and variance on toxicity value was observed due to different PAA: hydrogen peroxide ratio. In this study, hydrogen peroxide was eliminated from the PAA mixture using potassium permanganate to avoid the strict environmental risk assessments of hydrogen peroxide to obtain the permit from the authorities. Ecotoxicity data of PAA without hydrogen peroxide was obtained by conducting the battery of ecotoxicity test: the bioassays using *Vibrio fischeri*, *Daphnia magna* and *Pseudokirchneriella subcapitata*. Effect concentration (EC_{50}) of PAA without hydrogen peroxide was 0.84 mg/L for *Vibrio fischeri* and 2.46 mg/L for *Pseudokirchneriella subcapitata*, respectively whereas lethal concentration (LC_{50}) was 0.74 mg/L for *Daphnia magna*. The toxicity results showed that pure PAA was less toxic to the most commonly used aquatic species for toxicity tests compared to the commercial PAA.

Keywords: Peracetic acid, Hydrogen peroxide, Disinfection, Combined sewer overflows, Ecotoxicity

Paper ID: CEST2017_01061

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of toxicity of synthetic specific substances after ozonation process

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Abstract

Wastewater treatment processes have a key role in sustainable development as a tool of protection of surface waters from anthropogenic pollution. Ozonation process is a promising technology for removal of toxic and biologically resistant compounds from wastewater. However, the aim is not only to remove selected pollutants from wastewater but also to minimize any adverse / toxic effects of oxidation processes byproducts. In addition to assessment of physical and chemical indicators of water pollution it is very important to use also ecotoxicological bioassays for direct toxicity evaluation. This approach helps to predict the biological effects caused by wastewater discharges to water ecosystems and to find out whether the treatment process is sufficient to provide a satisfactory decrease of environmental impact (ecotoxicity). This paper documents our results in the field of removal of synthetic specific substances, especially alkylphenols and benzothiazole derivatives. Most of the compounds were efficiently removed by ozonation processes; however, toxicity of the samples remained relatively high. Further research will be focused on detoxification of the samples after ozonation.

Keywords: ecotoxicity, bioassay, ozonation processes, synthetic specific substances

Paper ID: CEST2017_01076

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biodegradability of benzothiazole ozonation products

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Abstract

Ozonation experiments were performed with model wastewater containing 100 $mg \cdot l^{-1}$ BT concentration. Ozonation was carried out in air-lift reactor with external recirculation of reaction mixture. BT removal efficiency of 80 % was measured. BT residual concentration and concentration of its degradation products after ozonation were expressed by COD and TOC values. Samples of ozonisated model wastewater were used for respirometric measurements performed with activated sludge microrganisms. Increase in exogenous oxygen uptake rate (OUR) compared to the endogenous phase was recorded in all measurements. Experimental data were fitted by Monod and Haldane equations. The best match of experimental and calculated data was achieved by Haldane kinetic model due to substrate inhibition. The results of respirometric measurements indicate that BT and its decomposition products are biodegradable. However, substrate inhibition was observed with higher COD content. Measurements have shown that ozonated wastewater OUR may increase and decrease over ozonation time. Toxicity test were performed in three organisms (*Sinapis alba*, *Daphnia magna* and *Vibrio fischeri*), and have shown that each studied organism reacts differently on ozonated wastewater.

Keywords: Ozonation, ozonation products, toxicity, oxygen uptake rate

Paper ID: CEST2017_01077

Spatial Disparity of Groundwater Depletion in Dhaka City

Md. Serajul Islam and Farzeen Farhana Islam

Abstract

Groundwater is of course a valuable natural resource for the people of Dhaka City as surface water such as lake, river, reservoir etc. are not accessible to them sufficiently. People of Dhaka City depend on groundwater specially to meet their urgent daily needs. But the present conditions of groundwater in the city are not favorable for its population. In many parts of the city there is scarcity of pure water. This study shows that the groundwater in Dhaka city is declining at an alarming rate. The continuous over withdrawal of ground water and irregular and insufficient recharge causes depletion of groundwater. Rapid growing urbanization in the past 30 years also contributed to the present condition of Dhaka City. Recently, it is found out that the declining trend of groundwater in Dhaka City is 3 meters per year. Moreover, predictions show that the demand is increasing day by day and no chances of improving the situation is there. The volume of groundwater in storage is decreasing in many areas of the Dhaka City due to permanent over pumping. Thus, it has become obligatory to find out solutions for improvement. Therefore, scientific research on groundwater depletion in Dhaka City is very crucial to bring out fruitful solutions.

Keywords : Spatial disparity, Ground water, Depletion, Dhaka City,

Paper ID: CEST2017_01087

Transport through a membrane of Fe(II) and Fe(III) from chloride medium using tri-n-butylphosphate and tri-n-octylamine as carrier

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Abstract

The aim of this work is to investigate extraction of divalent iron and trivalent iron from chlorides solutions by Tri-n-butyl phosphate(TBP) and Tri-n-octylamine (TOA) dissolved in kerosene.The physical and chemical parameters have allowed us to obtain the variables giving the optimum extraction efficiency.A chemical modelization has allowed us to suggest the extraction mechanism. The classical behaviour obtained in surroundings has been found, with an anion exchanger mechanism and solvation mechanism.

Keywords: Iron, transport, solvent extraction, environment, wastewater.

Paper ID: CEST2017_01101

Absorption of toluene in mixture of organics solvents « DEHP-Hexadecane » followed with biodegradation by activated sludge

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Abstract

A mixture of two organic solvents, Di (2-EthylHexyl) Phthalate (DEHP) and Hexadecane, was considered as absorbent for the degradation of toluene at 0.1% by volume of each of the two solvents in order to try to approach a real waste. The partition coefficients of the toluene in the pure mixture and in the "DEHP-hexadecane" emulsion in water were previously measured. The kinetics of degradation has shown that the degradation is rather slow because even after 7 days of cultivation, toluene still persists in the gaseous phase, taking account of the leaks. This can only be due to an oxygen limitation, because the amount of carbon present in the reactor is much greater with the addition of hexadecane (Béchohra *et al.*, 2015)Degradation rates of DEHP and hexadecane were 68 and 70%, respectively, after seven days and the mineralization rate was only 14.00% ± 0.05. Indeed, on the one hand, the degradation of the three sources of carbon is not complete, and finally, there are a presence of degradation by-products that have not been consumed by the microorganisms.

Keywords: Activated sludges, VOC, Biological treatment, Absorption, biodegradable solvent.

Paper ID: CEST2017_01120

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of Reactive Yellow 145 from simulated dye wastewater by Theobroma cacao pod-derived adsorbents

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Abstract

Industrial processes that discharges great quantities of reactive dyes in recipient waters merit the advancement in the color removal in wastewaters. This study produced activated carbon from Theobroma cacao pods, a waste from cocoa processing and used to remove Reactive Yellow 145 (RY 145) from simulated textile wastewater in batch experiments. The effects of operating parameters such as adsorbent dose, initial dye concentration and contact time on the adsorption of residual RY 145 were evaluated. CCD was used to optimize these operating parameters resulting to 90% removal of RY 145 after 1.5 h. Chemisorption was the dominant adsorption mechanism in this study as indicated by the high correlation of experimental data with both the Temkin isotherm (R^2=0.978) and the pseudo second-order kinetic model (R^2=0.999). Results suggest that CPAC can be an alternative for the treatment of dye-contaminated wastewaters.

Keywords: Adsorption; activated carbon; cocoa pods; reactive yellow 145; dye wastewater; optimization

Paper ID: CEST2017_01173

Removal of arsenic from water using smectite rich clay soil: insight from adsorption kinetics and adsorption isotherms

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Abstract

This study evaluates the applicability of smectite rich clay soils in arsenic removal. The mineralogical and chemical composition of the clay soils were examined using x-ray diffraction (XRD) and X-ray fluorescence (XRF) respectively. Batch experiments were used to evaluate the adsorption kinetics, isotherms and the effect of pH on As(III) and As(V) adsorption. The results showed that the As(III) data fitted well to pseudo second order of reaction kinetics while As(V) adsorption data fitted well to pseudo first order of reaction. Isotherm data was described by the Freundlich adsorption isotherm model. The adsorption of both As species was found to be affected by the solution pH. Maximum percentage of removal was found to be 53.8% at pH 6 for As(V) and 52.9% for As(III) at pH 8. It was concluded that smectite rich clay soils can be used for arsenic remediation from water. The study recommended further studies to enhance adsorptive properties of smectite rich clay soils in arsenic removal.

Keywords: Smectite rich clay soils; Adsorption kinetics; adsorption isotherm; mineralogical and chemical composition.

Paper ID: CEST2017_01269

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Monitoring of soil in Mediterranean olive groves irrigated with reclaimed water

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Abstract

Nowadays, many countries face significant problems of water scarcity. In this context, the reuse of treated wastewater represents a valid option, in some cases urged by the absence of viable alternatives. This study evaluates long-term effects of reclaimed water irrigation on soil of olive groves in a typical semi-arid region in Crete, Greece. Sampling was conducted in olive groves irrigated for more than 10 years with secondary treated wastewater. A 4-year monitoring period was conducted. Results shown that irrigation with reclaimed water had no significant impact on soil properties. Organic matter, nitrogen and phosphorus concentration was 2.5%, 625 mg/kg and 40 mg/kg, respectively. Soil salinity was also stable ranged from 1.0 mS/cm to 1.3 mS/cm. No accumulation of heavy metals in soils was observed during the experimental period.

Keywords: irrigation, water quality, carnations, domestic wastewater

Paper ID: CEST2017_01312

Potential of the drinking water supplied to the city of Barcelona and its metropolitan area to form emerging disinfection byproducts

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Abstract

Chlorinated and brominated trihalomethanes (THM4) are the main disinfection by-products known to be formed in the water supplied to the city of Barcelona and its metropolitan area. Previous efforts and investment have forced the levels of THM4 below the current regulatory limits after the potabilization process and in the distribution system. The present work aims at generating new knowledge on the potential of this potable water to form additional (unregulated) disinfection by-products (DBPs) classes: iodinated trihalomethanes, trihalogenated haloacetaldehydes, halogenated acetonitriles, halogenated acetamides, and haloacetic acids. To study this, DBP formation potential tests were performed with different water matrices representative of the mixtures that commonly occur in the distribution system, at different temperatures, and residence times. Water matrices considered included the finished water of two drinking water treatment plants, Ter and Llobregat, and the finished water of a seawater reverse-osmosis desalination plant (SWRO), per se or in mixtures. As for the investigated emerging DBPs, dibrominated species of haloacetic acids were the most abundant compounds. Total unregulated DBP concentrations measured ranged between 82 and 105 µg/L in the investigated water matrices, except in the case of desalinated water, where almost no DBPs were detected. Formation of these unregulated DBPs was linked to the DBP precursors (e.g, natural organic matter and bromide content) present in the water.

Keywords: haloacetics acids, haloacetamides, haloacetonitriles, iodinated trihalomethanes, desalinated water, trihalogenated acetaldehydes, mass spectrometry, GC-MS analysis

Paper ID: CEST2017_01387

Shipyards waste and sustainable management in Greece.

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Abstract

The shipbuilding industry and the several building or repair operations carried out in it, are reported as amongst the common sources of waste, which is not possible to extinguish but can only be eliminated through the adoption of the appropriate waste management techniques [1]. This need is enhanced further from the lack of an International regime [2] (with mandatory law requirements) specifying Shipyard operations, prevention actions and waste management techniques, and is immense in countries with a narrower regulatory establishment on Shipyard waste management, like Greece, which adopts the general E.U. Law requirements but does not offer a detailed regulatory basis concerning individual shipyard or industrial operations and the management of resulting wastes. This work, analyzes the several sources of waste generated from shipbuilding activities [3], and investigates the extent that these wastes can be managed in a sustained manner [4], for the case of "Neorion Syros" Shipyard (NSS hereafter) in Greece. The results show that, NSS undertakes almost all possible shipbuilding or repair operations (sandblastings, paintings, use of solvents etc.) apart from the dissolution of ships, thereby producing a broad range of solid and liquid wastes (VOCs, TBT etc.) and air emissions [5] that spread across Syros [6] and heavily pollute the island and the sea, especially under specific weather conditions, making the need for the elimination of pollution related with the operation of the Shipyard, an area of intense interest and importance.

Keywords : Treatment Shipyards Wastes, sustainable waste management, pollution, shipbuilding repair industry.

Paper ID: CEST2017_01423

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of microfiltration and ultrafiltration membranes for olive mill wastewater fractionation

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Abstract

Olive mill wastewater (OMW) is one of the main wastes generated during the production of olive oil and represents an environmental problem of this agro-industrial process. It is extremely difficult due to its considerable volume and high organic matter concentration. Its principal components are polysaccharides, sugars, polyphenols, polyalcohols, proteins, organic acids, and oil.Among them, phenolic compounds represent one of the major factors of the environmental problems caused by OMW. They are present in high concentration and they have different negative effects such as phytotoxicity, toxicity against aquatic organisms, suppression of soil microorganisms and difficulty to decompose. On the other hand, phenolic compounds possess high antioxidant activity that makes them interesting for the food, pharmaceutical and cosmetic industries. The recovery of these compounds by different physicochemical methodologies represents an important objective for this industry that will help to obtain interesting extracts and reduce the volume of this industrial by-product.In this work, the goal was the fractionation of fresh olive mill wastewater of two-phase olive oil production mills and directly driven to the laboratory. For this objective, and prior to run bench or pilot-scale experiments, a novel screening of microfiltration (MF), ultrafiltration (UF) and loose nanofiltration (NF) membranes was performed.

Keywords: olive mill wastewater, circular economy, membranes, polyphenols.

Paper ID: CEST2017_00383

EMERGING POLLUTANTS

Thursday 31 August 2017

Assessment of PFOS and PFOSF

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Abstract

Perfluorooctane-sulfonic acid (PFOS) and perfluorooctane sulfonyl fluoride (PFOSF) are pollutants covered by the Stockholm Convention on Persistent Organic Pollutants since 2009. Because of their unique lipophobic and hydrophobic properties PFOS, PFOSF, and related chemicals were widely used in production of different industrial and consumer goods. Due to widespread use and extreme resistance to environmental breakdown, these chemicals can be found practically everywhere. Based on data for 1998-2012 PFOS/PFOSF content was estimated at concentrations of 0.01 – 0.05% in:- different consumer goods (paints, varnishes, washing detergents, furniture, electric/electronic equipment, etc.), - industrial products (electric/electronic parts, fire extinguisher additives, etc.) Mentioned products were mostly imported.Analysis of the sectors that use PFOS and its salt shows that 70% (13 tons) of PFOSs was used in the textile and upholstery sector such as furniture, mattresses, pillows and similar products. The second largest user of PFOSs was the coating and additive industry with 13% (2.5 tons) and the third largest user of PFOSs was the sector, which mainly includes consumer goods like washing detergents, sanitary and household items, and antioxidants. The use of PFOSs in the latter sector is not allowed as per Part III of Annex B of the Stockholm Convention.

Keywords: persistent organic pollutants, emerging pollutants, PFOS/PFOSF

Paper ID: CEST2017_00286

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Risk assessment associated with the presence of emerging organic contaminants released from wastewater treatment plants in sludge amended soil and effects on terrestrial life: Greece as a case study.

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Abstract

The purpose of this study was to estimate the environmental risk associated with the existence of 99 emerging organic contaminants released from municipal wastewater in the terrestrial environment. Chemical analyses were carried out for 50 pharmaceuticals and illicit drugs; whereas a literature review was held to record the concentration levels of the target compounds in sewage sludge. Risk assessment was based on both terrestrial and aquatic toxicity data. An extensive literature review was also conducted in order to record the experimental acute toxicity data of these compounds (EC_{50}/LC_{50} values). In cases that no experimental toxicity data was available, ECOSAR model (U.S. EPA) was used. According to the results, triclosan presented the highest possibility for ecological threat both in terrestrial and aquatic data based risk assessment. Additionally, another 11 organic micropollutants, belonging to the groups of pharmaceuticals, synthetic phenolic compounds, siloxanes and benzothiazoles, exhibited environmental hazard, as their RQ values exceeded 1. Illicit drugs, perfluorinated compounds and benzotriazoles presented no environmental risk for the terrestrial organisms. The estimated threat due to nonylphenolic compounds seemed to be affected by the sludge source and the day of sampling, while these factors did not affect the risk presented by the rest of the compounds.

Keywords: emerging contaminants, wastewater, sludge-amended soil, risk assessment.

Paper ID: CEST2017_00425

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Investigation of benzotriazoles' fate in *Lemna minor* systems

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Abstract

The removal of five benzotriazoles (1H-benzotriazole, BTR; 4-methyl-1H-benzotriazole, 4TTR; 5-methyl-1H-benzotriazole, 5TTR; xylytriazole, XTR and 5-chlorobenzotriazole, CBTR) from water and treated wastewater using duckweed *Lemna minor* bioreactors was investigated. Batch experiments were initially carried out in triplicates to study the role of photodegradation, hydrolysis, and plant uptake on target compounds removal and the relevant kinetics constants and half-lives of the target compounds were calculated. Afterwards, a continuous flow lab-scale system comprised from one treatment line with three duckweed mini ponds in series was used to investigate the removal of target compounds from secondary treated wastewater. The system operated for a period of three months with a total hydraulic retention time of 8.3 days. All analyses of micropollutants were carried out using an HPLC-DAD system. According to the results, the tested substances were significantly removed in batch experiments with active *Lemna minor*. Calculation of half-lives values revealed significant differences according to the compound, ranging between 1.6 ± 0.3 d (CBTR) and 25 ± 3.6 d (4TTR). The target benzotriazoles were significantly removed in the continuous-flow system. The lowest removal was noticed for 4TTR (26%), while the highest for CBTR (72%).

Keywords: micropollutants, constructed wetlands, plant uptake, elimination

Paper ID: CEST2017_00426

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Photocatalytic degradation of o-Chloranil on nano Crystalline Cellulose Doped Titania

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Abstract

The photocatalytic degradation of o-chloranil was investigated in aqueous mixtures of nanocrystalline cellulose (NCC) doped titanium dioxide. Different loadings of catalysts NCC/TiO2 (10, 20, 40 and 80%) was synthesized and characterized by analytical techniques. The degradation was examined by observing the variation in substrate concentration employing UV spectroscopic analysis as a function of irradiation time in the presence of UV light at neutral pH condition. The 20% NCC/TiO2 catalyst showed excellent degradation and mineralization of o-chloranil in 2 h. The degradation products were analysed and identified by using LC-MS. The photo-catalyst offers many benefits such as easy preparation, non-hazardous, inexpensive, high stability and recyclability with no loss of activity.

Keywords: *o*-Chloranil; Advanced Oxidation Process; Nano Crystalline Cellulose; TiO_2; Photocatalytic Degradation.

Paper ID: CEST2017_00558

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The occurrence of "red" substances in "green" household products: A preliminary investigation

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Abstract

During the last decades, a vast number of synthetic organic substances, proved to be toxic for the environment and human health, have been included in almost every single product used in our everyday life, from cosmetics and detergents to baby care products. The green chemistry sector, trying to cope with this problem, introduced less toxic products, more friendly to the environment, with minimized toxic substances use. Many of these products today are being used by consumers and are labeled as natural products. However is this true in all cases? The present paper aims to highlight the "red" substances problem in "green" household products. Initially a literature review was performed to determine the most common categories of substances in household products. A preliminary investigation followed, by selecting representative products from different categories of household products, labeled as natural, and analyzing their ingredients according to their toxicity via relevant databases available online. The results revealed that most "green" products we use daily, actually include more "red" substances than we think they do...

Keywords: "red" substances, green chemistry, household products, toxicity, environment

Paper ID: CEST2017_00586

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Occurrence of antibiotics and bacterial resistance in wastewater and sea water from the Antarctic

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Abstract

The potential presence of introduced antibiotics in the aquatic environment is a hot topic of concern, particularly in the Antarctic, a highly vulnerable area protected under the Madrid protocol. The increasing presence of human population, especially during summer, might led to the appearance of pharmaceuticals in wastewater. The previous discovery of *Escherichia coli* strains resistance to antibiotics in seawater and wastewater collected in King George Island motivated our investigation on antibiotics occurrence in these samples. The application of a multi-residue LC-MS/MS method for 20 antibiotics, revealed the presence of several compounds, mainly quinolones and macrolids, in treated wastewater. Analysis of seawater collected near the exit of the human wastes also showed the sporadic presence of a few compounds at low ng/L levels, illustrating the impact of pharmaceuticals consumption and the poor removal of these compounds in conventional WWTPs. Our preliminary data demonstrate that antibiotics occurrence in the Antarctic aquatic environment is an issue that needs to be properly addressed. Periodical monitoring of water samples and the implementation of additional treatments in the WWTPs are recommended as a first step to prevent potential problems in the near future in Antarctica.

Keywords: Antarctic; antibiotics; bacterial resistance; wastewater and sea water; liquid chromatography-tandem mass spectrometry.

Paper ID: CEST2017_00630

Levels of Polycyclic Aromatic Hydrocarbons (PAH4) in some popular tea brands in Nigeria

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Abstract

The occurrence of 16 USEPA priority polycyclic aromatic hydrocarbons (PAHs) in twenty-three (23) popular green, black and herbal tea brands sold in Nigeria were investigated with focus on four PAHs (PAH4), classified by the European Food Safety Authority (EFSA) as suitable carcinogenic and mutagenic indicators: benz[a]anthracene (B[a]A), chrysene (CHR), benzo[b]fluoranthene (B[b]F) and benzo[a]pyrene (B[a]P). PAHs congeners were analyzed using an Agilent 7890A gas chromatograph (GC) with 7683B auto-sampler equipped with flame ionization detector (FID), with percentage recovery higher than 90.24%. The degree of contamination concentration expressed as sum of sixteen priority PAHs ($\sum_{16}$PAHs) ranged between 1.63±0.33–75.53±6.07, 4.71±0.23–79.61±7.02, and 12.52±0.15–26.89±0.68 µg/kg, for green, herbal and black tea, respectively. The PAH4 levels ranged from 1.28 – 44.57, 4.34 – 11.20, and 0.76 – 34.82 µg/kg, in green, black and herbal tea products, respectively. The highest PAH4 contribution relative to $\sum_{16}$PAHs was 71.37% in Twinings Pure Green Tea, 48.76% in Top Tea Regular (black tea), and 85.53% in Kidney Flush Herbal Tea. The estimated BaP-equivalent carcinogenicity (BaP-TEQ) and mutagenicity (BaP-MEQ) risks indicate highest TEQ in Joint Care Herbal Tea, while Typhoo Pure Green Tea had the lowest BaP-TEQ (0.16) and BaP-MEQ (0.43). Benzo[a]pyrene played a significant role in the carcinogenicity and mutagenicity potentials.

Keywords: Polycyclic aromatic hydrocarbons, PAH, Beverages, Carcinogens, Food contaminant, Mutagens

Paper ID: CEST2017_00644

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Chemical cleaning of adsorbed pharmaceutical on NF/RO membranes

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Abstract

Nanofiltration (NF) and reverse osmosis (RO) have proved to be effective in the removal of various pharmaceuticals. One of the main rejection mechanisms is interaction/adsorption since pharmaceuticals, especially hydrophobic, adsorb on membrane polymeric matrix. Albendazole as hydrophobic pharmaceutical passed through 6 different NF/RO membranes (NF, NF90, NF270, BW30, UTC-70HA and XLE) at a pressure of 10 bar. Adsorption was confirmed with increase in concentrations of albendazole in permeate, and therefore decrease in rejection factor, and appearance of new peaks (showing new bonds) on Fourier transformation infrared (FTIR) spectra. Commercially available cleaning solution (Nalco PC99) was used to remove adsorbed albendazole from the membranes. FTIR spectra were used to confirm efficacy of cleaning agent. The results showed that commercially available cleaning solution was not appropriate for removal of adsorbed hydrophobic compound. FTIR spectra after adsorption and after chemical cleaning were similar showing that bonds (direct H-bonding between H of the OH group and N of the heterocyclic ring, stretching of C=C double bond in aromatic ring, string bending of the methyl group) between membrane polymeric matrix and albendazole were still present.

Keywords: adsorption, pharmaceutical, cleaning, nanofiltration, reverse osmosis

Paper ID: CEST2017_00766

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Fate of hydroxychloroquine in the aquatic environment

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Abstract

Hydroxychloroquine (HCQ) is a drug used to prevent or treat malaria infections and to treat certain auto-immune diseases such as lupus and rheumatoid arthritis. It is a high production volume pharmaceutical and has a potential for being persistent and bioaccumulative. In this work hydrolytic and photolytic stability of hydroxychloroquine was investigated. Hydrolytic stability was examined according to the OECD guideline 111 and preliminary results show that hydroxychloroquine is resistant to hydrolytic degradation. The photolytic degradation of HCQ was investigated under simulated solar radiation in MilliQ water and spring water. The results showed that investigated pharmaceutical degrade very slowly with half-laves of 5.5 h and 11.6 h in spring and MilliQ water, respectively. Effect of pH value on photodegradation rate was examined and results show significantly influence, faster degradation was observed at higher pH value. Obtained half-lives ranged from 23.1 h for pH 4 to 5.5 min for pH 9. Photodegradation followed first order kinetics with coefficients of determination (r^2) higher than 0.99. Samples from hydrolytic and photolytic experiments were analyzed using high performance liquid chromatography.

Keywords: pharmaceuticals, hydroxychloquine, hydrolysis, photolysis

Paper ID: CEST2017_00817

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Occurrence of synthetic musks in marine shellfish along French coasts

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Abstract

The geographical distribution of synthetic musk (SM) contamination was investigated in filter-feeding molluscs collected along French coasts (English Channel, Atlantic and Mediterranean). Four SMs (tonalide - AHTN, galaxolide - HHCB, musk xylene – MX and musk ketone – MK) were analysed in samples collected between 2013 and 2015. Musk patterns were dominated by the polycyclic musks AHTN and HHCB at all sites and in all study years, accounting for more than 90 % of the sum of the four studied musks. Over the 3-year period, median values at all sites were 0.007, 0.017, 0.18 and 0.83 ng/g ww for MX, MK, AHTN and HHCB respectively. Maximum concentrations were found for HHCB (14.1 ng/g ww) and AHTN (2.40 ng/g ww) in the Seine Bay (English Channel). Wide variations in contamination levels were found across the study sites, probably related to domestic activities. The Seine Bay, subjected to major anthropic pressure, was the most heavily-impacted site, while samples from the Atlantic coast exhibited the lowest levels. This study demonstrated the widespread occurrence of polycyclic musks on French coasts.

Keywords: Synthetic musks, shellfish, coastal marine environment

Paper ID: CEST2017_00909

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Occurrence of emerging contaminants in a river system and characterization of the microbial community in the river sediments

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Abstract

The presence of four non-steroidal anti-inflammatory drugs (Ibuprofen, Naproxen, Diclofenac, Ketoprofen) and five endocrine disrupters (Nonylphenol, Nonylphenol monoethoxylate, Nonylphenol diethoxylate, Bisphenol A, Triclosan) in a Greek river system (Spercheios river) and in one of its tributaries (German ditch) which receives treated municipal wastewater was investigated. Water samples were taken from six points along the river, five samples along the ditch, while samples were also collected from the outfall of the wastewater treatment plant located nearby. The tested compounds were frequently detected in the river water while the concentrations were higher in ditch water and wastewater. Among the compounds, phenolic substances were detected in all samples, with nonylphenol and its selected ethoxylates being the dominant pollutants in the water column while the calculation of the daily loads of these compounds showed substantial discharged quantities in the Maliakos Gulf. Although the sewage plant seemed to be an important source for the compounds to the river system, all the compounds were also detected upstream the sewage treatment plant outfall, reflecting additional sources in the upstream basin. Finally, although the microbial community varies between different redox conditions, the removal efficiency is similar; also high micropollutants' concentration seems to decrease slightly Archaea population.

Keywords: emerging contaminants; surface water; wastewater; Fluorescence In Situ Hybridization analysis

Paper ID: CEST2017_00992

Impact of venlafaxine in the growth of the microalga *Pseudokirchneriella subcapitata*

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Abstract

It has been observed an increase in the consumption of antidepressants, and venlafaxine appears among the most consumed. Its presence in the environment, together with other antidepressants, has been reported all over the world. Nevertheless, the knowledge in its possible ecotoxic effects is still limited. Therefore, it is imperative to evaluate their impact in the aquatic ecosystems. In this context, the effect of venlafaxine in the growth of the microalga *Pseudokirchneriella subcapitata* was evaluated. The experiments were carried out in agreement to the inhibition test for algae (EC Regulation 440/2008, which was based on the OCDE Guideline 201). *P. subcapitata* was chosen, because it is highly sensitive to contamination from aquatic environment and it is also recommended as a standard organism for ecotoxicity tests. The effect of different concentrations of venlafaxine in the growth of the microalgae was evaluated by determining the content of chlorophyll *in vivo* by fluorescence and comparing to a control culture. Venlafaxine showed to have toxic effects to *P.subcapitata*, with EC_{10} and EC_{50} of 0.9 and 11.0 mg/L, respectively. According to the "Globally harmonized system of classification and labelling of chemicals (GHS)" (United Nations), venlafaxine can be classified as toxic to the aquatic organisms.

Keywords: Ecotoxicity, growth inhibition, *Pseudokirchneriella subcapitata*, venlafaxine

Paper ID: CEST2017_01033

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Determination of pesticides residues in food of vegetal origin: sample preparation, chromatographic techniques and applications

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Abstract

The determination of pesticide residues in trace levels contained in complex matrices, such as food, often requires extensive sample preparation including extraction and/or clean-up followed by instrumental analysis. The development of reliable, accurate, selective and sensitive analytical methods for the simultaneous determination of more than one residue in a simple analysis is crucial and essential. This review presents the techniques that have been developed and are applied all over the world for the qualitative and quantitative determination of pesticides in fruit and vegetable samples. Advantages and difficulties occurring at each stage of the analytical procedure are also outlined.

Keywords: Pesticides, food, sample preparation, residue analysis, chromatography

Paper ID: CEST2017_01226

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Development of a multi-class analytical method by SPE and LC-MS/MS for the determination of pharmaceuticals in wastewater samples

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Abstract

Over the last decades the consumption of pharmaceuticals by humans and animals has resulted in the appearance of their residues in the environment that may cause unknown risks. Present study aims to investigate the existence and the residue concentration levels of pharmaceuticals in wastewaters before and after processing by a sewage treatment plant (STP) with a membrane bio-reactor. Additionally, samples were further purified by the reverse osmosis process. In this work, a multi-class method for the simultaneous determination of pharmaceuticals in wastewater samples, has been developed, using SPE and LC-MS/MS analysis. The sample pre-treatment consisted of a solid-phase extraction using Oasis MCX and HLB cartridges. Analytes were pharmaceuticals mainly used as antibiotics, non-steroidal anti-inflammatory drugs, antihypertensives, antidepressants, anticonvulsants and drugs for stomach diseases (proton pump inhibitors) and for the prevention of cardiovascular diseases (statins). It was found that in the first waste water treatment stage of the bioreactor membranes is achieved a substantial reduction of pharmaceuticals concentrations while in the second stage of reverse osmosis is achieved almost complete elimination of pollutants.

Keywords: pharmaceuticals, environment, wastewater, SPE, LC-MS/MS

Paper ID: CEST2017_01265

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of niflumic acid during ozonation and identification of its transformation products by LC-QToF-MS

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Abstract

Recent studies have demonstrated the occurrence of pharmaceuticals in the aquatic environment, from ng to μg per litter, depending on their physicochemical properties and biodegradability. Among pharmaceuticals, nonsteroidal anti-inflammatory drugs (NSAIDs), including compounds used as analgesics, is one of the most important groups of pharmaceuticals due to their wide use [Coelho (2010)]. NSAIDs were detected in numerous secondary treated wastewater samples worldwide indicating their incomplete removal by the conventional processes applied in waste water treatment plants (WWTPs) [Loos (2013), Kasprzyk-Hordern (2009)]. Niflumic acid (NA) was detected in various environmental samples of Greece, recently. In particular, it was detected a) in concentration levels ranging from 420 to 675 ng/L in samples obtained from the main wastewater treatment plant (WWTP) in Athens in 2011 [Dasenaki and Thomaidis (2015)], b) in twenty-four hour flow-proportional samples of secondary wastewater samples, with 100% frequency detection, collected from the same WWTP in 2014 [Ibanez (2016)], c) in all treated sewage sludge samples collected from five WWTPs of Santorini in July 2013 in a mean concentration of 40.9 ng/g d.w. [Gago-Ferrero (2015)] and d) in samples collected from seawater of Eastern Mediterranean Sea, Saronikos Gulf and Elefsina Bay during December 2013 with frequency detection ≥ 50% [Alygizakis (2016)]. Although ozonation is a promising tertiary treatment technique for the elimination of micropollutants, the reactivity of ozone towards organic compounds may lead to the formation of structurally-related compounds called transformation products (TPs). The identification of these compounds is essential not only to provide a comprehensive risk assessment on micropollutants fate in the environment, but also to design improved technologies for the removal of persistent contaminants.In this study, the removal of NA during ozonation was investigated and the identification of its TPs was realized through suspect and non-target screening approaches. The influence of different initial ozone concentrations and different pH values of the reaction mixture on NA's removal was tested. After analysis by reversed-phase liquid chromatography quadrupole-time-of-flight mass spectrometry (RPLC-QToF-MS) in both positive and negative electrospray ionization mode, detection and identification of TPs was realized. Structure elucidation was based on accurate mass, isotopic pattern measurements and interpretation of the acquired MS/MS spectra. Moreover, an in-house retention time prediction model [Aalizadeh (2016)] was used as a supporting tool for their identification.Results indicated the highly reactivity of NA with the molecular ozone, since the reaction was extremely fast and was completed within the first minute. Initial ozone concentration and aqueous solution's pH were proven to be crucial experimental parameters. An initial ozone concentration of 5 mg/L led to total NA elimination, while 70% of removal was achieved at acidic pH when 2 mg/L of ozone were added. A total of thirteen TPs of NA were identified. The structure elucidation of the TPs showed that the oxidation occurred in the heterocyclic ring of the molecule, while the aniline-like part remained intact by ozone attack due to the presence of the three fluoride atoms, which act as electron withdrawing groups. The most abundant identified TP was 2-aminopyridine-3-carboxylic acid (NA-138), formed by the breakdown of NA structure during ozonation. This TP was confirmed through the analysis of the corresponding reference standard. The high reactivity of the pyridine-like moiety of the parent compound with ozone was proven in ozonation experiments in which NA-138 was used as parent compound. It was completely removed when 5 mg/L of ozone were added and three ozonation TPs of NA-138, and thus second generation TPs of NA were detected. A probable structure based on diagnostic evidence was proposed for the one of them, while only an unequivocal formula was assigned to the other two.

Keywords: ozonation, niflumic acid, pharmaceuticals, emerging pollutants, transformation products

Paper ID: CEST2017_01266

Identification of biotransformation products of p-methoxy methamphetamine and dihydro-mephedrone formed in activated sludge by LC-QToF-MS

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Abstract

Para-methoxy-methamphetamine (PMMA) is a new psychoactive substance (NPS). As a structurally related analog of methamphetamine, PMMA is presented mimic effects to ecstasy (3,4-methylenedioxymethamphetamine, MDMA) and through metabolic paths is transformed to para-methoxyamphetamine (PMA) (WHO, 2015). In addition, dihydro mephedrone (DHMEPH) is the major phase I human metabolite of mephedrone, a synthetic stimulant drug of the class of cathinones (WHO, 2014). These parent compounds and their metabolites are excreted in the aquatic environment due to incomplete removal by the sewage treatment or/and by biotransformation process occurring at the wastewater treatment plants (WWTPs) (Kiyua et al., 2015). In the aeration tanks of the WWTPs, microbial degradation processes are taking place, resulting in the elimination of the organic load during biological wastewater treatment, by formation of transformation products (TPs). The key-role to assess the risk to the exposure of aquatic biota to the formed TPs is; a) to obtain knowledge of how fast the parent compounds degrade/transformed and b) to identify the formed TPs as they can be more polar and thus environmentally (pseudo)persistent (Clarke and Smith, 2011). Little is known about the behavior and transformation products of PMMA and DHMEPH during wastewater treatment. Herein, batch reactors seeded with activated sludge from the WWTP of Athens were set up to assess biotic, abiotic and sorption losses of PMMA and DHMEPH. The main objectives of the study were: (a) the identification of the formed TPs by applying suspect and non-target screening strategies based on liquid chromatography quadrupole-time-of-flight mass spectrometry (LC-QTOF-MS) and (b) the structure elucidation of the candidate TPs, based on accurate mass and isotopic pattern measurements by HRMS and tentative interpretation of MS/MS spectra, using *in silico* fragmentation tools. The complementary use of reversed phase liquid chromatography (RPLC) and hydrophilic interaction liquid chromatography (HILIC) for the identification of polar TPs, and the application of in-house developed quantitative structure-retention relationship (QSRR) prediction models, in addition to the comprehensive evaluation of the obtained MS/MS spectra, provided valuable information to support the identification (Beretsou et al., 2016). O-demethylation and N-demethylation were found among the dominant biotransformation mechanisms. Other main observed reactions were hydroxylation, oxidation and N-methylation. Mephedrone was found to be formed back from its human metabolite DHMEPH. For all the TPs, tentative candidates were proposed. HILIC-HRMS analyses proved a powerful orthogonal tool for the identification, because many polar TPs presented higher sensitivity and clearer MS/MS spectra.

Keywords: transformation products; HRMS; activated sludge; PMMA; dihydro-mephedrone.

Paper ID: CEST2017_01331

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Uncertainties about analytical methods and removal processes of some drugs of abuse in the biological wastewater treatment

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Abstract

The Wastewater Treatment Plants (WWTPs) can represent a source of release of Emerging Organic Micropollutants (EOMs) to the environment since the removal taking place within their process units is usually very limited; therefore, the final effluent and the excess sludge may still contain a high load of EOMs (Petrie et al. 2015). However, the real capability of the WWTPs of removing EOMs is often unknown: the physical and biological processes might be able to increase their efficiency provided that the operating parameters and conditions are suited to achieve the required removal of EOMs (Naidu et al. 2016). Along with this uncertainty, the analytical methods commonly used for determining concentrations of EOMs often do not ensure the required reliability and reproducibility, due to the complexity of the matrix represented by either the wastewater or the sludge (Funke et al. 2016). Among the wide class of EOMs, the present study focused on some drugs of abuse, specifically Benzoylecgonine (BE) and 11-nor-9carboxy-Δ9-THC (THC-COOH). The double purpose of this study, carried out through laboratory scale investigations, was to evaluate the uncertainty factors of the analytical method used to detect these drugs in the liquid and solid phases of a full-scale WWTP (i.e. wastewater and sludge, respectively) and the contribution of abiotic and biotic processes to the removal of drugs in the biological reactor of the WWTP. The results obtained allowed to assess the optimal conditions of the method used to measure the selected drugs, with the aim to provide a relatively rapid and reproducible analytical tool and to minimize the interferences due to the matrix. Furthermore, the batch tests carried out at laboratory scale highlighted contribution of the biological processes to the overall removal observed in the oxidation tank of the WWTP.

Keywords: analytical method; biodegradation; drugs of abuse; emerging organic micropollutants; wastewater treatment plant

Paper ID: CEST2017_01352

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

EU approval of pesticides and biocides regarding the identity, the physicochemical properties and methods of analysis. Use of monitoring data in the regulatory procedure.

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Abstract

Pesticides and biocides consist a powerful tool in the agriculture and sanitary field, respectively, in order to satisfy the worldwide need for food and to protect human and animal health from unwanted pests. However, the indiscriminate misuse of these chemicals endangers environmental and human safety and for this reason they can be considered as emerging pollutants. Authorities worldwide establish regulations and guidelines regarding the authorization, use, monitoring and market control of pesticides in order to protect the environment and human safety. In this paper the data requirements for the approval of active substances, plant protection products and biocidal products as regards the identity the physicochemical properties and methods of analysis are described. The use of monitoring data in the regulatory procedure for the establishment of safe limits is also presented.

Keywords: Regulatory acceptable concentrations, plant protection product, biocidal product, drinking water, authorization

Paper ID: CEST2017_01369

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

GC/CI-MS/MS method for the identification and quantification of N-nitrosoethylmethylallyl-amine in plant protection products

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Abstract

A simple and sensitive method for trace level determination of the n-nitrosamine, N-nitrosoethylmethylallyl-amine in emulsifiable concentrate pesticide formulations is described. Solid phase extraction is used as a clean-up step of the sample before chromatographic analysis. Instrumental analysis involved gas chromatographic separation coupled to tandem mass spectrometry using Positive Chemical Ionization with methane as the reagent gas. (GC-CI-MS/MS). A gas chromatographic method with flame ionization detection (GC-FID) was used supplementary when the concentration levels of the analyte were higher than 50 μg g^{-1}. Both methods were validated with respect to linearity, accuracy, limit of detection and quantification as well as specificity. The average recoveries of the two fortification levels varied from 96.4 % to 98.5 % and the RSDs ranged between 2.3 % and 7.4 %.

Keywords: dinitroaniline herbicides, n-nitrosamines, N-nitrosoethylmethylallyl-amine, plant protection products

Paper ID: CEST2017_01372

Novel workflow for identification and determination of antibiotics and their transformation products in wastewater by liquid chromatography coupled to high resolution-mass spectrometry

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Abstract

Contaminants of emerging contaminants (EC) have been detected and reported in various environmental compartments [1-3]. However, knowledge on the occurrence of antibiotics (A) and their transformation products (TPs) is still scarce [2]. A list of 676 antibiotics and major TPs reported in literature was compiled. The collection of compound information was done in a systematic and reproducible way and included chemical identifier information (SMILES, InChIKey, InChI and CAS), connection with chemical databases (ChEBI, HMDB, KEGG, LIPID MAPS, PubChem and ChemSpider) and category based on chemical structure (i.e. Aminoglycosides, b-lactams/Cephalosporins, b-lactams/Penicillins, Sulfonamides). The compound list is available in NORMAN network website (http://www.norman-network.com/?q=node/236) and is part of NORMAN-SusDat database (http://www.norman-network.net/datatable/). Moreover, literature review conducted in context of this study, revealed that only a small fraction of these compounds (less than 10%) has been investigated so far. A second list with in-silico predicted TPs was also compiled. The current problem of in-silico prediction tools is that they produce a very large number of TPs, even when likelihood thresholds are implemented [4]. In our case, the number of predicted structures (~20,000) was high enough and therefore could only be managed by a systematic and automatic procedure. Therefore, a novel wide-scope suspect screening scheme was developed to evaluate the occurrence of A and TPs. The presented workflow will address that developments in high resolution mass spectrometry and retention time prediction. Workflow will highlight new cheminformatic tools that make quick, effortless and effective search of hundreds of substances known or suspected to be present in the environment.

Keywords: Antibiotics; Transformation products; Suspect Screening; Cheminformatic tools

Paper ID: CEST2017_01425

ENERGY TECHNOLOGIES AND SUSTAINABILITY

Thursday 31 August 2017

High altitude wind energy harvesting technologies

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Abstract

The environment is badly affected by use of traditional fossil fuels. To avoid these impacts there is a strong tendency toward renewable energy resources that are clean. Among renewable energy resources, wind is one of the most applicable ones. Usual horizontal axis wind turbines which are common in wind farms are designed to extract the energy of winds in low altitudes that are usually less than 150 meters. The point is that the stronger winds are always blowing in higher altitudes unreachable through towers of usual wind turbines. Recently some new technologies are developed to harvest the energy of these high altitude winds. These systems usually consist of a relatively light structure. Kite-gen and ground-gen are new classes of Airborne Wind Energy Systems (AWESs). These systems have aircraft or flying tethered wings to reach winds blowing at higher layers of the atmosphere that are not accessible by classic wind turbines. A variety of systems has been analyzed and tested and also some prototypes have been made. This paper introduces different technologies that have been developed to use the energy of high altitude blowing winds. A classification of these technologies is presented. Practical ideas are also proposed to be considered in the future researches to achieve more environmentally friendly systems.

Key words: environment, wind, high altitude.

Paper ID: CEST2017_00655

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Regulating environmental and public health impacts of hydraulic fracturing in the UK: lessons drawn from two case studies in the U.S.

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Abstract

The United Kingdom is in the early stages of exploration and development of its natural gas resources, with the first test well dug in 2010. In 2017 the UK appears poised for commercial drilling to begin. Licenses for shale gas exploration are now being issued in rounds, after a halt in 2011 due to concerns over probable links to earth tremors. The current licensing approvals follow a review[i] on shale gas extraction commissioned by the UK government (2012) that concluded hydraulic fracturing 'can be managed effectively as long as operational best practices are implemented and enforced through regulation.' [ii] Hydraulic fracturing or *fracking* remains controversial. Data from the United States with its much longer history of natural gas development provides evidence of risk to environmental and public health from fracking processes, including depletion of water supply, ground and surface water contamination, effects on air quality from emissions, and change in 'quality of life' as communities become heavily industrialized with expansion of gas extraction operations. Sources of risk include potential migration of pollutants from fluids used in the extraction process, migration of toxic gases, liquids and solids that exist naturally underground, and impact on water supply due to the high water volume used in shale gas exploitation. Studies have shown that there is potential for contamination leading to environmental and public health effects at all stages of the development of the natural gas well site, from site preparation to decommissioning at the end of the well's functional life.[iii] The United States has significant experience with the use of fracking to extract natural gas. Therefore, that country's experience may provide useful analogues to the situation of the UK. This research examines two case studies in the U.S. in order to draw lessons useful in enhancing the regulatory structure in the UK.

Keywords: Natural gas; Hydraulic fracturing, Unconventional drilling; fracking

Paper ID: CEST2017_00661

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Innovative nano-materials and architectures for integrated piezoelectric energy harvesting applications

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Abstract

In an era of shrinking conventional energy resources, the development of low-power-consumption portable devices, sensors and body-implantable devices, the concept of generating power by harvesting energy from the ambient environment and biomechanical movements are attracting huge interest. The most efficient way to harvest electrical energy is to utilize the piezoelectricity of ferroelectrics. In the paper, a practical example of self-assembled ferroelectric at nano-scale, deposited on a substrate, is presented, being the base for the development of a high-performance energy-harvesting device. The device concept, the signal processing unit and the potential applications are finally presented.

Keywords: piezoelectricity of ferroelectrics, self-assembled integrated piezoelectric device, selective wave-to-energy conversion, intelligent energy harvesting concept

Paper ID: CEST2017_00785

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ethanol production using *Zymomonas mobilis* cells immobilized on Cane Bagasse

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Abstract

With rising oil prices and decreasing availability, as well as damage to the environment, it is necessary to look alternatives for the production of liquid fuels such as ethanol. For its production several supports have been used, in this work was carried out a study of the ethanol production using cells of *Zymomonas mobilis* immobilized on bagasse of cane as support which showed a good ability to adsorb bacterial cells, so the system was operated at continuous culture at different dilution rates D (from 0.05 to 0.33 h^{-1}) and different concentrations of sucrose (from 50 to 300 g L^{-1}). The best results were achieved at a sucrose concentration of 200 g L^{-1} operating at a dilution rate of 0.262 h^{-1}, reaching an ethanol production of 78.2 g L^{-1}, having a sucrose consumption of 97 % and a yield of bioethanol from sucrose of 0.40 g EtOH /g sucrose, representing 78.4% with respect to the maximum theoretical yield.

Keywords: Zymomonas mobilis, bioethanol, sugar cane bagasse, immobilized cell, continuous culture.

Paper ID: CEST2017_00951

ECOLOGY AND ECOSYSTEM MANAGEMENT

Thursday 31 August 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Continuous production of KNO_3 nanosalts for the fertilization of soil by means of a Spinning Disk Reactor

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Abstract

In this study the production of high soluble material nanoparticles was successfully performed by means of a spinning disk reactor (SDR). This result was possible due to the use of a potassium nitrate saturated solution, which was continuously recycled back to the reactor after removal of the produced solid nanoparticles. Several process configurations were checked. It appears to be mandatory that the recycled saturated solution must be free of residual nanoparticles since their presence would lead to heterogeneous nucleation. In this respect, a small amount of nitric acid was added to the stream to permit the residual nanoparticle dissolution. Moreover, a spiral wounded piping system was developed in order to increase both the contact time and the mixing condition of the saturated solution with the added acid before entering the SDR.

Keywords: SDR, nano-salts, continuous-production, process-intensification, DLS.

Paper ID: CEST2017_00226

Vegetation cover and soil characteristics Correspondence analysis in Wadi Yalamlam, Saudi Arabia

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Abstract

Wadi Yalamlam is known as one of the significant Wadis in Western Saudi Arabia. The wadi is considered as one of the most important water torrents for the western region of the country. It starts from the top of Hijaz Mountains and pours into the Red Sea. It has a high amount of annual rainfall, about more than 200 mm. This work was conducted to study the floristic composition of seven stands of the Wadi and its relation to specific soil characteristics. The study revealed that the seven stands were represented by 48 species belong to 26 families. Fabaceae and Poaceae were the richest. Stands 1 and 7 were the most diverse while stand 6 was the least. Plant diversity was discussed in relation to the soil chemical composition.

Keywords: Wadi Yalamlam, Saudi Arabia, Floristic composition, Plant diversity, species richness, soil characteristic.

Paper ID: CEST2017_00241

$\delta^{15}N$, $\delta^{18}O$ and $\delta^{13}C$ isotopes in sedimentary material from Dispilio excavation, north Greece

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Abstract

Lacustrine sediments retain organic and inorganic components presenting valuable information regarding the past climate variations in lake basins as well as the present conditions. Soil samples, that referred to Dispilio excavation were subjected to stable isotope analysis ($\delta^{18}O$, $\delta^{13}C$, $\delta^{15}N$) trying to assess paleoclimatic information. $\delta^{18}O$ and $\delta^{13}C$ exhibited an excellent correlation typical for closed basins and long residence-time lakes. No isotopic disequilibrium events detected allowing a paleoclimatic interpretation. Two trends distinguished in soil core. The one concerns the lower part (1.00-2.00m) with enriched mean $\delta^{18}O$ values highlighting a cooler and drier environment. The upper part (0.40-0.80m) exhibits depleted $\delta^{18}O$ values highlighting a warmer and wetter environment. A runoff episode detected in the upper zone probably enhanced by deforestation events. This is consistence with the ^{14}C order of Early/Middle Bronze age where an intense human activity has been reported.

Keywords: isotopes, sediment, Dispilio, Kastoria

Paper ID: CEST2017_00410

Rural communities under Human-Wildlife Conflict: transforming the wild rabbits problem to a food source and an opportunity for local economy

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Abstract

The European wild rabbit (*Oryctolagus cuniculus*), outside its natural habitat, is usually considered an agricultural pest. In Lemnos Island, Greece, during the last decades, a large increase of the wild rabbit population (WRP) has become a plague on the island's biodiversity, ecosystems and crops. This disturbance affects local economy, imposing the need for WRP control, and builds conflicts regarding conservation, an issue known as Human-Wildlife Conflict (HWC). Although, various management actions were implemented by local authorities, the results were minimum and localized, increasing the local HWC.In this research, the potential use of wild rabbits as a biotic resource was detected by studying Lemnos local communities' perceptions, focusing on local agricultural development, WRP impact and management, and natural conservation. Interviews from stakeholders and 318 citizens' questionnaires were collected. Results showed common expectations on local development, but diverse opinions on WRP control policies and conservation values management. The nutritional value of wild rabbit, its positive hunting legislation and the increase of local hunting tourism, enhances the opinions for using wild rabbits as a local food and touristic innovation opportunity. This proposed sustainable management strategy for WRP control, slowly acquires popularity, even though building consensus is difficult under the ongoing Lemnos HWC.

Keywords: *Oryctolagus cuniculus*, food chain, citizens' perceptions, sustainable development

Paper ID: CEST2017_00901

ENVIRONMENTAL ODOUR, MONITORING AND CONTROL

Thursday 31 August 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The methodological approach to impact assessment for promoting a sustainable and healthy community in Val d'Agri (Basilicata - Italy)

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Abstract

This study aims to develop an innovative and methodological approach for environmental monitoring in critical industrial areas as the Val d'Agri (Basilicata - Italy). The interest for this area is due to the proximity of the largest Italian gas and oil pre-treatment plant, called the "Center Oils Val d'Agri" (COVA), to the urban settlement in Viggiano (PZ), a small village in South of Italy. Since the extraction of oil is carried out in populated areas, chemicals released by this type of industrial activity could have impact on population health. In particular, oil refineries and petrochemical plants are usually associated with the emission of Volatile Organic Compounds (VOCs), mainly deriving from production processes, storage tanks, gas pipelines and exhausted areas. Therefore, in this study, VOCs were monitored at the high spatial-temporal resolution, by means of a smart network consisting of highly sensitive Photo Ionization Detectors (PID) and by air samples collection during nuisance events and AirServer-TD-GC/MS-O analysis. In addition, sensors of meteorological parameters (i.e. temperature, humidity, pressure, wind speed and direction) were used for source identification. This monitoring network is proven to be a useful tool to collect real time information about the emission sources and their impacts on the urban settlements and to provide a mapping of the territory.

Keywords: VOCs, Photo Ionization Detectors (PID), gas and oil pre-treatment plant, petrochemical complex, sensor network.

Paper ID: CEST2017_01084

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

BTEX compounds in screen printing risk assessment on occupational health

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Abstract

In the printing facilities different chemicals (varnishes, adhesives, inks, cleaning agents) are used and they all have a negative impact on employees' health and the environment. The aim of the paper is to examine levels of benzene, toluene, ethyl-benzene and o- m-, p- xylene (BTEX) in the air of the working area where the process of screen printing takes place, as it is the most toxic technique since the inks used in screen printing contain several volatile organic compounds. Also, most of screen printing industry in Serbia have not automated the processes of printing form preparation, printing and screen cleaning after printing. Air samples were taken in the breathing zone of employees ~ 150 cm above ground level during the operations of preparing, printing and screen washing for two seasons. Identification and quantification were performed using the GC-FID technique. The paper also presents the average concentration of exposure, the individual effect and the cumulative effect of ethyl-benzene, m + p xylene and o- xylene. The maximum value for average exposure concentration (AEC) was measured for m + p xylene 16.99 ppm, individual effect (IE) was 0.16, and the additive effect of these three pollutants was 0.278. Concentrations of BTEX compounds were below the acceptable national and international exposure limits. Although the concentrations were below the permissible value, most printing shops work eight hours a day five days a week. In these conditions, the risks of exposure of employees cannot be negligible.

Key words: screen printing, pollutant, GC-FID technique, exposure limit

Paper ID: CEST2017_01140

AGROFORESTRY AND THE ENVIRONMENT

Thursday 31 August 2017

Effects of increased atmospheric CO_2 concentrations on photosynthetic characteristics of spring wheat in semiarid areas of Northwest China

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Abstract

To provide a theoretical basis for the high-yield cultivation of spring wheat under increased CO2 concentrations, an open-top chamber (OTC) experiment with the spring wheat variety Dingxi 24 was conducted during 2013 in Dingxi, Gansu, China. The photosynthetic characteristics of spring wheat under different CO2 concentrations were analyzed. The results showed significant midday depressions of photosynthesis under both control and elevated CO2 levels. The variation of intercellular CO2 concentration in the spring wheat leaves presented a "V" shape, while the diurnal variation of transpiration rate (Tr) possessed a two-peak curve. Compared with the control concentration of 370 μmol/mol, under the CO2 concentrations of 460 and 550 μmol/mol, the net photosynthetic rate (Pn) increased by an average of 14.68% and 28.20% over the whole growth period, respectively, the stomatal conductance (Cs) decreased by an average of 15.29% and 24.83%, respectively, the intercellular CO2 concentration (Ci) increased by an average of 10.38% and 26.14%, respectively, and the transpiration rate decreased by an average of 6.63% and 12.41%, respectively. The increases of Pn and Ci, as well as the decreases of stomatal conductance and transpiration rate, were different at different growth stages under the increased CO2 concentrations.

Keywords: Increased CO2 concentration, Photosynthetic Characteristics, Spring wheat, Semiarid areas, Northwest China

Paper ID: CEST2017_00466

Stand structure analyses of *Quercus ithaburensis* subsp. *macrolepis* silvopastoral systems in Greece

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Abstract

The species *Quercus ithaburensis* subsp. *macrolepis* forms open forests in Greece that belong in the sub-Mediterranean vegetation zone (*Quercetalia pubescentis*), forming typical silvopastoral systems. These forests are degraded with a major part of them having being converted to agricultural fields, pastures or urban areas. The structural analysis of these forests is analyzed in this study from a wide network of sample plots, representative of the species growing area. The parameters measured from each sample plot were: ground cover at each layer, number of tree per hectare, diameter at breast height (Dbh), total height, height at the crown base (HCB), crown length, basal area, slenderness index (H/D), crown ratio (CR), dominant height and crown competition factor (CCF). The low values of the CCF, H/D, stand density and basal area as well as the high values of CR confirm that the stands formed by the species not only are widely scattered but also, in most areas, cannot be characterized as forest but as individual trees, that is almost open growing trees.

Keywords: valonia oak, Mediterranean region, silviculture, stand structure

Paper ID: CEST2017_00829

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Chilling and forcing requirements to budburst for early and late - flushing tree species

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Abstract

Most of the temperate tree species has to fulfill chilling requirement during fall and early winter in order to start budburst in spring. Many researchers warn that some species might not attain their chilling requirements in a changing climate conditions. Our aim in this study was to detect the dates when chilling requirements are attained for different tree species and to evaluate tradeoffs between chilling and forcing. We collected dormant twigs in the cold period of the year 2015 – 2016 from the wild in Schoodic Peninsula of Acadia National Park, Maine, USA. Our results showed that early–flushing species (*Betula papyrifera*, *Alnus glutinosa*) has very low chilling requirements whereas late–flushing species (*Picea mariana*, *Abies balsamea*) has much higher chilling requirements. The transition from endodormancy to ecodormancy for the early–flushing species appeared in the middle of November and for late–flushing species in the second part of December. For the all investigated tree species non–linear and in all cases strong relationship was detected between accumulated thermal time and chilling.

Keywords: chilling, forcing, dormancy, budburst

Paper ID: CEST2017_00853

Effects of grazing and understorey clearing on regeneration of a valonia oak silvopastoral system in Western Greece

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Abstract

Valonia oak (*Quercus ithaburensis* subsp. *macrolepis*) forms traditional silvopastoral systems in Greece and other eastern Mediterranean countries. In a meeting that was organized under the framework of the AGFORWARD (FP7) research project, local stakeholders of the Xeromero area (Western Greece), where valonia oak forms such agroforestry systems, expressed their concerns for the low regeneration of the oaks, and attributed the problem to the livestock overgrazing and the overgrowth of the woody understorey. To test this hypothesis, an experiment was organized in the particular area. Specifically, four sheep and goat sheds as well as the pathways that the livestock follow daily for grazing were identified and 6 paired plots, 5X8 meters in size each, were established per shed territory, a total of 24 plots. In each pair, one plot was fenced and the other plot was left free to grazing. Woody understorey vegetation was cleared in half of each plot in early autumn of the first growing season. Data were collected twice per year (May and October) and included number of seedlings and young samplings, acorns and acorn-cups as well as the floristic characteristics. A two-years results show that understorey clearing did not have any significant effects on two variables measured while fencing significantly increased the number of seedlings and young saplings as well the number of acorns only in October.

Keywords: Agroforestry, silvopastoral systems, regeneration, Mediterranean region, Quercus ithaburensis subsp. Macrolepis

Paper ID: CEST2017_00924

From a green perspective: management pressures on forest ecosystems from Danube Delta Biosphere Reserve linked with soil mesofauna dynamics and foliar gas - exchange parameters

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Abstract

The investigation carried out in one of the most important wetland zone with an international value - Danube Delta Biosphere Reserve aims to assess ecological status of forest ecosystems under different management and climatic conditions. Ecophysiological analysis of plant communities to evaluate their adaptation status together with qualitative and quantitative aspects of soil mesofauna for understanding the indirect and direct effects of forest management practices were approached. Four sites located in northern part of Danube Delta were studied - two natural forests, one of them being a strictly protected area of national interest corresponding to IUCN category I and the other one a forest with native species as *Populus alba* and *Salix alba*. For comparison two forest plantations (*Populus x canadensis* and respectively *S. alba*) were also analyzed. Significant differences were found in gas-exchange parameters (photosynthesis, respiration, stomatal conductance), water use efficiency and relative water content in species from plantations versus natural forests, especially in drought period. The results highlighted the major influence of climatic conditions that occurred during the study period on edaphic mesofauna. Under the influence of drought and high temperatures were found significant changes in terms of global abundance, weight of systematic / trophic groups and spatial distribution of mesofauna.

Keywords: Danube Delta Biosphere Reserve, forest ecosystem, edaphic mesofauna, gas - exchange parameters

Paper ID: CEST2017_00959

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Functional diversity and ecosystem resilience in some forests "Natura 2000" sites in Northeastern Romania

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Abstract

Capacity for resilience and ecosystem stability of natural systems based on their biodiversity is required to maintain essential ecosystem goods and services over space and time. Loss of resilience may be caused by the loss of functional groups. Based on this perspective three natural forest ecosystems from "Natura 2000" Network situated in Northeastern part of Romania were studied. Central Moldavian Plateau is situated at confluence of two bioregions, steppic and continental, thus many species and habitats occur at the limit of their areal. Investigated stands are represented mainly by forest - steppe vegetation with mixed tree species of oaks and hornbeam. Leaf functional traits (gas-exchange parameters, relative water content) were analysed in order to evaluate functional pattern of different trees stands in relation with environmental change, climatic extremes and soil type. For the purpose of the study two groups of soil mites with bioindicator value, Mesostigmata and Oribatida were investigated from both qualitative and quantitative points of view. Dynamics of oribatid and gamasid communities during the two years with different climatic conditions showed significant changes in coenoses structure and spatial distribution of these mites, but also a remarkable stability illustrated by the composition of edifying groups and high specific diversity level.

Keywords: "Natura 2000", functional diversity, forest - steppe, leaf traits, soil mites

Paper ID: CEST2017_00963

USE OF MICROWAVE COMMUNICATION LINKS AS NEAR GROUND WEATHER SENSORS

Thursday 31 August 2017

Rainfall estimation using commercial microwave links (CMLs) attenuations : Analyse of extreme event of 1rst september 2009 in Ouagadougou

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Keywords: microwave, precipitations, attenuation, telecommunications, hydro-meteorological, Floods, quantitative precipitation estimation (QPE)
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Abstract

With the exponential increasing of mobile phone users, the CML network in West Africa is growing, and thus providing a high potential for CML-derived precipitation measurements. In this work we use the performances data of the CMLs to determine the rainfall quantities of the rainy event which marked the memory of the inhabitants of the capital Ouagadougou on September 1st, 2009. In this study we use the attenuation of a microwave link to establish the rain rate. The working frequency is 13 GHz, the path length 7.5 Km and vertical polarization. The time series of attenuation are transformed into rain rates and compared with rain gauge data. The method has successful in quantifying the rainfall. The correlation between 1 hour data of the microwave link and the rain gauge is 0.63. The cumulative rainfall bias during the event less than 5%. These results demonstrate the opportunity to use the microwave backhauling in mobile network to assess rainfall in Africa in this context where the hydrometeorological risk increases every day

Keywords: precipitations, attenuation, telecommunications, Floods, quantitative precipitation estimation (QPE)

Paper ID: CEST2017_01278

FOOD WASTE

Thursday 31 August 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Utilization of waste yeast biomass from brewery industry for the production of nutritional fatty acids

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Abstract

Unsaturated fatty acids (FAs) are accepted as significant in human nutrition and therefore new possibilities are looked for in biotechnological production. One of these sources may be yeast biomass, a waste by-product of brewery and winemaking that is generated regularly in large volumes. The possibility of utilization of this resource for the production of dietetically beneficial FAs (e.g. palmitoleic acids) was investigated. Two strains of biotechnologically important yeast strains and two samples of waste yeast biomass from brewery industry were studied for their FA content. Because many factors affect the yeast cells growth and the lipid content and composition, we have studied a range of cultivation conditions in the laboratory strains. The analysis of FA profile showed that biotechnological yeasts might be viable source of the nutritional FAs, as their content in *S. cerevisiae* was not impacted by the cultivation conditions. Our data suggest that, like *Kluyveromyces polysporus*, *Saccharomyces cerevisiae* can be used for production of palmitoleic acid in a wide range of conditions (unlimited or limited). Data from the waste yeast biomass confirmed the high content of palmitoleic acid but also showed the importance of the fermentation strain type that is employed in the process.

Keywords: palmitoleic acid; waste biomass; yeasts

Paper ID: CEST2017_00645

Use of peanut's (*Arachis hypogaea L.*) industrial waste rich in polyphenols, to develop a functional food kind of "marzipan"

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Abstract

Mexican agribusiness generates approximately 96,000 tons of peanut waste per year, most of which are unused and often become environmental pollution problem. Several studies have shown that these byproducts contain phytochemicals, such as polyphenols, whose concentrations depend on the variety, maturity and crop conditions. The aim of this work was to extract the phytochemical compounds present in the pericarp and skins of the peanut (Arachis hypogaea L.) and its incorporation in a functional food. Extracts of peanut skins had a higher content of polyphenols and antioxidant capacity compared to those obtained in the pericarp. It was found that this component contains 56.0 g of dietary fiber / 100 g of sample, total phenols of 72.11 ± 7.81 mg of gallic acid equivalents / g and its antioxidant capacity determined by the FRAP reducing power method was 491.4 ± 54.2 μmol of trolox / g. In this study, 1.25, 2.5, 3.75 and 5% skins was incorporated on the marzipan formulation to increase the polyphenol and fiber content. The substitution of 2.5% of skins had greater sensorial acceptability.

Keywords: peanut, waste, polyphenols, marzipan, skin.

Paper ID: CEST2017_00722

Use of coconut mesocarp and extracts of cocoa cuticle to increase antioxidant capacity of baking products.

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Abstract

Due to their phytochemical content in the last decade the interest for using food by-products has been increasing. These compounds could be used as raw material to generate improved food products. The Mexican chocolate and cocoa industries generate annually approximately 171 thousand tons of byproducts even than coconut industry. Nowadays the disposal of these byproducts is inadequate, generating pollution problems. The aim of this work was to evaluate the increase of phytochemical content and antioxidant activity of “chapata” (a Mexican bakery product), added with coconut mesocarp and cocoa cuticle extract. Chapata presented 10 fold higher polyphenol content than control; the antioxidant capacity was 5 fold higher measured by DPPH and 3 fold higher by ABTS method. Confocal Laser Scanning Microscopy micrograps, showed formation of alveoli uniformly distributed with smaller size in relation to the control chapata, due to the higher fiber content. The improved chapata, showed greater acceptance in terms of flavor and color, obtaining an "I like" rating with 100 untrained panelist.

Keywords: Byproducts, coconut, cocoa, polyphenols, antioxidant activity.

Paper ID: CEST2017_00723

Functional characterization of peanut (*Arachis hypogaea*) waste and its use in the development of nutraceutical products

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Abstract

Peanut (*Arachis hypogaea*) is a legume composed of seeds, cuticle and pericarp, structures composed mainly of mostly insoluble fiber phenolic components, antioxidants and proteins. In the present work, it was characterized physicochemical and functionally to the pericarp and tegument, obtaining a humidity of 2.37 and 5.97 g/100 g, ashes of 3.22 and 2.69 g, 6.54 and 19.12 g of proteins, 2.84 and 13.99 of ethereal extract, 14.51 and 38.78 g of non-nitrogenous extract, 72.86 and 19.43 of crude fiber, respectively. Also, for the functional properties values of 0.39 and 8.75 mL of water/g were obtained for HC, 3.80 and 7.32 mL of water/g for AAC as well as 2.49 and 6.32 g/g of oil for AaC respectively. Non-standard microbiological results were obtained for the pericarp, which discards its use in product development. Only the tegument was used for the preparation of a wheat flour tortilla,, in which 1% of this was replaced by peanut cuticle; with this, the importance of the use and use of these residues is emphasized to provide the consumer with nutritional benefits, such as fiber and protein in this particular case; thus helping to reduce the production of such waste by not being used.

Keywords: peanut, cuticle, physicochemical, functionally, use of residues

Paper ID: CEST2017_00739

Sustainability challenges: conversion of fibrous agroindustrial waste from sugar cane in animal food

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Abstract

In Mexico, one of the problems that most concern in the industrial sector is the final destination of the waste, making this a challenge for sustainability; such is the case of fibrous waste from sugarcane, since being lignocellulose compounds need prior to its use a treatment to delignify the fibers. In this investigation, the bagasse of the grass *Saccharum officinarum* was subjected to an alkaline treatment based on sodium hydroxide. The development of a pre-digested base food from cane bagasse for protein-supplemented cattle is presented. In order to reduce the lignins content in the applied fibers an alkaline treatment with sodium hydroxide (2.0 Normal). *In vitro* digestibility tests, protein, and mineral content, percentage of moisture were performed. For the physical characterization of the integral and post-treatment fibers, the technique was used: confocal microscopy with laser scanning. According to the results obtained it was possible to corroborate that the alkaline treatment confers a greater digestibility to the bagasse and therefore, its results can be applied in bovine animal feeding technologies. One of the advantages of the formulation of an alkaline food is the reduction of lignin which facilitates the assimilation of nutrients in the ruminant digestive system.

Keywords: animal feed, bagasse, chemical composition, sustainability

Paper ID: CEST2017_00740

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Production of lipase by newly isolated *Rhodotorula mucilaginosa* by using molasses, Important environmental pollutant

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Abstract

This present work describes the production and biochemical characterization of lipase by *Rhodotorula mucilaginosa* in a culture supplemented with molasses. This study reveals the utilization of renewable resource for their cost effective production and influence on the process under various conditions. In the production of lipase, culture conditions and media components are investigated as important parameters. After optimizing the incubation periods, effects of molasses concentrations, medium pH and incubation temperature. Olive oil with various concentrations as a different carbon sources were incorporated into the production medium and lipase activity were determined. The activity and specific activity of lipase immobilized on alginate. Maximum lipase activity was obtained during 6th day of fermentation at 150 rpm, pH 5, and 30°C temperature. When the concentration of the molasses in medium supplemented with olive oil *Rhodotorula mucilaginosa* showed the highest lipase activity in the medium with 1.0% molasses. Besides These results, important environmental pollutant molasses; can use as a cheap carbon source for biotechnological applications.

Keywords: lipase, Production, Yeasts, Molasses.

Paper ID: CEST2017_00866

An innovative solar drying method for transforming hotels' food wastes into animal feed

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Abstract

Through a pilot scale realization, an innovative, simple technology and low emissions process is attempted the safe transformation of source separated food wastes, mainly from hotels (and generally from the hospitality industry and restaurants), into animal feed, utilizing an altered solar drying process. A greenhouse-type solar dryer will be developed in order to convert a food waste to animal feed, which uses solar drying processes in the shortest possible period, towards the production of feed. The resulting by-products, once dried out and pasteurized, have a final application as animal food. The greenhouse, with a roof height of 4.7m and total area of 384m^2, will be consist of two parallel concrete corridors 5 m wide and 20 m long, completely covered by a strong polycarbonate cover (Plexiglas), resistant to unfavorable climatic conditions. Using free solar energy for drying and pasteurized source separated food wastes can be beneficial from the point of view of energy consumption and, consequently, the drying system cost. The main innovation of the process is using the most abundantly available energy source in Greece – and the Mediterranean basin generally - the sun.

Keywords: Food waste; animal feed; solar drying; pet food

Paper ID: CEST2017_01100

ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Thursday 31 August 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Microfluidic sensors using LTCC technology for environmental monitoring applications

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Abstract

The lab-on-chip testing units are booming nowadays, due to robustness, simplicity of use and reliability. Multilayer nano-ceramic technology, functionalized with sensing materials at nano-scale, and further developed towards obtaining microfluidic test elements for environmental applications, represents the purpose of the paper.

Keywords: LTCC; multilayer nano-ceramic; microfluidic test elements; environmental applications

Paper ID: CEST2017_00447

ENVIRONMENTAL PLANNING, MANAGEMENT AND POLICIES

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Views of high school students on the impacts of mass tourism in the coastal zone of Ialyssos, Rhodes

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Abstract

The purpose of this research is to explore the views of A and C class students of the high school of Ialyssos, Rhodes, on issues concerning the impact of mass tourism in the coastal zone of the region and the comparative study between the two groups. In this urban complex there are a number of tourist accommodations of all categories that span across the large coastline for the visitors convenience. This fact attracts the researchers' interest to record the views of students whose lives are in direct connection with the tourism sector. The ultimate goal is the research findings to be used for interventions in education for sustainable development. From the survey results general lack of knowledge about the topic is recorded. Although students argue that pollution received by the sea from tourism activities is a key problem for the coastal zone, they have a positive view about the concept of mass tourism. They question the pressures on natural resources and the environment, as they believe there is infinite capacity in nature to recover. They also argue that the increasing number of tourists will ensure, through its economic benefits, both the environment and the touristic future of the region.

Keywords: Mass tourism, environmental impacts, students views

Paper ID: CEST2017_00224

Investigation and monitoring the perspective V.T.I trainees have, regarding significant environmental problems aiming to the adults education

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Abstract

Environmental education is a learning process that enhances citizens 'knowledge and awareness about the environment and associated challenges, develops the necessary skills and experience to meet these challenges, and fosters attitudes, motivations, and commitments so that the well-informed citizens are able to make accurate decisions and take responsible action (UNESCO, 1978). This paper aims to analyse and monitor the perspective V.T.I trainees have, regarding significant environmental problems and environmental education in general. Based on this research, the view of respondents gained from previous levels of education is listed, as well as the evaluation of environmental education.

Keywords: Environment, Education, Environmental data analysis, Vocational Training

Paper ID: CEST2017_00570

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Renewable energy sources in Poland and selected EU countries

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Abstract

This paper presents the essence of Renewable Energy Sources (RES) in Poland and chosen UE countries based on selected economic regulations. Further, the benefits and restrictions coming from implementation renewable energy sources have also been pointed out. The aim of the article is to present and assess the state of knowledge on renewable energy sources and ecology in selected EU countries. The analysis is based on the questionnaire, which was main tool of conducted research. The study aims to answer the question: whether and how the state of knowledge of the EU inhabitants about renewable energy sources can affect the development of renewable energy. The study uses the descriptive, statistical and analytical methods. As a preliminary tool, the descriptive method is used. The following part of the study presents the results of research carried out among citizens of some EU states. Based on obtained results it was possible to draw reliable conclusions about how promote ecology among Polish society.

Keywords: Renewable Energy Sources, Development of Renewable Energy

Paper ID: CEST2017_00806

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Castles and fortresses in Prefecture of Preveza

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Abstract

In the Prefecture of Preveza the castles preserved in prominent locations. The castles were defensive fortifications and were built in suitable natural environment for the purpose of keeping the crossings and roads from antiquity to the Ottoman period. Other castles, most of which are still visible today, are coastal and others are inland, but others were built from the Mycenaean period to late antiquity and others from the late Byzantine era to the Ottoman times.Regardless of the date, the purpose was always the same: defense and protection from invasion, guarding key land and sea routes and trade development.Many castles can be exploited to serve tourism development networks and environmental recovery of the beautiful landscape. The natural landscape and castles combine mountain and sea, and of course many forms of alternative tourism.

Keywords: castles, fortification, roads, tourist destinations, cultural management, protection, environment, network.

Paper ID: CEST2017_01098

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Sustainable development as a subject of measurement in New Public Management context

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Abstract

The aim of the article is to propose measurable definition of green jobs based on balanced and sustainable development which is ample of green economy and New Public Management concepts. This approach is justified due to nature of NPM, which uses management by goals and effectiveness measurement. Proposed in this paper green jobs characteristic based on section E of PKD is more specific and can be source of measurement not only in Polish conditions.

Keywords: efficiency, green jobs.

Paper ID: CEST2017_01377

ADVANCED OXIDATION PROCESSES

Friday 1 September 2017

Photo Fenton degradation of an azo day color (Yellow Sun)

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Abstract

The production of dyes and their use generates persistent effluent biorefractory non-biodegradable, highly colored, toxic, carcinogenic and mutagenic. It is in this context the advanced oxidation processes (AOPs) have emerged, they can treat the dyes in aqueous solution because they generate highly reactive species such as hydroxyl radicals (OH•). In this work, an azo dye (Yellow Sun), was treated by the photo-Fenton process using design of experiments. We could establish a mathematical model representative of the degradation of the dye with a deviation less than 10% with the experimental; the best yield 97, 68% is obtained with a hydrogen peroxide concentration 1 mmol L^{-1}, concentration of catalyst equal to 1 mmol L^{-1} and a concentration of the dye 10 mg L^{-1}.

Keywords: Advanced oxidation processes, hydroxyl radicals, photo-Fenton, yellow sun dye.

Paper ID: CEST2017_00060

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Changes on dissolved oxygen in phenolic wastewaters during the oxidation by Fenton reagent

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Abstract

When dihydroxylated benzenes are oxidized, during the initial minutes there is an elevated consumption of dissolved oxygen (DO), achieving a minimum value. Next, DO increases following second order kinetics, whose reaction rates depend on the nature of the compounds. In this stage, occurs the catalyst regeneration that releases oxygen, being possible to establish a relation-ship between the rate of OD formation, k_{DO} (L^2/mg^2 min) and the iron regeneration. The OD release is greater during the oxidation of hydroquinone (k_{DO}=0.32) than catechol (k_{DO}=0.24), because the ortho-substituted benzenes may form organometallic complexes that act as chelator agents. For resorcinol the OD formation is very slow (k_{DO}=0.04) because may form supramolecular structures with ferric ions impeding its regeneration. By the turbidity of the water, it has quantified the amount of iron involved in the formation of metal-complexes. At the maximum turbidity, in the case of hydroquinone all dissolved iron is as Fe^{2+}. However, for catechol, 4% of catalyst is as Fe^{3+} and for resorcinol, 53%.

Keywords: dihydroxylated bencenes, dissolved oxygen, iron regeneration, iron complexes, turbidity

Paper ID: CEST2017_00332

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Induction of color in wastewaters oxidized by sono-Fenton technology

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Abstract

Color induction in oxidized phenolic waters with Fenton-like reagent is favored by working at pH=3.0, similarly to the case of UV or dark Fenton operation. In this condition, $FeOH^{2+}$ species is predominant and its presence would generate an additional supply of hydroxyl radicals, which would increase the degradation yield of phenol to colored by-products (quinones). The maximum intensity of color created in the water is obtained when carrying out the treatment with 4 mol H_2O_2/mol phenol and 40 mg Fe^{2+}/L. When using UV or dark Fenton light, the highest degree of color is achieved with 20 mg Fe^{2+}/L. This difference may indicate a change in the reaction stoichiometry of iron species with the organic matter. By operating with ultrasound waves, the formation of (hydro)peroxo iron complexes may occur, due to the interaction of the $Fe(OOH)^{2+}$ species with catechol or with carboxylic acids like 2,5-dioxo-3-hexenedioic, which would generate color in the water. The rate of decomposition of $FeOH^{2+}$ and Fe $(OOH)^{2+}$ species to ferrous ions is increased by using ratios around 0.025 kW L/mg Fe, observing an increase in the kinetics of color formation and degradation.

Keywords: color, (hydro)peroxo complexes, phenol, sono-Fenton

Paper ID: CEST2017_00333

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Catalytic wet air oxidation (CWAO) of cationic red GTL over the Fe_2O_3-CeO_2-Bi_2O_3/γ-Al_2O_3 catalyst under mild reaction conditions

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Abstract

The catalytic wet air oxidation (CWAO) of cationic red GTL over the Fe_2O_3-CeO_2-Bi_2O_3/γ-Al_2O_3 catalyst was investigated under mild operating conditions in a batch reactor. The catalyst was prepared by wet impregnation, and characterized by N_2 adsorption-desorption (BET measurement), X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS). The effect of the reaction conditions (catalyst loading, reaction temperature, solution concentration and initial solution pH) was studied. The Fe_2O_3-CeO_2-Bi_2O_3/γ-Al_2O_3 catalyst exhibited good catalytic activity and stability in the CWAO of cationic red GTL under atmospheric pressure. When the reaction temperature, the solution concentration and the initial pH of the solution increased, the decolorization efficiency was improved. The apparent activation energy for the reaction was 79 kJ mol-1. Hydroperoxy radicals ($HO_2\cdot$) and superoxide radicals ($O_2\cdot^-$) appeared as the main reactive species upon the CWAO of cationic red GTL.

Keywords: Catalytic wet air oxidation (CWAO); Cationic red GTL; Iron oxides catalyst

Paper ID: CEST2017_00380

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Experimental design optimization of a reverse osmosis membrane for olive mill wastewater purification after advanced oxidation

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Abstract

Although membranes are a mature technology, many aspects are still in development. The main handicap is membrane fouling, investigated by a plethora of researchers in the last years to convince investors to implement membranes as substitutes of a range of unit operations at industrial scale. In the field of wastewater treatments, this is especially problematic, given the low economic value of the product, that is, treated water. The management of the effluents generated by olive oil industries represents an ever-increasing problem still unresolved. Within this framework, the prediction of the performance of a selected membrane is mandatory for its operation when implemented in a treatment process at industrial scale. The core of the present work was the modelling and optimization of a reverse osmosis (RO) membrane operation for the purification of a tertiary-treated olive mill wastewater stream (OMW2TT). Statistical multifactorial analysis was employed to examined the variables including the operating pressure (P_{TM}), tangential velocity (v_t) and operating temperature (T). Upon the optimized parameters, namely ambient temperature (24 ° C), moderate operating pressure (31.5) and turbulent flow (4 m s^{-1}), the standards to reuse the purified effluent for irrigation, discharge to sewers or even reused in the production process were ensured.

Keywords: Wastewater reclamation; Membrane processes; Reverse osmosis; Modelization; Olive mill wastewater.

Paper ID: CEST2017_00384

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Kinetic modeling of the operational variants in a batch Ozonation-Adsorption process

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Abstract

In this work, a mathematical model has been proposed as a basis for the study of the combined adsorption-ozonation process (Ad/Ox) with the complexity involved in a three-phase system. The description of this operation involves the consideration of several parameters regarding kinetic and adsorption phenomena of the system. This paper presents the analysis of Ad/Ox process compared with the simple ozonation, checking the favorable effect of the presence of activated carbon (AC) in ozonation, both primary degradation and mineralization of phenol solutions. The study focuses on Ad/Ox with granular activated carbon (GAC), and analyzes the phenol degradation kinetics depending on the amount of AC. In this way it was possible to establish an order of priority in the relevance of the parameters of the proposed mathematical model. It was found that the adsorption constant may vary meaningfully in the same process.

Keywords: Adsorption, activated carbon, ozonation, kinetic modeling, phenol.

Paper ID: CEST2017_00390

Removal of Methylene Blue dye solution by Fenton-like process using heat treated Laterite

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Abstract

Laterite, an Iron rich soil from Dano, was heat at 800 °C and used as catalyst in methylene blue (MB) removal, a prototype of organic dye, by Heterogeneous Fenton process. The catalyst porosity was characterized through Nitrogen and MB adsorption isotherms. Nitrogen adsorption and desorption revealed that the LT-800 has a weak BET specific area, around 7m2.g-1. MB adsorption isotherms were plotted with Langmuir and Freundlich equations. The MB removal rate was of 96 % after 20 minutes of adsorption plus 80 minutes of Fenton reaction at room temperature According to the HPLC analysis results and the UV spectrum, the MB removal was based on both adsorption and degradation process. However, the degradation process was essentially heterogeneous.

Keywords: Laterite; Methylene blue Organic dyes; Heterogeneous Fenton-like process.

Paper ID: CEST2017_00465

Degradation, mineralization of chloro phenol using ceria doped Tio_2 under photocatalytic ozonation

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Abstract

An efficient photocatalytic activity of ceria doped TiO_2 (Ce/TiO_2) for the photo-ozonation of tetrachlorophenol in aqueous solution was examined. Different loadings of catalyst materials Ce/TiO_2 (1%, 2.5% and 5%) were prepared and characterized by Powder X-ray diffraction (XRD), nitrogen adsorption-desorption (BET), scanning electron microscopy (SEM), transmission electron microscopy (TEM), inductively coupled plasma optical emission spectrometry (ICP-OES), and Ultraviolet-visible diffuse reflection spectrum (UV-DRS). Photocatalyzed ozonation with 2.5% Ce/TiO_2 yielded 100% degradation and mineralization of tetrachlorophenol in 1.5 h at neutral pH conditions. The extent of degradation of tetrachlorophenol and its mineralization were confirmed by GC-MS. For 100 mg/L of tetrachlorophenol, 0.05 g L^{-1} of catalyst was found to be the optimum for effective mineralisation. The reused experiment confirmed that Ce/TiO_2 kept a good photocatalytic activity and stability, and it was a promising heterogeneous catalyst. The catalyst is fully recoverable and reusable multiple times with no loss of activity.

Key words: Tetrachlorophenol, Photo-catalyst, Advanced Oxidation; Ce/TiO_2; Degradation.

Paper ID: CEST2017_00518

Olive mill wastewaters total organic carbon degradation using TiO_2 nanoparticles

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Abstract

Olive mill wastewaters (OMW) constitute an important pollution factor for the olive oil-producing regions but also a significant problem to be solved for the agricultural industry. The main reason is the large wastes amounts produced in relatively small time interval, which should be processed with safety for the environment. Because of the high organic content, it is imperative to use Advanced Oxidation Technologies in order to reduce the organic load of these wastewaters. We used TiO_2 nanopowder (Degussa P-25) as a low cost, low toxicity and effective photocatalyst for the degradation of the organic load of the wastewaters in an olive oil production facility at the prefecture of Ileia Western Greece. The treatment of OMW showed that the Total Organic Carbon (TOC) can be reduced over 44% after 300 minutes under UV irradiation. In addition we studied the effect of the TiO_2 mass in respect to the total volume ratio of OMW as a critical factor for the effective degradation of the TOC. The sample with a mass/volume = 15 mg/ml shows the highest photocatalytic decomposition efficiency (44%) in comparison to the mass/volume = 0.5 mg/ml which shows a 30% efficiency after 300 minutes of UV exposure.This easy-going treatment technology, aim to transform resistant organic molecules into others which could be further biodegraded in the natural environment.

Keywords: Olive Mills Wastewater, Photocatalysis, TiO_2 nanopowder.

Paper ID: CEST2017_00589

Trimethylamine oxidation by peroxydisulfate activated by Fe^{+2} or CuO. Risk of N-nitrosodimethylamine formation

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Abstract

Methylamines i.e. monomethylamine, dimethylamine and trimethylamine are present in wastewater both as a result of organic matter degradation, as well as as originated from anthropogenic sources. Depending on both types of oxidant as well as oxidant/methylamine ratio, methylamines can be oxidized to nitrates and carbon dioxide. Such a reaction may be stopped at the stage of intermediates formation such as formic acid, formaldehyde, and nitrite. However, a probem occurs in case of a formation of another compound, namely N-nitrosodimethylamine (NDMA), which is considered to be strongly mutagenic and carcinogenic. NDMA can be formed as a result of reaction of strong oxidants with e.g., dimethyl or trimetylamine. On the other hand, strong oxidant called peroxydisulfate (PDS) is lately often considered as very useful oxidant. Before use, PDS, however, has to be activated. Several types of the activators were pointed out, among them the application of ions of some metals on lower valence (such as Fe^{+2}) or oxides of some metals (such as CuO) seems to be the most promising. An influence of activation method of PDS activation on PDS reactivity with trimethylamine was the basic subject of this study. Peroxydisulfate could be considered as 'safe' oxidant against trimethylamine presence in water. This means that PDS destroys TMA without NDMA formation. The relatively low destruction rate of TMA (less than 2%) shows, however, that remain part of TMA may act as NDMA precursor for subsequently applied disinfection agents like chloramines and ozone.

Keywords: Di/tri- methyl amines, oxidation, peroxydisulfate - PDS, NDMA

Paper ID: CEST2017_00638

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of pharmaceuticals from drinking water matrix in a flow-through AOPs reactor

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Abstract

The paper deals with the first stage of research project aimed at macrolide antibiotics (azithromycin, clarithromycin, erythromycin, roxithromycin), sulfonamides antibiotics (sulfamethazine, sulfamethoxazole, sulfathiazole) and non-steroidal anti-inflammatory drugs (diclofenac, ibuprofen, ketoprofen, naproxen) removal from wastewaters by advanced oxidation processes (AOPs) in flow-through AOPs pilot unit. The study focuses on removal efficiencies of various combinations of advanced oxidation processes (O_3, H_2O_2, UV, O_3/UV, H_2O_2/UV, O_3/H_2O_2) from artificially contaminated drinking water matrix. The study investigates the dependence of removal efficiency on added amount of oxidizing agent(s) in each combination. Combinations that reach the best removal efficiencies will be tested in the second stage of the research project as the tertiary step of treatment at municipal wastewater treatment plant.

Keywords: Advanced oxidation processes, Macrolide and sulfonamides antibiotics, Non-steroidal anti-inflammatory drugs, water matrix

Paper ID: CEST2017_00677

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment by immobilized photocatalysis of timber yard wastewater

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Abstract

Water sprinkling prevents the wood from rotting and becoming infested with insects. This form of storage is largely used in case of severe winter storms during which large quantities of trees can be uprooted (long storage) and in the logging industry for short storage. In both cases wastewater, contaminated by organic substances leached from the wood and the bark, can be discharged to the aquatic environment.The potential of immobilized photocatalysis to degrade the log preservation wastewater has been evaluated in a falling-film photoreactor, with titanium dioxide immobilised on non-woven paper. Wastewater was produced in a pilot-scale aspersion system in which four wood logs were sprinkled continuously with recycled water for up to six months. The degradation yield after 24hrs (DOC based) varies in function of the wood species: 75% for common beech and 90% for oak.

Keywords: immobilized photocatalysis, titanium dioxide, synchronous fluorescence, UV-visible spectroscopy, wood preservation

Paper ID: CEST2017_00734

Photocatalytic degradation of macrolide antibiotic azithromycin in aqueous sample

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Abstract

Azithromycin (AZI) is widely used macrolide antibiotic and its presence in waste water treatment plant (WWTP) influent is unequivocal. Many studies have shown that AZI is not being removed from the waste waters during the conventional waste water treatment. Therefore it can reach the environment and have possible adverse effect on the living organisms. It is of great importance to develop methods for waste water treatment that could completely remove pollutants such as AZI. Photocatalysis, one of advanced oxidation processes (AOP), has been presented as effective in removing organic pollutants such as pharmaceuticals in numerous studies. In this work aqueous samples of AZI have been subjected to photocatalytic degradation. Nanostructured sol-gel TiO_2 was used as a catalyst but in the form of a film which makes the possible future implementation more applicable. Photocatalytic degradation was optimized in order to find the best experimental conditions for complete removal of AZI. Sample analysis was conducted on HPLC-MS/MS which was also used for monitoring of AZI degradation and determination of possible degradation products.

Keywords: photocatalysis, sol-gel TiO_2 film, azithromycin, HPLC-MS/MS

Paper ID: CEST2017_00816

Development of standardized method for the determination of the degradation of nitric oxide (NO) in the air by photocatalytic materials: Inter-laboratory validation tests

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Abstract

The need of a uniform experimental procedure for assessing the performance of photocatalytic inorganic materials contained in building materials led the European Committee for Standardization (CEN/TC386/WG2) to elaborate a Technical Specification (TS).Taking into consideration the importance of the effects which will be of possible variations in the implementation of the reference method, parallel photocatalytic tests according to the TS were performed in the current study.6 European labs were participated in an inter-laboratory exercise where the experiments had to be done in a special design CEN reactor using LED system. The experimental procedure and conditions were taken from the draft TS and were referred to the average irradiance, inlet NO & NO_2 concentration, T°C and RH inside the reactor, flow and reactor net volume. Identical photocatalytic samples were provided to all participants. The results obtained from the 6 labs showed a variation between 18% and 31% on the photocatalytic NO conversion while the mean value was 26%. The corresponding photocatalytic rate was ranged between 2600 μg/m^2h and 4100 μg/m^2h presenting a mean value of 3400 μg/m^2h. The homogeneity of the lamp and the homogeneity of the deposition of TiO_2 are the main factors impacting the results.

Keywords: NO photocatalysis, building materials CEN Technical Specification, inter-laboratory tests

Paper ID: CEST2017_00850

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Enhanced photocatalytic degradation of emerging contaminants on copper–nitrogen modified titania

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Abstract

Current economic growth is based on intensive industrial activity which is inevitably producing high quantities of wastes that also affect the water reservoirs. In order to reduce the consequences of this contamination, scientific efforts are focused on advanced water purification processes, including photocatalytic treatment based on titanium dioxide nanostructures. Herein, the development of innovative photocatalysts consisting of titania modified by both copper and nitrogen (N–Cu/TiO_2) was investigated. These mixed (anion–cation) modified TiO_2 nanostructures prepared using a combustion sol–gel synthesis, were first characterized with XRD, EDX, UV/vis, Raman, and FTIR techniques. The analysis confirmed that N–Cu/TiO_2 is well crystalized in the anatase phase, while the non–detection of copper compounds in XRD spectra is attributed to the existence of well dispersed copper oxide nanoparticles onto the surface of the catalyst. The evaluation of the photocatalytic properties was performed under UV light irradiation using two emerging contaminants, caffeine and salicylic acid, frequently detected in municipal wastewaters. Based on the experimental results, copper loading influences the photocatalytic process and enhances the final degradation efficiencyi, compared to the reference material (N/TiO_2). An optimum copper loading value was determined and the results are compatible with a photocatalytic mechanism implying more efficient light absorption and/or reduced recombination of the photogenerated carriers.

Keywords: Titanium dioxide photocatalysis; copper–nitrogen modification; caffeine; salicylic acid; water treatment.

Paper ID: CEST2017_00947

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Catalytic wet peroxide oxidation of methyl orange over Al/Fe pillared sepiolite

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Abstract

In this work, oxidation of methyl orange azo dye with hydrogen peroxide on Al/Fe pillared sepiolite catalysts was studied. The catalytic tests were carried out in a glass reactor in batch operation mode at the atmospheric pressure. The effects of various operating parameters such as catalyst dosage, active metal ratio, calcination temperature, pH, H_2O_2 concentration, temperature and time on the elimination of methyl orange were investigated. Optimum conditions were determined as 0.1 g/100 mL for catalyst dosage, 8% for active metal ratio, 500°C for calcination temperature, 3.7 for pH, 0.15 M for H_2O_2 concentration and 25°C for temperature. Under these conditions 90.68% methyl orange elimination was achieved at 4 hours of reaction time without considerable iron leaching.

Keywords: Sepiolite, azo dye methyl orange, catalytic wet peroxide oxidation, pillared clays, catalyst

Paper ID: CEST2017_00948

Usage of green synthesized nZVI for degradation of three different dye molecules

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Abstract

The aim of this study was to optimize decolourization of synthetic solution containing dye molecule, using nano zero valent iron, synthesized by an oak leaves extract (OAK-nZVI), in Fenton process. Same process conditions were applied on three structurally different dye molecules: azo, antraquinone and triphenylmethane dye. The study included process optimization of dye solution decolourization, wherein the optimal conditions were determined (concentration of OAK-nZVI, the dose of hydrogen peroxide, pH and initial dye concentration) at which the significant percentage of decolourization were achieved. Optimization was performed by the response surface methodology (RSM). RSM enabled identification of the key variables and their impact on each process. Further testing included characterization of the obtained effluents, indicating that there is a degradation of the whole dye molecules. All results confirmed that OAK-nZVI is an efficient catalyst and the source of iron in the Fenton process, and that these particles are inexpensive and environmentally friendly material for this type of treatment.

Keywords: nZVI, green synthesis, dyes, Fenton process

Paper ID: CEST2017_00983

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Reactive dye removal by paper mill sludge impregnated with iron (III)

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Abstract

This paper presents evaluation of the possibility of using Fe-impregnated paper mill sludge (Fe-PS) in the heterogeneous Fenton process of anthraquinone Reactive Blue 4 (RB4) dye removal. In order to determine the effectiveness of the oxidation process, experiments were carried out in two stages: (i) adsorption of RB4, and (ii) oxidation through a Fenton process. The percentage of dye removal by adsorption, and adsorption followed by Fenton process was 82.0, and 90.9%, respectively. Adsorption and degradation kinetics indicate higher reaction rate of decolorization by Fenton process. The content of iron leached into solution after Fenton process was 0.29 mg/L. These results provide basis for further investigation of paper mill sludge application in terms of optimization of Fenton reaction conditions, reuse of material and assessment of solution toxicity.

Keywords: paper mill sludge, reactive dye, Fenton process

Paper ID: CEST2017_01004

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Soil remediation contaminated with phenanthrene by *in situ* chemical oxidation using modified clay as catalyst

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Abstract

Phenanthrene is a polycyclic aromatic hydrocarbons (PAH) listed as one of the 16 priority pollutants by the United States Environmental Protection Agency, which tends to be adsorbed to solid particles. Removing or treating soil contaminated by PAH is urgent as hydrocarbons can leach into groundwater and reach residential areas. This work aims to remediate the contaminated soil with phenanthrene by in situ chemical oxidation using sodium persulfate (SP) and hydrogen peroxide (HP) with activation by heterogeneous catalysis. The experiments were carried out using two types of soils named white soil (WS) and red soil (RS). For the catalyst synthesis, full factorial design was used varying the concentrations of sodium hydroxide, ferric sulfate and ferrous sulfate, totalizing 11 tests. The 11 catalysts were applied in batch tests lasting 72 hours for each oxidant in each soil, in order to evaluate the activation efficiency in phenanthrene removal. The results showed the efficiency of the catalysts in the in situ chemical oxidation for degradation of phenanthrene. It was possible to achieve about 70% removal of the contaminant in tests using sodium persulfate and between 55 and 60% removal in tests using hydrogen peroxide.

Keywords: advanced oxidation process, polycyclic aromatic hydrocarbon, priority pollutant, Fenton like, sodium persulfate

Paper ID: CEST2017_01009

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Efficiency of TiO_2 photocatalytic degradation of stevioside in natural aqueous solutions by nested experimental design and mechanism of degradation

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Abstract

The present study deals with the photocatalytic transformation of stevioside, under simulated solar irradiation using titanium dioxide as a photocatalyst. The investigation has involved a study of stevioside decomposition under a variety of experimental conditions, the identification of intermediate compounds, as well as the assessment of mineralization. A fully nested experimental design was applied to study the effect of various matrices, as well as, the initial stevioside concentration on the variation of the photocatalytic efficiency. LC-HRMS in positive and negative ESI mode, was brought to bear in assessing the temporal course of the photocatalyzed process. More than one hundred unknown transformation products, most of them in the form of several isobaric species were identified. By employing accurate mass determination, we were able to attribute an empirical formula to each species and through MSn analyses we were capable to characterize the detected transformation products and to distinguish several isobaric species. The overall transformation mechanism was assessed and involved the hydroxylation/oxidation of the molecule and the subsequent loss of the glucoses bound to the parent compound. Acute toxicity of stevioside and its derivatives was evaluated as well using the Vibrio Fischeri bacteria

Keywords: Photocatalysis, stevioside, sweeteners, experimental design

Paper ID: CEST2017_01018

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Formation potential of disinfection by products of 4 water sources after Nanofiltration (NF) and Advanced Oxidation Processes (AOPs) at optimal and sub-optimal conditions

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Abstract

The importance of understanding the impact of different precursor removal treatments on disinfection byproducts (DBP) formation concentrations. This can be elucidated by exploiting the physico-chemical characteristics of NOM in raw water source groups to minimise the formation of DBPs.. Pre-curser technology treatments include coagulation, Ion exchange, Adsorption, membranes biotreatment, ozone and AOPs. Establishing correlations experimentally between different raw water sources, water treatment used and DBP formation, by measuring raw water characteristics at the point before treatment and DBP-FP in the corresponding final water just after treatment using the analytical methods as above and the previously established methods for HAA and THM analysis. Analytical methods for the determination of DBPs from 16 categories are used to determine an extensive range of DBPs, giving a better understanding of the composition of the DBP mixture as a whole. The analytical methods can then be used to determine and compare water treatment technologies under optimal and suboptimal conditions and hence provide operational advice on minimising DBP formation by comparing treatment methods.

Keywords: **Disinfection byproducts; Nanofiltration; Advanced Oxidation Processes.**

Paper ID: CEST2017_01024

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of selected pesticides by ozone based processes

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Abstract

Discharging various micropollutants into aquatic environment in general and in particular substances classified as priority, hazardous and persistent generate serious concerns due to their potential adverse effects on human health and the living organisms in the environment. Mostly these are synthetic and non-synthetic substances and their effective removal requires non-traditional processes, novel approach and technologies. Ozone based processes and nZVI (nano zero-valent iron) are considered the prospective ones. Five chlorinated pesticides, i.e. hexachlorobenzene (HCHB), hexachlorobutadiene (HCHBD), lindane (LIN), pentachlorobenzene (PCHB) and heptachlor (HCH) were selected as model pollutants. Higher volatility is characteristic for these substances. Research was focused on evaluation of efficiency and removal rates of selected organochlorine substances from model water by integrated ozonation and nZVI (O_3/nZVI) process. Effect of ozonation and nZVI treatments on the same components were also carried out and used as reference for comparison.

Keywords: nanoiron particles, nZVI, organochlorinated compounds, ozonation, zero - valent iron

Paper ID: CEST2017_01075

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Treatment of textile wastewater in the Fenton process in the presence of iron nanocompounds and Cu^{+2} ions

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Abstract

Methods used to decompose pollutants in textile wastewater include oxidation/precipitation in the Fenton process. New research trends cover the application of iron nanocompounds in the reaction system. Iron nanocompounds exhibit catalytic activity which increases the effectiveness of oxidation processes. Also other metal nanocompounds or metal ions, in this number Cu^{+2}, are active in supporting pollutant decomposition in the Fenton processes. The aim of the study was to determine and optimize the efficiency of pollutant decomposition in textile wastewater by the Fenton method in the presence of iron oxide nano-particles and Cu^{+2} ions and to compare it with the classical Fenton method. The Fenton process was optimized as a result of studies on the effect of compounds used in the treatment, doses of iron, nano-iron and Cu^{+2} ions, hydrogen peroxide and pH of the solution on the efficiency of decolorization and decomposition of pollutants. It was found that the efficiency of pollutant decomposition in which iron nanocompounds and Cu^{+2} ions were applied, was even twice as high as in the classical method. It was probably connected with the catalytic action of iron oxide nanoparticles and Cu^{+2} ions and higher concentration of hydroxyl radicals in the reaction system.

Keywords: textile wastewater, Fenton process, iron nanocompounds, Cu^{+2} ions

Paper ID: CEST2017_01155

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Removal of emerging contaminants from water via peroxymonosulfate activation with various iron sources (Fe^{2+}, Fe^{3+}, ZVI)

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Abstract

This project studied the conversion of caffeine (stimulant), ibuprofen (analgesic), and diuron (herbicide) with novel Sulfate Radical-based Advanced Oxidation Processes (SR-AOPs). Chemical oxidation was achieved through electron transfer activation of peroxymonosulfate (PMS), from different iron sources including the ferrous ion (Fe^{2+}), the ferric ion (Fe^{3+}) and zero-valent iron (ZVI) in different size particles. The in-situ generated radical species mainly included sulfate radicals ($SO_4^{\bullet-}$), which have high redox potential for electron abstraction (2.5-3.1 V). Among the iron sources tested, ZVI was the most efficient and reactive form because of the slow and continuous release of Fe^{2+} and electrons that favors the production of a greater percentage $SO_4^{\bullet-}$. Controlled Fe^{2+} release, minimizes undesirable quenching (consumption) of $SO_4^{\bullet-}$ by the Fe^{2+}, making ZVI the preferred method for PMS activation. Overall, the contaminant with the highest removal percentage, irrespectively of the oxidizing system used, was ibuprofen because of its aromatic ring and lack of electron withdrawal groups in its structure.

Keywords: peroxymonosulfate, zero-valent iron, caffeine, diuron, ibuprofen

Paper ID: CEST2017_01175

In-lake treatment with hydrogen peroxide for cyano-HABs control at Delft, NL (Lake Delftse hout) during the summer of 2015

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Abstract

The presence of harmful cyanobacterial blooms (cyano-HABs) in surface waters negatively impacts the surrounding ecosystem while at the same time they limit its usages (for drinking water, irrigation and recreational purposes). Current research activities are focusing on treating Cyano-HABs at source as part of prevention ormitigation strategy. Application of hydrogen peroxide (2.5 mg/L H_2O_2), for the selective and rapid termination of Cyano-HABs has been successfully applied in fresh water lakes. It was therefore decided to treat the undesirable symptoms of cyano-HABs in the lake Delftse hout (NL) with H_2O_2. The lake was treated with 5 mg/L H_2O_2. A higher concentration was used because of the floating layers of cyanobacterial scum. H_2O_2 rapidly reacted with cyanobacteria and left no residual concentration within minutes of the application. The cyanobacteria population, mainly consisted of *Aphanizomenon* and *Dolichospermum* (formerly known as *Anabeana)*, was reduced to less than 1% and 3%of their initial concentration, respectively, 24 hours after the treatment. No adverse effects were observed on other flora and fauna. Following treatment microcystin concentration was below warning levels, and entrance to the public was allowed two days after treatment.

Keywords: *Dolichospermum* sp., *Aphanizomenon* sp., cyanotoxins, hydrogen peroxide, in-lake treatment.

Paper ID: CEST2017_01179

Photochemical oxidation of alcohol ethoxylate (Brij30®) by PS/UV-C process

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Abstract

In the present study, photochemical oxidation of an alcohol ethoxylate (AE) was experimentally explored. Poly(oxyethylene) (4) lauryl ether, commercially known as Brij30®, was selected as a model AE. Persulfate (PS)/UV-C oxidation of aqueous Brij30® (20mg/L) was investigated at a wide range of initial PS dosage varying between 0.5-5.0 mM and at two initial reaction pH values (3.0 and 6.0). The results obtained for both initial pH values indicated that increasing PS dosage did not have a significant effect on Brij30® removal efficiency and higher than 90% Brij30® abatements could be achieved after 60 minutes of treatment time. Total organic carbon (TOC) removals were significantly improved with increasing initial PS dosages for both initial pH values tested. PS dosages higher than 1.5 mM yielded higher than 90 % TOC abatement efficiencies. Second-order reaction rate coefficients for Brij30® and TOC with sulfate radical ($SO_4^{\bullet-}$) was determined as $1.62\times10^9\pm 3.5\times10^7$ $M^{-1}s^{-1}$ and $1.2\times10^6 \pm 2.39\times10^5 M^{-1}s^{-1}$, respectively. Toxicity of PS/UV-C treated aqueous Brij30® solutions towards the marine photobacterium *Vibrio fischeri* was also investigated to determine the possible toxic behavior of oxidation products.

Keywords: Alcohol ethoxylate, Kinetic modeling, Photochemical oxidation, PS/UV-C process, Vibrio fischeri inhibition

Paper ID: CEST2017_01250

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Photocatalytic decomposition of Nimesulide by treatment with TiO_2 nanoparticles

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Abstract

During the last two decades, pharmaceuticals have been recognized as environmental contaminants. Nimesulide, is a NSAID with analgesic and antipyretic properties, usually used for the treatment of acute pain and has been detected from several researchers through the years in environmental samples. In this study, we explored the application of heterogeneous photocatalysis (TiO_2 in suspension) for the degradation of Nimesulide. Different factors that affect the photocatalytic process were compared: load of catalyst and pH. Under optimal conditions (100 mg L^{-1} TiO_2 at pH 6), 5 mg L^{-1} Nimesulide can be removed within 45 min (k= 0.152 min-1) by using Degussa P-25. The transformation products generated during the treatment were investigated and characterized by means of liquid chromatography coupled to high resolution mass spectrometry. Also, the toxicity of Nimesulide and its transformation products was evaluated. The main Nimesulide phototransformation pathways were observed to be hydroxylation and fragmentation. Finally, mineralization and ion analysis was performed and a feasible transformation mechanism is proposed.

Keywords: Nimesulide, photocatalysis, kinetics, transformation products, TiO_2

Paper ID: CEST2017_01315

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Degradation of cephalosporins in aqueous solutions by UVc, UVc/H2O2 and UVc/PS

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Abstract

Cephalosporins are a widely used class of b-lactam antibiotics in human and veterinary medicine and they are detected at significant concentrations at the inlet and outlet of Waste Water Treatment Plants. The present study was focused on the degradation of three cephalosporins, namely cefuroxime, cefotaxime and ceftazidime, in aqueous solutions under UVc (i.e. λ=254 nm) irradiation, either alone or in the presence of two oxidants (H2O2, and PS (Na2S2O8)). Specifically, the effect of various parameters such as the concentration of cephalosporins, the concentration of the oxidants and the value of pH, as well as the effect of the aqueous matrix, were studied. Moreover, the second order constants of the reaction of each cephalosporin with hydroxyl and sulfate radicals, kOH and kSO4-·, were determined according to the method of competitive kinetics. For all the above processes, the degradation of cephalosporins excibited a pseudo-first-order kinetic pattern. The direct UVc irradiation resulted in high degree of degradation of cephalosporins but showed negligible decrease on TOC removal. TOC was significantly decreased in the case of UVc/PS photochemical degradation. However, none of the studied methods was able to achieve total mineralization.

Keywords:UVc/H2O2, UVc/PS, cephalosporins, cefuroxime, cefotaxime, ceftazidime

Paper ID: CEST2017_01318

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Synthesis of boron and silver co-doped TiO2 photocatalysts for the degradation of the antibiotic Sulfamethoxazole in aqueous solutions

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Abstract

The present study focused on the preparation of various boron- and silver- codoped photocatalysts, using titanium isopropoxide as substrate, and the comparison of their photocatalytic efficiency with the commercial TiO2 catalyst Aeroxide-P25. The doped photocatalysts were prepared using the solvent – thermal method. Photocatalysis experiments were carried out under both solar irradiation and visible light in order to evaluate the influence of doped and undoped TiO2 catalysts on the degradation of the antibiotic sulfamethoxazole (SMX). According to the results, boron doped photocatalysts contributed the most to SMX removal from aquatic solutions, although the most efficient catalyst of all proved to be titanium dioxide (TiO2).

Keywords: photocatalysis, solar, visible, co-doping, SMX

Paper ID: CEST2017_01319

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Degradation of cefuroxime in aqueous TiO2 suspensions under simulated solar radiation

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Abstract

The photocatalytic degradation of the antibiotic cefuroxime was studied under simulated solar radiation in aqueous suspensions of a commercially available TiO2 catalyst (Aeroxide-P25). The effect of various parameters, as the initial concentration of cefuroxime, TiO2 concentration and pH value, was investigated. In addition, the photocatalytic degradation of cefuroxime in complex water matrices (waste water and synthetic fresh and hydrolyzed urine), was studied. Moreover, in order to investigate the mechanism of photocatalytic oxidation of cefuroxime, the effect of addition of isopropanol, a strong inhibitor of the free hydroxyl radicals, HO •, was studied.

Keywords: TiO2, photocatalysis, solar, cephalosporin, cefuroxime

Paper ID: CEST2017_01320

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Comparative study of ceftriaxone removal by UVc photolysis and UVc based oxidation processes (UVc/H2O2 and UVc/PS)

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Abstract

The removal of ceftriaxone in aqueous solutions by three UV based photolytic processes (direct UVc photolysis, UVc/H2O2, UVc/Persulfate (UV/PS)) was investigated. UVc irradiation was provided by a low pressure mercury lamp emitting predominately at 254 nm. An immersion well, laboratory scale, batch photoreactor has been used. The objective of this study was to assess the performance of the above treatments on the removal of ceftriaxone from water, and evaluate the effects of factors in the treatment efficiency, including the oxidant dosage, initial ceftriaxone concentration, initial solution pH, and the chemical composition of water, using different (more complex) water matrices, as waste water and synthetic fresh and hydrolyzed urine.

Keywords: UVc/H2O2, UVc/PS, cephalosporin, ceftriaxone

Paper ID: CEST2017_01321

Iron(II)-impregnated activated carbon composites applied as Fenton-like catalysts for degrading persistent organic compounds

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Abstract

The aim of this work is to investigate the efficiency of a relatively cheap Fenton-like catalyst, Iron-impregnated activated carbon, towards the photo-degradation of organic compounds in aqueous solutions. The catalysts were prepared by wet impregnation method of activated carbons of different textural and chemical properties. Their efficiency as Fenton like catalysts towards Indigo Carmine (IC) degradation in aqueous solution are investigated. UV light irradiation tests are carried out to determine the performance of the prepared Iron-impregnated composite towards the degradation of IC in aqueous solution under different conditions using an UV - Consulting Peschl Laboratory Reactor System. Effects of solution pH and initial concentration of dye onto the process performance are established. Raw and composite materials are characterized by Nitrogen adsorption-desorption isotherms and SEM analysis. The total Iron content of synthesized composites is determined by UV-Vis spectrophotometry using phenantroline. The obtained results emphasize an enhancement of IC degradation in case of the heterogeneous photo-Fenton process conducted with an ozone generating UV lamp.

Keywords: composite, activated carbon, photocatalysis, Fenton, anionic dye

Paper ID: CEST2017_01396

SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geophysical and geochemical investigation of hydrocarbon subsurface contamination

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Abstract

In Serbia as in many other countries, hydrocarbon contamination (such is Light Non-Aqueous Phase Liquid - LNAPL contamination of soils) near oil refinery or gas station remains a major problem of environmental concern. The detection of petroleum hydrocarbon contaminants such as LNAPL in the subsurface using geophysical and geochemical methods, has been the subject of considerable interest in recent years. Their surface non-invasive detection is based principally upon the electrical soil properties and processes related to biodegradation of the hydrocarbons. Geophysical investigation is conducted at the location of RNS (Refinery Novi Sad), Serbia. The objective of this study was to evaluate the possibilities of geophysical (Electrical Resistivity Imaging-ERI, and Ground Penetrating Radar-GPR) techniques in detecting and locating anomalies of hydrocarbon contamination. Geochemical investigation of LNAPL contamination at this site are compared with ERI and GPR interpretation results. Sediment samples at RNS were collected from both uncontaminated and contaminated locations. Samples were obtained using Eijkelkamp rig and stored in the laboratory refrigerator until measurements were made. Evidence, obtained from a joint geochemical and geophysical investigation approach, indicated that subsoil which has been saturated with hydrocarbon contamination for a long period (> 1 year) exhibits an increased conductivity or decreased resistivity.

Keywords: environmental pollution, LNAPL, ground penetrating radar, contamination, electrical resistivity imaging, soil sample chemical analysis

Paper ID: CEST2017_00099

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of groundwater vulnerability by DRASTIC-LU, Khemis Miliana Plain (Algeria)

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Abstract

In recent years, groundwater vulnerability assessment has become a very useful tool for planning and decision-making on groundwater protection. The main value of vulnerability maps is that they can be used as a preliminary and effective tool for planning, policy, and operational levels of the decision-making process for groundwater management and protection. Vulnerability maps that will be developed during this research will become valuable planning guides and can help water planners in the region make informed and environmentally responsible decisions regarding Land use and the protection of groundwater quality, which will allow planners to focus on priority areas. The objective of this study is to determine vulnerable areas of groundwater in the study area, using a recent DRASTIC-LU model.

Keywords: Groundwater quality- Vulnerability- DRASTIC-LU model- Khemis Miliana Plain

Paper ID: CEST2017_00245

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Preliminary evaluation of heavy metal pollution in fluvial sediments within peri-urban areas – a Portuguese case study

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Abstract

Heavy metal pollution is a serious problem because living organisms may incorporate heavy metals into their tissues and transfer the heavy metals into the food chain, leading to their bioaccumulation. There are several sources of heavy metals, such as mining, industries, waste disposal, fuel combustion and phytosanitary treatments in agricultural fields. Although the EU's strategy has led to good progress in reducing heavy metal emissions within member states, it is a worthwhile subject to evaluate the already diffused heavy metals and their concentrations in the pedosphere.Peri-urban areas have been subject to greater land-use changes and urbanisation pressure. This study evaluates the potential heavy metal pollution over a stream network located in a peri-urban catchment (~6 km^2) near the city of Coimbra in Portugal. High contents of heavy metals were recorded in fluvial sediments, reaching, for example, 188.0 mg/kg Cu, 658.9 mg/kg Zn and 154.5 mg/kg Pb. However, high heavy metal concentrations were not equally dispersed over the stream network. Hence, it is considered that runoff, sediment sources and their mobilisation are important parameters for assessing the unequal dispersion of heavy metals in peri-urban areas.

Keywords: EU strategy, food chain, heavy metal, peri-urban, sediment.

Paper ID: CEST2017_00679

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterization of calcium carbonate produced by ureolytic bacteria (*Sporocarcina pasteurii* ATCC 6453 and *Bacillus aerius* U2) and effect of environmental conditions on production of calcium carbonate

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Abstract

Microbial carbonate precipitation (MCP) occurs as a byproduct of common microbial metabolic processes by ureolytic bacteria. In this study, the effects of different growth parameters such as urea concentration, temperature, pH and $CaCl_2$ concentration were examined on calcium carbonate mineralization by *Bacillus aerius* U2 and *Sporosarcina pasteurii* ATCC 6453. Mineralogical and textural data show that U2 gave rise to $CaCO_3$ precipitations as amorphous extracellular polymeric substance (EPS) and calcite and vaterite crystals, whereas ATCC 6453 produced EPS and vaterite. For *B. aerius* U2, the initial and final pH levels are 5.5 and 9.28, respectively. The highest $CaCO_3$ mineralization was observed at 20 ^oC and 300 mM urea for U2 strain, whereas at 30 °C and 333 mM urea for ATCC 6453. Our results indicate that $CaCl_2$ caused enhanced $CaCO_3$ mineralization. 1000 mM $CaCl_2$ was the most efficient concentration at $CaCO_3$ mineralization in *B. aerius* U2 and *S. pasteurii* ATCC 6453. The obtained data indicate that $CaCl_2$ (1000 mM concentration) caused enrichment for $CaCO_3$ mineralization for *B. aerius* U2 and *S. pasteurii* ATCC 6453. The microbial calcium carbonate precipitation by U2 at lower temperature (<30 ^oC) conditions is made possible the method to employ in wider climate zones for geotechnical applications.

Keywords: Ureolytic bacteria, biomineralization, calcium carbonate, vaterite, calcite

Paper ID: CEST2017_00840

Application of thermal plasma for inertization of metals in acid mine drainage treatment

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Abstract

Acid mine drainage (AMD) is a strongly acidic aqueous solution containing high levels of sulfate and toxic metals. In this study, the treatment of mine-impacted water (MIW) aimed at its safer disposal was investigated. Firstly, shrimp-shell and mussel farming waste were used as metal biosorbents and alkalinizing agents and thermal plasma technology was then applied for the inertization of metals contained in the substrate. The substrates employed for the MIW remediation were raw shrimp shell (SS) and mussel byssus filaments (MB). SS contains chitin in its composition, a metal-sorbent biopolymer, and calcium carbonate, an acidity removal agent. SS and MB saturated with metals from MIW were submitted to pyrolysis in a direct current thermal plasma reactor. Scanning electron microscopy (SEM/EDS) and flame atomic absorption spectroscopy (FAAS) were carried out in order to verify the metal inertization. The vitrification the inertization of the metals present in the samples analyzed was shown to be efficient, reaching to 99.8 to 100%. It was noted that the pyrolysis of the filter material impregnated by metals through thermal plasma allows the total inertization of these metals, and they can return to the environment or be stored in an environmentally safe way.

Keywords: Acid Mine Drainage, shrimp-shell, mussel byssus, toxic metals, thermal plasma.

Paper ID: CEST2017_00899

Remediation of toxic metal contaminated sediment using three types of nZVI supported materials

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Abstract

For in situ remediation of river sediment the most extensively applied nanoparticle is nano zero valent iron (nZVI). It is due to nZVI properties and effectiveness in the removal of toxic metals as well as low-cost regarding its production. The application of in situ treatment in laboratory conditions with kaolinite, bentonite and carboxymethyl cellulose supported nZVI was demonstrated. Small-scale laboratory studies have shown that the percentage of removed metal (Ni, Zn and Pb) ranged up to 80% depending on the material used for supporting nZVI. A microwave-assisted sequential extraction procedure was employed to assess toxic metal potential mobility and risk to the aquatic environment. In order to evaluate the extraction potential of toxic metals and the effectiveness of the treatment applied, single-step leaching tests were performed (TCLP, DIN and SPLP). In situ treatment in the laboratory proved to be very effective, providing the choice of optimal doses of three different material used for supporting nZVI towards the concentration of toxic metals in the sediment. Generally, nZVI can be an effective and versatile tool for remediation of sediment polluted with toxic metals.

Keywords: supported nZVI, toxic metal, in situ remediation, sediment

Paper ID: CEST2017_00946

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Adsorption kinetics, equilibrium and thermodynamics of naphthalene onto loess soil

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Abstract

Adsorption behavior of naphthalene onto loess soil was investigated based on adsorption kinetic and adsorption isothermal experiments. The saturated adsorption capacity of naphthalene onto soil from Lanzhou (LZ) was higher than those onto loess soil from Jiayuguan (JYG). The soil properties have an obvious influence on adsorption of naphthalene on loess soil. The naphthalene adsorption equilibrium was reached within 24h, and the adsorption kinetics was well described by the pseudo-second-order model, and also followed the intraparticle diffusion model. The adsorption processes were controlled by the external liquid film diffusion, surface adsorption, intra-particle diffusion, etc. Besides, the adsorption equilibrium data were fitted well with the Henry and Freundlich isothermal model. The saturated adsorption capacity was weakened with the decrease of temperature, suggesting a spontaneous endothermic process. The results of thermodynamic parameters analysis showed the adsorption was mainly a physical process and was enhanced by chemical adsorption.

Keywords: Loess soil; Adsorption; Kinetics; Thermodynamics parameters; Naphthalene

Paper ID: CEST2017_01242

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Determination of sulfonylurea herbicide residues in agricultural soil

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Abstract

As the consequence of triazines and some chloroacetanilide herbicides ban, the use of sulfonylureas has significantly increased. With the aim of establishing the impact of agriculture to the environment and quality of agricultural product, a monitoring program has been carried out in order to evaluate presence of SUs in agricultural soil. Of the 68 analyzed soil samples (0-30 cm) under intensive agricultural production, SUs were present in 20 samples. Extraction was performed by modified QuEChERS method. For the determination of SUs residues HPLC-DAD and Zorbax Eclipse XDB C18 column were used. Mobile phase composed of 0.1% CH_3COOH and acetonitrile; gradient (52-47% acetonitrile); flow rate 0.9 ml/min; wavelength 230 nm. The results obtained for the validation parameters completely fulfill SANCO/825/00 rev. 8.1 16/11/2010 criteria. In the most of the analyzed soil samples, residues of thifensulfuron-methyl, nicosulfuron, oxasulfuron and rimsulfuron were found. Iodosulfuron-methyl-sodium and prosulfuron have been established in only 3.9% of samples, while residues of metsulfuron-methyl, amidosulfuron and tritosulfuron have not been found, or their content was below the limit of detection.

Keywords: soil, sulfonylurea herbicides, residues

Paper ID: CEST2017_01277

Thorium as an environment stressor for plant growth

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Abstract

The plants of *Nicotiana glutinosa* (L.) were hydroponically cultivated on Hoagland nutrient media supplemented by thorium, tartaric acid, putrescine and/or phosphates. The accumulation of thorium by tobacco was monitored. The effect of thorium on the photosynthetic apparatus (contents of photosynthetic pigments, rapid fluorescence PSII,) was studied. Deficiency of phosphorus in the medium caused about 10-times higher Th accumulation in plants. However, the selected species – *N. glutinosa* does not have ability to accumulated Th enough for phytoremediation of contaminated environment. The application of putrescine on leaves lead to higher Th translocation to shoots but the effect of tartaric acid on Th accumulation was not observed. The presence of thorium in plants caused an increase in contents of photosynthetic pigments and a decrease in values of selected fluorescence parameters. Exogenous application of putrescine showed a potential in phytoremediation methods to support translocation of heavy metals to shoots.

Keywords: fluorescence, phytoremediation, putrescine, tartaric acid, thorium

Paper ID: CEST2017_01374

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Weathering of metallurgical slags exposed to rhizosphere conditions

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Abstract

Metallurgical slags disposed in the vicinity of historical industrial centers are the reason of environmental concern due to the potential release of the elements including toxic ones. This study addresses the impact of organic acids rich root exudates on the weathering of copper metallurgical slags. The simulation was made to reflect conditions encountered in the field and to assess the potential environmental risk associated with disposal of these wastes.

Keywords: rhizosphere, root exudates, metallurgical slags

Paper ID: CEST2017_01439

SPATIAL ENVIRONMENTAL PLANNING

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The contribution of accessible urban greenspace in the quality of residents' life in the Attica Basin - A spatial analysis

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Abstract

The current study focuses on the investigation and determination of the accessible urban green spaces in a particular region by exploiting methods of processing and analysis in Geographic Information Systems (GIS) environment. The aim of this study was the analysis of people's access into urban green spaces, using the Accessible Natural Greenspace Standards (ANGSt) Model, assessing the role and the contribution of these areas to the adaptation of climate change, at local level (Attica basin). According to the obtained results, the accessibility of urban green areas is sufficient, covering the largest percentage of Attica basin indicating that the majority of residents have access to urban green spaces. An adequate existence of green area is as important as the accessibility and the combination of these two indices, among others, can create a more efficient way to evaluate the quality of urban environment for its residents. Finally, ANGSt model allows the comparison of green areas accessibility, within different urban pattern, among different cities and countries. Indicating that the accessibility and the existence of green areas are two independent but complementary indices the combination of which may lead to more accurate results.

Keywords: Accessible Natural Greenspace Standards, Climate Change, Urban Green Area, GeographicInformation System, City Resilience

Paper ID: CEST2017_01280

ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Study on the evaluation of ETS abatement effectiveness in China

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Abstract

This paper constructs the evaluation tool based on China's seven pilots ETS operation experience and DID method by setting the necessary condition, sufficient conditions and evaluation standards, and taking the actual data from Chinese pilots ETS to do the empirical analyze, as well as inspect the reliability and validity of this evaluation tool. Analyze showed that: Shenzhen, Hubei and Chongqing ETS are efficient in mitigation, Guangdong, Beijing, Tianjin ETS have malfunction in emission reduction, Shanghai ETS does not have the effectiveness of emission reduction. This research shows that there are five key elements for executing impact on emission reduction effectiveness of ETS: total amount of quotas, potential emission reduction rate, mechanism coverage scale, control group's emission reduction rate, economic growth rate.

Keywords: ETS evaluation, mitigation efficient, China

Paper ID: CEST2017_00233

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Modelling vulnerability of drought in the Great Plain of Hungary

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Abstract

The Carpathian Basin is characterized by varying hydrological extremes, both in space and time. In fact, that the drought is significant and growing risk factor for Hungary, particularly in the Great Hungarian Plain, but in the other parts of the country signs of desertification are also found. Severe or moderate droughts occur in Hungary almost every year. However, the frequency of drought has increased, especially in recent decades. The aim of the study was to research drought phenomenon with calculation different drought indexes and based on this develop a drought vulnerability model to identifying and monitoring this phenomenon.In this study we calculated Reconnaissance Drought Index (RDI), Standardised Precipitation Index (SPI), Precipitation Deciles (PD) using DrinC software and Palfai Drought Indices (PaDI) to identifying and monitoring drought in our sample area (Karcag) which are situated in the Great Hungarian Plain.The result of drought indices calculation showed different types of drought in different years, however there were correlation between the indices and the input parameters were also simular. Thus using the all values of indices, a new drought categories were created using centroid defuzzification methods. Thus a new drought classification method were worked for the evalution of drought. We created 5 new categories: year without drought, mild drought, moderate drought, drought, heavy drouht and based on these categories we evaluated the drought phenomenon in our sample area.

Keywords: drought indices (RDI, SPI, PD, PaDi), defuzzyfication, modelling drought vulnerability

Paper ID: CEST2017_00525

Development of software for calculation of waste materials in graphic industry

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Abstract

Graphic industry is well known for producing a large amount of waste both during the production process as well as after using certain graphic products. The major issue is that this waste consists of various components: printing paper, colors and varnishes, isopropyl alcohol and oil compounds, as well as other, more or less damaging and dangerous chemical substances. The first step towards solving this problem is to calculate the amount of waste which will appear at the end. However, it is observed that there is no program for precise calculation of this waste material which could substantially facilitate its prediction although printing houses do have the waste material data. Based on this information, we have developed the first software for calculating not only the amount, but also the types of different waste during the process of preparation, printing and finishing according to the input data, such as paper consumption and printing technique. Thus it is possible to predict the capacity of waste management. The software was developed in the integrated development environment of the Microsoft Visual Studio, in the programming language Visual C#. Application of this software significantly speeds up the process of calculating waste materials in the graphic industry, which has been proven in one large printing house that has precise values of the waste materials for the previous year. By comparing the obtained values in the software with the real values of the waste material in the analyzed printing house, it is evident that the developed model provides rather precise data on the amount of waste material in the graphic industry.

Keywords: graphic industry, waste, software, calculation waste.

Paper ID: CEST2017_00673

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Modelling groundwater inflow to a mine pit: A Monte Carlo approach

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Abstract

Development of hydrological modelling methods to describe the behaviour of groundwater and surface runoff has been the subject of research for many years. This study aims to develop a Monte Carlo approach for simulating the probable formation of a mine pit lake in Kışladağ, Turkey by modelling the groundwater inflow to the open pit together with the precipitation, surface runoff and evaporation. Modelling methodology is based on a systems modelling approach. Results reveal the validity of the proposed system dynamics model for estimation of groundwater inflow to the mine pit. Sensitivity analysis are also carried out to assess the influence of model parameters on groundwater inflow. The results indicate that the model is more sensitive to the changes in radius of influence than hydraulic conductivity and static water level.

Keywords: Hydrological modelling, Mine Pit, Groundwater, System dynamics modelling

Paper ID: CEST2017_00757

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Nonlinear Autoregressive with Exogenous Input (NARX) approach for modeling of the single-multi metals adsorption from aqueous solution by resin

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Abstract

In this study, Nonlinear Autoregressive with Exogenous Input (NARX) neural network model was developed to predict the adsorption efficiency of Cd^{2+}, Ni^{2+} and Zn^{2+} ions from aqueous solution using a tannin (valonia type) resin as adsorbent. These ions are frequently encountered in a mixture in various industrial waste waters. The experiments have been performed for the chosen pH 5.0, 20 °C temperature, 350 rpm agitation rate and in the concentration range from 10 to 150 $mg.L^{-1}$ for single ions and their binary and ternary mixtures in aqueous solutions. Experiments with three metals were composed of seven tests; three separate single metal (Cd^{2+}, Ni^{2+} and Zn^{2+}), three binary mixtures (Cd^{2+}+Ni^{2+}, Ni^{2+}+Zn^{2+}, Cd^{2+}+Zn^{2+}), and one ternary mixture (Cd^{2+}+Ni^{2+}+Zn^{2+}). The NARX technique was used to fit the adsorption efficiency.

Keywords: NARX, artificial intelligence, modeling, adsorption, heavy metals

Paper ID: CEST2017_00881

Monitoring spatial distribution of PPCPs using chromatographic methods and Geographical Information Systems

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Abstract

The present study combines the chromatographic analysis of Pharmaceuticals, Personal Care Products (PPCPs) and Geographical Information System. (GIS). These PPCPs were at concentrations ranging from 5ng L^{-1} to 1µg L^{-1}, emphasizing Ibuprofen (until 400 ng L^{-1}) or Bisphenol A (until 50 0ng L^{-1}). The second part of the study is divided in two steps. Information required was integrated into a common Geographical Information System (GIS) framework. For this, location of the sampling points, population data (number of inhabitants, inhabitants ranged by age and sex) and the results of the chromatographic analysis were incorporated into the geo-referenced system (reference system ETRS-1989) established in the GIS structure, according to official standards, following the Spanish Spatial Data Infrastructure. The second step was a spatial analysis of the PPCPs, establishing a descriptive model of territorial presence of contaminants by combination of their location at a particular place with population densities. As remarkable results a high concentration of anti-inflammatories in the big cities or the detection of THC metabolites closed to the youngest populations were observed.

Keywords: Monitoring, Turia River, HPLC-MS/MS, GIS, PPCPs

Paper ID: CEST2017_00917

SOLID WASTE MANAGEMENT

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Sulphate resistance of micro-silica and zeolite with micro-silica contained concrete evaluated by statistical method

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Abstract

The use of natural resources and enhancing the use of waste materials as admixture of cement replacement is very important for sustainable development. This paper presents the experimental study of the sulphate attack on concrete prepared according to classic recipe and study of the effectiveness of concrete with 5% of micro-silica cement replacement and 8% of micro-silica and zeolite preplacement in controlling the damage arising from such attack. Ca, Si, Fe and Al ions dissolved from the cement matrix into liquid aggressive medium 0.005 wt. % H_2SO_4 (pH value 3) measured periodically during 270 days under laboratory temperature of 23 °C were determinated by X-ray fluorescence analysis. Statistical method of correlation analysis between the dissolved ions each other according to type of concrete recipes was calculated. Conclusions based on mathematical approach were formulated considering the best concrete mixture for the sulphate resistance point of view.

Keywords: acid corrosion, concrete deterioration, correlation coefficient, supplementary materials

Paper ID: CEST2017_00421

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Quantitative estimation model of solid waste on construction site

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Abstract

Nowadays, the growth rate on China's construction area is about 20 billion m^2 / year, which account for about 50% of the global construction area and solid waste has accounted for about 40% of urban waste. In the "13th Five-Year Plan", in order to achieve the optimal allocation of resources, the solid waste emissions on construction site will be reduced by 70%. How to accurately calculate the types of solid waste and how to recycle solid waste have become an important issue on the development of China's construction industry. In this paper, the solid waste database on construction site takes the seven factors into consideration, such as building type, structure form, construction craft through field investigation, survey and questionnaires, and an estimation model of solid waste on construction site is proposed. In this model, the solid wastes in the construction process are analyzed theoretically, and the methods of decomposing-combination measurement, material tracking approach, waste classification system, are put forward. The model can predict the amount of construction waste on construction site and provides strong support for the resource utilization and reduction of solid waste. The model will solve the important problems in the current construction industry and provide guidance for waste disposal.

Keywords: solid waste, reduction, model

Paper ID: CEST2017_00424

A bi-objective optimization approach to a municipal solid waste management system

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Abstract

Municipal solid waste management is one of the most important elements of urban management, especially for those metropolises dealing with increasing waste generation. To support effective municipal solid waste management systems, the economic factor is considered as one of the most critical criteria to be taken into account. While minimizing the opening cost of the waste management system's facilities is considered as one of the main factors in view of the government authorities such as municipalities, minimizing the transportation cost is the main interest of the sectors responsible for handling and transferring wastes (mostly contracted private sectors). Taking these two factors into account, this study proposes a bi-objective mixed-integer programming model for a municipal solid waste management system to optimize the total cost. Utilizing the lexicographic optimization method, the proposed model is successfully implemented in the general algebraic modeling system optimization software and obtained more efficient results than the common approaches of a single objective modeling.

Keywords: Municipal Solid Waste (MSW); Mixed-Integer Programming (MIP); Location-Routing Problem (LRP); Lexicographic optimization

Paper ID: CEST2017_00482

Mechanical and flame retardancy properties of polyester-(pine cone/boron oxide) composites

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Abstract

In recent years researchers focused on solid waste management due to the environmental issues and ecological susceptibility. Renewable resources such as natural fibers are environmentally friendly and low-cost alternatives when compared to other fibers like glass and carbon. Turkey has much potential of pine forests which is 54,000 ha and its total stone pine cone production is annually 3500 tons. Pine cone as a solid waste was used to produce composite materials due to these various advantages. Boron compounds compresses combustion by sealing the surface of the burning material and inhibit mass transfer of combustible vapors by blocking its contact with oxygen. Considering these properties of boron it was used with pine cone as a filler to provide flame retardancy. Boron oxide and waste pine cone fibers were used to manufacture the polyester composites by using casting process. Flame retardancy (limiting oxygen index (LOI)), some mechanical (bending strength, flexural modulus) and physical properties (water absorption, swelling thickness) were investigated at different fiber content. SEM analysis of the final products was performed to observe morphological structure.

Keywords: Polymer matrix composites, boron oxide, waste pine cone, flame retardancy, mechanical properties

Paper ID: CEST2017_00652

Teaching sciences and mathematics through the reuse of waste to produce a solar heater

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Abstract

Plastic has become the most common material since the earlier 20th century and the modern life (LAW et al., 2014). However, at the same time that it is very useful because of its properties, like durability, lightness and low cost, it also become a problem at the end of its life cycle, in other words, in the moment to disposal. The European Commission for environmental issues highlights that much energy and raw material are lost, instead of recycling into new products. The aim of this project is develop new pedagogical practices for teaching the subjects sciences, geograph and mathematics through Environmental Sciences, raising awareness in children from Elementary School regarding to the importance of reuse of waste and solar energy. The Project was developed in a public school in São José town, Santa Catarina State, where a workshop for reuse of PET bottles and milk long-life packing was carried out to produce a solar healer.

Keywords: plastic waste, healer solar, solar energy, science education

Paper ID: CEST2017_00895

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Ways to raise recovery potential of NFe metals from MSWI bottom ash

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Abstract

NFe metal fraction in bottom ash from waste-to-energy plants comprises a small but valuable part compared to glass, ceramics, magnetic fraction and ferrous scrap. Therefore, attempts to raise non-ferrous separability efficiency are economically reasonable. This paper wants to discuss not only basic parameters influencing the efficiency of non-ferromagnetic separation method based on eddy currents, especially the size, shape and conductivity of the separated material, properties of other fractions including humidity and their mutual interaction, but also the type and arrangement of the separator. On the basis of detailed analysis, still commonly unused approaches and advances will be proposed.

Keywords: waste-to-energy, metal recovery, eddy currents, separation

Paper ID: CEST2017_00898

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

A study on low energy demand materials used in glasscrete to counteract alkali-silica reactions

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Abstract

The potential of waste glass use in concrete as an alternative outlet to landfilling is excellent; however glasscrete (i.e. concrete with glass aggregate) suffers from durability problems caused by alkali-silica reactions (ASR). The use of pozzolanic materials to counteract ASR has been increasingly studied. This paper investigates the ability of selected low-energy demand binders/pozzolans to counteract ASR in glasscrete: these include paper sludge ash (PSA), a by-product of the paper making industry, used together with a standardised pozzolanic material for concrete, i.e. Pulverised Fly Ash (PFA) an industrial by-product of electric power stations. A number of laboratory tests were performed on the different glasscrete mixes to assess properties (workability, compressive and tensile strengths and elasticity moduli and water absorption). Mortars were also tested for alkali-silica reaction (ASR) using the accelerated mortar bar test, which showed that ASR was effectively counteracted, towards better glasscrete durability. Glasscrete mixes were identified, with similar strengths as the respective control mixes with natural aggregates. Workability was however affected in all mixes and should be addressed in further research.

Keywords: Solid waste management, glasscrete, alkali-silica reaction, alternative concrete binders

Paper ID: CEST2017_01029

Vermicomposting of municipal solid wastes

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Abstract

The purpose of this study is the production of compost out of municipal solid waste (MSW) through the method of vermicomposting using *Eisenia foetida*. Within the scope of this study, the quality of municipal solid waste compost that is produced as a result of composting process through the method of vermicomposting and the conditions of treatment were compared. 14 reactors were used and each of them had 3 kg of waste capacity. In five reactors, municipal organic solid waste that underwent a predecomposition in other five reactors, municipal organic solid waste that did not undergone a predissociation was going to be vermicomposted. In four reactors, municipal organic solid waste were composted through classical methods and these reactors were observed as control reactors. Throughout the study, some analyses was carried out on the samples of leachate that came through the reactors and the process of compost was observed. In order to determine the quality of compost that was produced after the completion of composting process, the analyses including fermenting degree (rottegrad), cytotoxicity, hygiene (salmonella) and heavy metal (copper, lead, cadmium, nickel, zinc, chrome) were implemented.

Keywords: Vermicomposting, *Eisenia foetida*, compost quality, municipal solid waste.

Paper ID: CEST2017_01043

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Trichoderma spores and 6-pentyl-alpha-pyrone production in solid state culture for biological control

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Abstract

Many *Trichoderma* species are able to produce spores and secondary metabolites like 6-pentyl-alpha-pyrone (6-PP), a lactone with antibiotic properties and coconut aroma. The aim of this work was to compare the ability of three strains of filamentous fungi: *Trichoderma harzianum G18*, *Trichoderma viride G19*, *Trichoderma asperellum G17* to produce spores and 6-PP in solid state culture (SSC). Sugarcane bagasse added to nutriment solution was used as support material for the culture. The maximum concentration of spores and 6-PP obtained by *T. harzianum G18*, were respectively $5.2x10^9$ spores/ g of carbone source and 0.08mg of 6-PP /g of Dry Matter (DM).

Keywords: *Trichoderma species*, solid state fermentation, 6-pentyl-alpha-pyrones, spores, sugarcane bagasse.

Paper ID: CEST2017_01127

REFINING THE ASSESMENT OF HUMAN EXPOSURE TO EMERGING CONTAMINANTS AND THEIR HEALTH EFFECTS

Friday 1 September 2017

Occurrence of selected pharmaceuticals in flooded arable soil: Bioaccumulation in root vegetables and health risk assessment

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Abstract

The presence of 12 pharmaceuticals (analgesics/anti-inflammatories: *ibuprofen*, *salicylic acid*, *diclofenac*; lipid regulator and cholesterol lowering statin drug: *benzafibrate*; psychiatric drug: *carbamazepine*; histamine H2 receptor antagonists: *ranitidine*; β-blocking agent: *propranolol*; diuretic: *hydrochlorothiazide*; antihypertensive: *losartan*; antibiotics: *erythromycin*, *clarithromycin*; calcium channel blocker: *diltiazem*) were determined in flooded arable soil samples collected from region in the northern Serbian province of Vojvodina heavily flooded during May 2014, when exceptionally heavy rains fell on Serbia and many cities and villages were completely under water. This region was selected for the investigation as it is the area of intensive agricultural production. Additionally, samples of potato and carrot were collected and analysed on the same pharmaceuticals, as uptake of selected pharmaceuticals by root vegetables may represent a worst case scenario of direct contact between the flooded soil and the consumed crops. Samples were prepared using solid-phase extraction and the presence of 12 pharmaceutical compounds in the extracts was analyzed by ultra-high performance liquid chromatography coupled to triple quadruple mass spectrometry (UPLC—MS/MS). Taking into account that contents of selected pharmaceuticals were below limit of detection, the health risk associated with the target compounds in analysed vegetables should not be of concern for the Serbian consumers.

Keywords: Pharmaceuticals, flooded arable soil, bioaccumulation, health risk

Paper ID: CEST2017_00298

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of heavy metals in wild mussels *Mytilus Galloprovincialis* from the Marmara sea coast of Tekirdag (Turkey)

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Abstract

Concentrations of eight heavy metals (Cd, Cr, Cu, Hg, Ni, As, Pb, and Zn) were identified in tissues of the mussel *Mytilus galloprovincialis* that are seasonally collected along the Marmara coast of Tekirdag. The concentrations (mg/kg d.w.) of these metals ranged from 1.20 to 2.79 for arsenic (As), 0.13 to 0.75for cadmium (Cd), 0.42 to 2.46 for chromium (Cr), 1.55 to 3.5 for copper (Cu), 1.01 to 2.46 for nickel (Ni), 76.8 to 88.98 for zinc (Zn), and 2.67 to 9.2 for lead (Pb). These levels were lower than the permissible limits set by the European Commission and Food and Drug Organisation Permissible limits for Pb, As, and Zn were exceeded during some periods. Evaluation of the public health risk associated with consumption of mollusks indicates that there is no evidence of risk to the *Mytilus Galloprovincialis* consumer. However, because chronic exposure of to trace metals can cause health problems for humans, toxic chemicals must be periodically and carefully monitored.

Keywords: Mussel (Mytilus galloprovincialis), Heavy metals, Marmara Sea, Coastal pollution

Paper ID: CEST2017_00569

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biological potential of barley (*Hordeum vulgare*) and radish (*Raphanus sativus*) in water quality monitoring

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Abstract

Quality and impact of water characterized by its high content of certain pollutants used for watering of the tested plants: barley (*Hordeum vulgare*) and radish (*Raphanus sativus*). was tested in laboratory conditions. Water sampling was performed at two locations on the River Douro in Portugal. Physico-chemical analysis of water indicates that. according to Portuguese regulations for water quality, electrical conductivity, ammonia, iron (Fe), magnesium (Mg) and some heavy metals (arsenic (As), selenium (Se)) were in values that exceed the maximum allowable concentration. The pharmaceuticals (paracetamol, naproxen, ibuprofen, hydrochlorothiazide and azithromycin) were registered over the limit of detection in water sample Douro I, contrary to that, in all analyzed water samples pesticide substances were below the detection limit. Increased amounts of As, Se and Mg from the water sample Douro I caused stimulation of fresh & dry weight of radish shoot and its length by 30, 23 and 71% respectively. In contrast, seed germination & germination energy of radish were significantly inhibited by the same water, while in the case of barley there was no significant differences. Douro II water sample significantly stimulated length and fresh weight of roots of barley by 23 and 81%, compared to the control. These effects are attributed to the presence of iron in a greater amount in this water sample. Morphological factors have proved better in relation to physiological factors. An expressed variability of parameters indicates their potential as possible bioindicators.

Keywords: Douro river, pollutants, phyto-indicators, barley, radish

Paper ID: CEST2017_00879

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Personal noise exposure in different microenvironments

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Abstract

Noise pollution is a major environmental issue, especially in urban areas where noise levels tend to be higher because of intensive traffic and industry activities. Epidemiological studies have demonstrated that noise exposure can cause a number of adverse physiological and psychological responses and diseases to human health. Accurate assessment of exposure is essential for health risk assessment. The aim of this study was to assess personal noise exposure in different microenvironments (MEs) according to time-activity patterns of individuals. Data were collected from 31 volunteers using questionnaires and smartphones. Participants were 20-26 years old and were carrying smartphones for 5 working days. The analysis of time-activity patterns and GPS data was performed using ArcGIS software. GPS data were classified into six location categories (home, work/study, other indoor, other outdoor static, outdoor walking and in-vehicle travel) to determine time spent in each location.The results showed that there was a significant difference between noise levels in six location categories. The highest average noise level was determined in-vehicle travel location 62.8 dB. The difference between in-vehicle travel location and other locations were 12.2, 11.0, 6.4, 14.8 and 6.6 dB, respectively in home, work/study, other indoor, other outdoor static, outdoor walking locations.

Keywords: Noise pollution, exposure, GPS, microenvironment

Paper ID: CEST2017_00986

Phthalate exposure in Turkish children aged 8-9 years in Konya

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Abstract

The present study aimed to investigate the concentrations of five phthalate metabolites in the urine samples from children aged 8-9 years from Konya in the central region of Turkey and to determine the effect of residence and gender on the concentrations of the metabolites. Children were selected by household sampling. Urine samples were collected in glass vials and were stored at −20 °C until analysis. Phthalate metabolites including mono-n-butyl phthalate (MnBP), monomethyl phthalate (MMP), monoethyl phthalate (MEP), monobenzyl phthalate (MzBP), mono-2-ethylhexyl phthalate (MEHP) were measured using LC–MS/MS. Enrolled sample was consisted of 587 children, 65.8% from urban area, 50.3% male. Measurements above the limit of quantification (LOQ) was 99.8% in MnBP, 97.6% in MzBP, 98.6% in MEP, 100% in MEHP and only 4.1 % in MMP. MnBP, MzBP, MEP, and MEHP was detected in urine with a median (25p-75p) concentration of of 106.9 (65.3-186.3), 10.5 (5.3—19.2), 26.8 (12.7-51.4), 20.9 (12.6-35.6) µg/g-creatinine, respectively. There was significant differences between rural and urban residence, whereas no gender difference was observed. Urinary concentration of MnBP, MzBP were found to be lower in urban areas, however, MEHP was higher. Findings indicated that phthalate exposure varied by types of phthalates, residence of children.

Keywords: Phthalates, metabolites, exposure, urine, children

Paper ID: CEST2017_01065

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Time course of changes in structure and morphology of chrysotile asbestos by dissolution

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Abstract

The alteration of chrysotile by dissolution was investigated with the aim of revealing the effect of time course on its structure and morphology. At pH 1.3, both Mg and Si contained in chrysotile continued to dissolve for 28 days, and the extent of dissolution after 28 days of Mg was approximately four times greater than that of Si. As the dissolution time progressed, the octahedral sheets of magnesium hydroxide are destroyed and the residual silicon component transformed into amorphous silica. The dissolution reaction initially proceeds the outermost octahedral sheet of magnesium hydroxide. After 28 days, chrysotile altered into sheet-like form or fiber-like form formed by connecting nanoparticles, while there were fibers maintaining hollow structure.

Keywords: Chrysotile, Dissolution, Structure, Morphology, Fiber

Paper ID: CEST2017_01215

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Physiological response of the lichen *Evernia prunastri* transplanted near a landfill in central Lithuania

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Abstract

Landfilling is the most widely used method for disposal of municipal solid waste. The waste disposal sites are a matter of concern due to their adverse effects on the environment and health. Lichen *Evernia prunastri* were used for biomonitoring the effect of air pollution in the vicinity of one of the largest solid waste landfill in Lithuania. Lichen transplants were exposed for 3.5 months. Potential quantum yield expressed as Fv/Fm in thalli was affected at the closest to the pollution source sites and the values were lower in comparison with the control. The conductivity of leachate and content of malondialdehyde content (MDA) increased in lichen material transplanted at sites facing the landfill.

Keywords: atmospheric pollution; biomonitoring; lichen; landfill.

Paper ID: CEST2017_01329

BIOWASTE

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Valorization of *Eucalyptus globulus* bark as a growing-media component for potted plants

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Abstract

Eucalyptus globulus bark is a waste from pulp and paper industries. This work aims to use *E. globulus* bark as raw-material for substrates formulation. Three types of bark were used: fresh bark (FB) milled to 6 mm particle size, and two hydrothermally treated barks (HTB1: 20' 60°C; HTB2: 40' 100°C). Barks were mixed at 25 and 50% (v v^{-1}) (S25; S50) with peat. FB was phytotoxic, causing low germination (91%) and root growth inhibition (0.1 cm length) of *Lepidum sativum* seeds. HTB1 and HTB2 reduced significantly toxicity with germination rates of 98 and 100%, and root lengths of 5.1 and 5.2 cm, respectively. Potting test, using Chinese cabbage, revealed lower germination (95%) in FB mixtures than in HTB1, HTB2 and commercial substrate (CS) (98-100%), reinforcing the FB phytotoxic. S50 decreased plant growth, probably related with lower water retention, as well as nitrogen immobilization inherent to woody substrates. S25 showed shoot weight, and roots growth statistically equal or higher than CS, encouraging use of this proportion of hydrothermally treated bark in substrate formulation.

Keywords: *Eucalyptus globulus*, bark, industrial waste, hydrothermal treatment, substrate.

Paper ID: CEST2017_00437

Biosorption of cationic textile dyes by a forest industry residue: *Pinus pinaster* bark

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Abstract

The potential of *Pinus pinaster* bark (PP) for the removal of methylene blue (MB) and malachite green (MG) dyes from aqueous solutions in single and binary systems was investigated. In the single systems, batch experiments were carried out to study kinetics and equilibrium of MB and MG adsorption by pine bark. The influence of contact time (till 8h), adsorbent dose (2.5-5-10 g/L), temperature (25-40-60ºC), pH (2-4-6), particle size (0.1-0.5, 0.5-1 and 1.6-2 mm) and initial dye concentration (10-100 mg/L) on adsorption percentage and capacity was analysed. More than 70% of both dyes could be removed in less than 1 h and almost completely when equilibrium was reached. Temperature was the less significant variable. In the binary system, MB and MG exhibited competitive adsorption. Kinetics and equilibrium data were described by the pseudo-second order and Langmuir models, respectively. Adsorbent morphology and functional groups present were characterized before and after adsorption by scanning electron microscopy (SEM) and Fourier transform infrared (FTIR) spectroscopy. Maximum adsorption capacities (22.2-41.7 mg/g for MG and 31.3-50.0 mg/g for MB) revealed that pine bark can be used as an effective adsorbent for removing cationic dyes.

Keywords: Biosorption, Cationic dyes, Pine bark, Wastewaters.

Paper ID: CEST2017_00528

Life Cycle thinking, the key for a Circular Economy: the Municipality of Halandri case

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Abstract

The present work is an overview of a Horizon 2020 project called Waste4Think, which proposes source separation and separate collection of the Fermentable Household Waste (FHW) in the Municipality of Halandri, aiming to evaluate this material as potential feedstock for the valorization of alternatives for the recovery of high-grade materials. Eco-innovative solutions which will be employed in the Municipality also include: Citizens involvement methodologies reinforced with the use of the Information and Communication Technologies (ICT tools such as Apps, educational materials and serious games), separate collection for nappies and biowaste from supermarkets, use of decision making tools for the optimization of the collection and operation of the plants and the implementation of the Zero Waste Nursery concept.A Food Residue Biomass (FORBI) product is generated from the pre-sorted FHW, (the only non-recyclable fraction of MSW). FORBI is generated by drying/shredding household food waste, which is door-to-door collected by the Municipality. FORBI is a valuable raw material that may be used for: the production of biogas (Hydrogen, Methane and HYTHANE), compost, animal feed, bioethanol, electricity, pellets, activated carbon and an alternative fuel for the cement industry.Preventing landfill disposal of the FHW follows a life Cycle Thinking (LCT), which is the key of a Circular Economy (CE). The present work is a part of the H2020 project “Waste4Think”. It is envisioned that the results will help transform the Municipality of Halandri from being a “Waste generator” to being a “Biomass producer”.

Keywords: Life Cycle Thinking, Circular Economy, Waste management, Eco-design, fermentable fraction of household waste.

Paper ID: CEST2017_00923

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Characterisation of various biomass waste

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Abstract

Agricultural biomass as an energy resource has several environmental and economical advantages and has potential to substantially contribute to present fuel demands. It was well-known that straw and rape residue are a potential sources of energy and value-added by-products among the various biomasses. The results of thermal analysis indicate that thermal degradation of the biomass waste occurs through three steps: decomposition of hemicellulose (220–315 °C), cellulose (315–400 °C) and part of lignin (137–900 °C) and resulted in the formation of char.

Keywords: biomass waste, thermal analysis, FTIR spectroscopy

Paper ID: CEST2017_01302

HAZARDOUS WASTE MANAGEMENT

Friday 1 September 2017

Main principles for hazardous wastes management in Armenia

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Abstract

In the Republic of Armenia main principles for wastes management include: Protection of the environment and human health against adverse impacts of wastes; - Use of advanced achievements in science and technioogy for implementation of wastes-free and low-waste technologies to minimize amounts of wastes;- Comprehensive use of raw materials; - Environmentally safe disposal (treatment, recovery, destruction) of inappropriate-for-use. wastes. The regulatory-legislative basis of hazardous waste management are covered by provisions of the "Basel Convention on the control of transboundary movements of hazardous wastes and their disposal" ensuring environmental safety and preventing illegal traffic of hazardous wastes. The "Law on Waste of the Republic of Armenia" was adopted in 2004 and regulates legal and economic basis of issues relevant to collection, transportation, storage, processing, use, disposal, minimizing volumes of waste, including hazardous wastes. The following main elements of hazardous wastes management are important:

- Wastes state registration;
- Wastes generation standards and wastes disposal limits;
- Wastes identification/passportization;
- Wastes State Cadastre;
- Register of establishments carrying out operations on wastes generating, recycling and re-use.

In Armenia the problem of hazardous wastes management is worsened by the fact that polygons for treatment and disposal of hazardous wastes are lacking in the country.

Keywords: wastes, governance, regulation, environmental protection, environmental safety

Paper ID: CEST2017_00287

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

UVC detection as a potential for alpha particle induced air fluorescence localisation

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Abstract

As part of the decommissioning process, Plutonium-Contaminated Material (PCM) has to be identified, so it can be disposed of appropriately. Most conventional alpha detectors are only effective at relatively short range. This puts personnel in close proximity to the radiation exposure from this and other types of radiation. Alpha particles cause ionisation in air resulting in the emission of ultraviolet (UV) photons. These have a considerably longer mean free path than alpha particles, providing an avenue to detect alpha contamination from a distance. However, the intensity of this UV light is exceedingly small in comparison to natural daylight, making detection difficult in the field. Although the majority of emitted photons are in the 300 to 400 nm wavelength range, it may be possible to detect those in the UVC range (180 – 280 nm) as natural UVC is blocked by Earth's atmosphere. UVC detection is already used in the detection of fires and corona discharge. A group of such detectors have undergone a series of tests to determine their suitability for detecting UVC emissions from alpha particle induced air fluorescence. Results to date have shown that long range UVC detection and location is possible with these detectors.

Keywords: UVC detection, Alpha-induced air fluorescence, UVTron detector, Nuclear decommissioning, Plutonium-contaminated material

Paper ID: CEST2017_00676

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Determination of the surface properties of ZSM-5 zeolite by inverse Gas Chromatography

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Abstract

Inverse gas chromatography (IGC) has been used to measure the surface adsorption of some probes (n-alkanes on a series (n-C6 to n-C9) on ZSM-5 zeolite. The adsorption thermodynamic parameters (the standard enthalpy (ΔH^0), entropy (ΔS^0) and free energy of adsorption (ΔG^0) and the dispersive component of the surface energy (γ_S^d), of zeolite surface were estimated by using the retention time of different non-olar probes at infinite dilution region. Dispersive component of the surface energy of zeolite was calculated between 290 and 320 °C. It was observed that, γ_S^d values decrease with increasing temperature.

Keywords: Inverse gas chromatography, Adsorption thermodynamic parameters, Surface energy, ZSM-5 zeolite

Paper ID: CEST2017_00704

Electrochemically generated bimetallic reductive mediator $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$ for the degradation of CF_4 to ethanol by electro-scrubbing

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Abstract

The remediation of the electronic gas, CF_4, using commercially available technologies produces another type of greenhouse gas (CO_2) and corrosive side products. The aim of this study was to degrade CF_4 gas at room temperature into useful products using an electrogenerated $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$ mediator. The initial electrolysis of the bimetallic complex at the anodized Ti cathode produced $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$, which was confirmed by electron spin resonance spectroscopy. The degradation of CF_4 followed the mediated electrochemical reduction by electrogenerated $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$. The removal efficiency of CF_4 was 95% using this electroscrubbing process at room temperature. Fourier transform infrared spectroscopy in both the gas and solution phase showed that CH_3CH_2OH was the main the product formed during the removal of CF_4 by electrogenerated $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$ at electroscrubbing with a small amount of CF_3CH_3 intermediate.

Keywords: Bimetallic mediator, $Cu^{1+}[Ni^{2+}(CN)_4]^{1-}$, MER, CF_4 degradation; Ethanol formation

Paper ID: CEST2017_00845

Rhodotorula glutinis: Extracellular synthesis of silver nanoparticals and lipase productionusing food industry waste, molasses

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Abstract

In the present study, an attempt has been made to evaluate the enzyme activity inhibition of silver nanoparticles originating from yeasts against a major yeast mediated extracellular enzyme, lipase by *Rhodotorula glutinis*. Yeast was cultivated in molasses medium for lipase production. Crude enzyme was incubated with silver nanoparticles, the enzyme activity was determined after the post treatment with different concentration of nanoparticles. Silver nanoparticles were synthesized by *Rhodotorula glutinis.* The different parameters were optimized for the synthesis of AgNPs. The culture was centrifuged at 72,000 × g for supernatant was mixed with 1 mM $AgNO_3$ solution for the synthesis of AgNPs. All the reaction mixtures were incubated at room temperature for under light. The optical characteristics of the synthesized silver nanoparticles were analysed using UV–Vis spectrophotometer, FTIR, SEM, ZS. Crude enzymes were obtained after the respective incubation period by the respective fungal organism. Nanoparticles treatment and the enzyme activity was evaluated by suitable enzyme quantification assays. Finaly we demonstrated the inhibitor or activator effect of the different concentrations of silver nanopartical on the lipase productivity by *Rhodotorula glutinis.* Enzyme activity of all the tested enzymes was not inhibited in all the tested concentration**.**

Keywords: *Rhodotorula glutinis*, Lipase, Silver nanopartical.

Paper ID: CEST2017_00865

HEAVY METALS IN THE ENVIRONMENT

Friday 1 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Investigation of elemental composition of *Dianthus leucophaeus* Sibth. var. *leucophaeus* from tungsten mining area

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Abstract

The accumulation of metals in both aquatic and terrestrial ecosystems poses a relevant environmental risk as a consequence of several contaminating human activities such as mining or melting. In this regard, heavy metal accumulation in environment constitutes a serious health problem for animals and humans via biomagnification processes in the trophic chain. Some metals and metalloids such as Zn, Cu, Fe, Mg and Mn are taken up by plant roots to different extents to maintain the essential biochemical and cellular processes. Others with unknown biological role can enter into plant tissues and damage normal processes, either passively or due to their similarity with essential ions. The aim of this study is to evaluate the behaviour of *D. leucophaeus* which spread on the abandoned W mining area of Uludağ Mount. Thus, elemental composition (W, Mo, Zn, Fe, Cu, Cd, Mn, Pb, Cr, Co, B, and Bi) of this plant species in order to understand the contribution of elemental composition of surviving capability of this plant. Elemental contents of different parts of plants were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) after acid digestion processes. Our results indicate that contents of many elements in soils of these species were increased depending on mining activities.

Keywords: *Dianthus leucophaeus*, tungsten, element, inductively coupled plasma-mass spectrometry.

Paper ID: CEST2017_01044

ATMOSPHERIC SCIENCES

Saturday 2 September 2017

Investigation into the indoor and outdoor air pollution of PM2.5 and PM10 in a university of Zhengzhou during wintertime

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Abstract

In this paper, the particle mass concentrations of PM2.5 and PM10 are determined by a portable air particulate monitoring instrument in different places of the University of Zhengzhou; meanwhile, the temperature, the humidity, the ventilation condition, the indoor area and other indicators are observed in the sampling point. On the basis of the monitoring results, the concentration differences of PM10 and PM2.5 between the indoor environment and the outdoor environment are compared, and the influence factors of the dust content in the indoor air are analyzed and discussed. The results show that there is a negative correlation with indoor concentration of PM2.5/PM10 while ventilating and the humidity doesnot affect PM10/PM2.5 obviously.

Keywords: PM2.5, PM10, university, influencing factors

Paper ID: CEST2017_00159

Impact of elevated CO2 concentration on growth and water use efficiency of spring wheat under free-air conditions at semi-arid rain-fed area of northwest China

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Abstract

Spring wheat (*Triticum aestivum* L. 'New Dingxi 24') was grown at ambient (370 μl l^{-1}) and elevated (620 μl l^{-1}) concentrations of CO_2 in a mini free-air CO_2 enrichment (FACE) facility to study the impact of CO_2 enrichment on growth, yield, and water use efficiency (WUE) in a semi-arid area in northwest China. The results showed that at the elevated CO_2 concentration the plant height (20.1%), leaf area index (18.8%), average number of grains in a spike (22.5%), and thousand-kernel weight (17.2%) were higher than that of ambient CO_2 concentration(CK), whereas the proportion of sterile spikes was 41.5% lower in the CO_2-enriched plots. The period from sowing to harvesting was 5 days longer (within which the filling–milking stage was significantly longer) in the CO_2-enriched plots. Consequently, the yield (15.4%) and water use efficiency (WUE) (15.4%) was significantly higher in the CO_2-enriched plots. Overall, the results suggest that the higher yield was mainly attributable to the greater average number of grains in a spike and higher thousand-kernel weight. Moreover, the improved WUE helped to counteract the negative effects of moisture stress.

Key words: Triticum aestivum; CO_2 enrichment; grain yield; yield components; water use efficiency

Paper ID: CEST2017_00423

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation of the Version 7 TRMM Multi-Satellite Precipitation Analysis (TMPA) 3B42 product over Greece

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Abstract

In this research work, the latest version 7 (V7) of the Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA) 3B42 product is evaluated over Greece, at five different temporal scales; 3, 6, 12, 24 and 48 hrs. Evaluation is conducted using data from 34 rain gauge stations, for the 2009-2014 period. It has been found that, although there is a notable improvement in the accuracy of the estimates at coarser time scales, the product reliability still remains low (the value of the efficiency coefficient is about 0.22 and about -0.23 in the 48 hr and 3 hr scales respectively). Furthermore, the product systematically underestimates precipitation and the correlation between the satellite and ground data is poor – lower than 0.6 in all cases. The examination of the spatial distribution of bias shows that the error at high resolution temporal scales (3 hr and 6 hr scales) is negative in the greatest part of the country, in contrast to the lower scales, at which the product turns to slightly overestimate precipitation over the regions that are generally characterized by lower total precipitation amounts.

Keywords: TRMM, 3B42 V7, evaluation, precipitation, Greece

Paper ID: CEST2017_00498

Agricultural drought monitoring in Shanxi by using temperature vegetation dryness index

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Abstract

Considering the conditions of droughts occurred frequently in recent years, especially the agricultural drought, Shaanxi Province was selected as the study area the NDVI (Normalized difference vegetation index) and LST (land surface temperature) , and to establish for the first time LST-NDVI feature space using the compound MODIS data from in 2014, June through August. Then, the spatial distribution of drought in the Spring Maize at Different Growth Stages were obtained based TVDI (temperature vegetation) , and the variation tendency of the drought in Shaanxi was analyzed. TVDI was verified using the 0-20cm relative soil moisture. The results showed that the drought more serious, and the disaster area is growing, from the spring maize seven-leaf stage to tasseling period. A trend is demonstrated expanding from east to west. The TVDI was validated by using 0-20 cm relative soil moisture data, and it was found that the TDVI and soil moisture had better correlation, at the significance level of 0.01. The TDVI could better reflect the drought status of spring maize at different growth stages.

Paper ID: CEST2017_00632

Air dispersion modelling for the evaluation of population exposure to pollutants emitted by complex areal sources

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Abstract

In this work an application of the CAREA model is presented for the evaluation of the population exposure to pesticides emitted by agricultural fields. CAREA is a Gaussian air dispersion model based on a simplification of the AERMOD formulation because AERMOD is hardly applicable on an high number of complex polygons. CAREA was applied to pesticides emitted by 1519 agricultural fields and considering 2584 receptors distributed on an area of 8430 km^2. CAREA was run with an hourly time step from March to September. CAREA output provided, for each receptor, a relative concentration value that was assumed proportional to the receptor exposure The analysis of the results showed a smooth exposure distribution with 46% of non-exposed receptors instead of the cut off distribution achieved by proximity models.Finally, an experimental measurement campaign was carried out in order to find suitable distances for the assessment of population exposure. To this aim, the air concentration of a pesticide was evaluated by an high volume sampler equipped by quartz fibre filters for aerosols. An AERMOD simulation was performed in order to assess the spatial distribution of the concentration over a test site, thus an experiment was carried out in order to assess the differences between the two models.

Keywords: CAREA, pesticides, Gaussian Air Dispersion Model, Complex areal sources, exposure

Paper ID: CEST2017_00877

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The determination of particulate matter pollution in Kaunas city

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Abstract

Particulate matter pollution is a major environmental issue in a large number of cities causing adverse effects on human health. It is a mixture of solid, liquid or solid and liquid particles suspended in the air, which vary in size and composition. The aim of this study was to determine and evaluate the concentration of particular matter (PM_{10}), which is 10 micrometres or less in diameter, in Kaunas city, Lithuania. The measurements were carried out in 35 sites of Kaunas city. We used a real-time dust monitor (CEL - 712 Pro MicroDust, Casella) with an ambient air pump. The results of the study showed that the concentration of PM_{10} in high traffic intensity sites (more than 10,000 vehicles/day) ranged from 22.4 to 32.3 µg/m^3 with the average value of 26.3 µg/m^3, while in low traffic intensity sites (less than 3,000 vehicles/day) PM_{10} values varied from 15.3 to 20.8 µg/m^3 with the average value of 17.8 µg/m^3. We compared the concentrations of PM_{10} in areas of multi-storey buildings blocks and individual houses blocks. It was found that the average concentration of PM_{10} was higher in areas with multi-storey buildings 24.2 µg/m^3, while in areas with individual houses - 19.2 µg/m^3.

Keywords: Particulate matter, air pollution, traffic, measurements

Paper ID: CEST2017_00982

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

PM10 concentrations, trace elements and sources' identification in three representative receptors of Western Macedonia, Greece.

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Abstract

Many epidemiological studies have revealed consistent associations between ambient concentrations of inhalable (PM10) particles and their elemental composition with adverse respiratory health effects. On the other hand, suspended particulate matter emissions from several types of sources can be identified by the investigation of their particle element composition. The objectives of this work were to present the results of PM10 concentrations and trace elements obtained from 1-year sampling/analysis campaign. Three different sampling sites of the region of Western Macedonia in Greece were selected to investigate the PM10-associated elements fingerprints in samples of airborne particles: S1 in the center of Kozani, where urban activities and traffic density occur, S2 in the city of Ptolemaida located close to the industrial area, and S3 in the village of Eratyra in a rural residential district. The PM10 samples were analyzed by ISP-MS instrument. Twenty five elements were detected at quantifiable concentrations in the examined PM samples. Finally, an attempt was made to identify the main PM10 sources that affect the sampling sites. For this purpose was applied the multivariate Positive Matrix Factorization (PMF) receptor model.

Keywords: PM10, elemental composition, PMF

Paper ID: CEST2017_01023

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Geometric Structures in mesoscale urban flows

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Abstract

Geometric structures with the shape of waves, ramp, cliff, and step changes are commonly observed in a wide range of temporal signals such as meteorological or energy production time series. Traditionally, geometric shapes found in turbulence were examined in the context of coherent structures; they are believed to dominate the turbulent energy and mass exchange within the atmospheric boundary layer during surface-layer plumes or mixed-layer thermals. More recently, meteorological geometric structures have been associated with low-dimensional chaotic systems; in energy production time series, geometric structures are associated with significant energy losses. In this study a simple linear technique is used to extract geometrical shapes from datasets that were measured at a suburban location experiencing a number of different mesoscale modes. General characteristics of the atmospheric fields were examined by applying Principal Component Analysis and Integral Statistics as an objective measure of air mass stagnation, recirculation and ventilation. Certain geometric structures were found to be associated with particular flows: e.g. temperature positive cliff-ramps and ramp-cliffs appear mainly during night time and under weak flow fields. This study discusses new methods based on single station common meteorological measurements that enhance our understanding of complex processes. These methods are directly applicable to a wide range of fundamental and applied science areas.

Keywords: Urban, mesoscale, structures, geometric shapes

Paper ID: CEST2017_01237

HEAVY METALS IN THE ENVIRONMENT

Saturday 2 September 2017

The distribution characteristics and bioaccumulation of arsenic in food webs around a realgar mine, China

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Abstract

Arsenic (As) is a ubiquitous but carcinogenic metalloid element. Shimen realgar mine has the largest As mine in Asia with a mining history of 1500 years, therefore it could induce substantial increase of arsenic concentration in the environment and living organisms, and ultimately into human bodies. The total As in surface soil, sediments and water were in the range of 35-5000 mg/kg, 43-4543 mg/kg and 5-3293 μg/l, respectively. The As concentrations were decreasing with the distance from the central mining sites, indicating the As mining activities had produced eminent impact on As contamination in Shimen. Throughout the study sites, the rank order of As in biota was tadpole>earthworms>crab>frog>loach>other fishes. The total As concentrations in soil, litter and earthworms showed a significant positive relationship. The $\delta^{13}C$ and $\delta^{15}N$ value in the same species of organisms varied greatly with sites, which suggest the impact of diet difference on the trophic levels of the same species in the food chain. The trophic levels for various species of organisms were determined as from 1.25 to 3.76 based on $\delta^{15}N$ values. In streams, As levels were much higher in lower trophic organisms, but were quite stable at higher trophic levels, indicating no bio-magnification of As in the food chain, however, the reservoir showed slight arsenic concentrations and obvious biomagnification through the food webs. Moreover, the As speciation, including iAs(III), iAs(V), MMA, DMA, AsB and other species were analyzed to explore the biotransformation of As and the sources and bio-transfer of organic As in food chain. It found that the organic As species increased with trophic level in the contaminated streams, while the reservoir showed contrast pattern.

Keywords: arsenic speciation, HPLC-ICP-MS. bioaccumulation, transformation, trophic level

Paper ID: CEST2017_00293

Evaluation of heavy metals binary metals mixtures toxicity on spring barley *Hordeum vulgare*

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Abstract

Heavy metal pollution is considered as one of the most serious problems worldwide and has significant environmental and human health impact. Cadmium and lead contamination is widespread due to their intensive use. Heavy metals are always found in the environment in the mixtures rather than as single elements. Within the last several decades scientific and regulatory concern over the ecological effects and risks assessment of chemical mixtures has increased as mixtures of chemicals usually elicit different toxicity to living organisms. The aim of the study was to investigate the effect of lead (Pb) and interactive effect of the binary mixture of lead (Pb) and cadmium (Cd) to the growth of spring barley (*Hordeum vulgare* L.). The seedlings of barley were treated with single Pb (ranging from 0.1 to 100 mg/L) and Pb mixture with Cd. Single and combined metal treatment impaired the growth of spring barley, altered the content of photosynthetic pigments and induced lipid peroxidation.

Keywords: barley, cadmium, lead, mixture

Paper ID: CEST2017_00355

Heavy metals risk assessment in water and bottom sediments of ICOLLs in northern Poland

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Abstract

Natural diversity of intermittently closed and open lakes and lagoons (ICOLLs) depends on mutual interactions of several factors: (i) an impact of sea water and land background; (ii)temporary meteorological situation; (iii) hydrological conditions; and (iv) the shape of lake basin. However, some regional, local or even sudden impacts including anthropogenic ones create their final ecological status. To identify heavy metals risk assessment in ICOLLs located in Polish coastline selected metals were determined in water and bottom sediment samples collected in 10 water reservoirs. Multidimensional data set of 22 variables was explored by the use of chemometrics according to seasonality (Spring, Summer, Autumn), sample type (water, sediment) and level of isolation (fully isolated, partially and fully connected lakes). The results showed that 70% and 77% of the data variance can be explained by the use of principal component analysis for waters and sediments, respectively. Waters of fully isolated or partially connected lakes are more abundant with Ho, Ir, Nd and Sm, while less abundant with Pr and Sr. Some ICOLLs are spatially diversified according to Al, Fe, Mn, Ti, V and Yb indicating an anthropogenic impact due to periodical backwash of absorption filters in municipal water treatment plants located nearby.

Keywords: Baltic Sea, coastal lakes and lagoons, heavy metals, multivariate analysis, spatiotemporal variation

Paper ID: CEST2017_00362

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Mercury accumulation in two freshwater fish species in Flanders (Belgium). Internal distribution and effects of length, weight and sex.

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Abstract

Detrimental effects of chemical pollution - primarily caused by human activities - on surface waters and aquatic ecosystems, have increasingly gained attention. This pollution causes destruction of habitat, leading to a decrease in biodiversity. Mercury is the only metal incorporated in the EU list of priority compounds recommended to be measured in biota, preferably in tissue of prey species (Directive 2013/39/EG). Because of its hydrophobic qualities, mercury is prone to easily bio-accumulate and magnify through the food chain, which will eventually also affect humans. In the present study, accumulated levels of mercury are compared in both muscle and liver tissue of perch (*Perca fluviatilis*) and European eel (*Anguilla anguilla*) collected at 15 sampling locations in Flemish (Belgian) waterbodies. These results will create a better insight in respect to which concentrations are accumulated in fish species with different backgrounds as well as the internal distribution within the organism. Furthermore, effects of size, weight and sex are taken into account, since both age and reproduction are expected to have an influence on accumulation and storage of pollutants. The results show a correlation of accumulated mercury with indicators of age and/or condition (i.e. length, weight. No difference between sexes could be found. Furthermore, a significant difference in accumulated mercury levels between targeted species could be found, with the highest concentrations in eel. In perch, higher concentrations could be found in muscle compared to liver tissue.

Keywords: mercury, accumulation, fish, internal distribution.

Paper ID: CEST2017_00400

Sewage Sludge application on cotton cultivations: Soil properties interactions

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Abstract

Application of sewage sludge (SS) to agricultural soils is a current practice in EU. European legislation permits its use in agriculture when concentrations of metals in soil do not exceed the maximum permissible limits. In a soil classified as Typic Xerochrepts located in Lamia area, central Greece, a field experiment was conducted for two consecutive years, to study the influence of municipal SS application on cotton yield and soil properties. The experimental design was complete randomized blocks with four treatments: 1. Control, 2.inorganic fertilization, 3.Sewage sludge 6000 dry SS kg/ha, and 4.Sewage Sludge10000kg dry SS/ha, each replicated 4 times. The results showed that SS application on both rates, and inorganic fertilization did not cause significant difference in cotton yield. Soil properties, at the end of the second year of SS application, significantly affected by SS application to a positive direction i.e. pH decreased slightly, organic matter increased, available phosphorus increased significantly, as well as total nitrogen concentration, exchangeable potassium and available zinc. The potentially toxic elements like lead, chromium, and nickel were not significantly affected by SS application for both rates. Available Cu and Zn concentrations, however, increased significantly at both SS applications rates compared to the control.

Keywords: Sewage sludge, cotton, fertilization, heavy metals

Paper ID: CEST2017_00475

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Soil pollution with heavy metals from the mass graves from I and II World War in Poland. Looking for solution

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Abstract

The article presents the problem of soil pollution with heavy metals from corrosive metal elements of military equipment in Poland. The issue concern mass graves from I and II World War on south part of Poland. The influence of mass graves on the environment is poorly investigated. Some of the mass graves are still unknown and non-localized. The research shows the significant role of heavy metals (eg. Cd, Cr, Cu, Ni, Zn) released into the soil and groundwater, which endanger human health and natural environment. Mass graves are dangerous for us, because many of them are located near to human settlements and rivers. Systematically, chemical elements pass into the soil from metal weapons, buttons, badges, and more. By this, the soil and groundwater is several times higher saturated of heavy metals than from communal waste.
The aim of this paper is to propose one of the solutions, possible to reduce this problem. The authors propose testing archaeological research of mass graves with the metal detector (type VLF, with distinction between different types of metals), in order to locate, safeguard and transmit for the conservation and display in a local museum.
Keywords: heavy metals, pollution, metal detector, archaeology

Paper ID: CEST2017_00544

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Trace metals in mussels, in contact with ships laid-up within the gulf of Elefsis, Greece

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Abstract

The use of organotin compounds as biocides in antifouling paints has been banned since 2008 by the International Convention on the Control of Harmful Anti-fouling Systems on Ships of the International Maritime Organization. As a result, copper-based anti-fouling paints have been extensively used. Antifouling residues represent a significant, heterogeneous source of metallic contamination in the marine environment, where boating activities occur. However, it is often difficult to discriminate between metal inputs from ship and other sources, such as urban run-off. Laid-up ships, therefore, provide an opportunity for studying metal inputs from the specific source in the absence of other major sources.Results from a field project within the Elefsis Gulf, Greece, demonstrate a statistically significant difference (one way ANOVA, $p<0.05$) characterizing As, Co, Cu, Mn and Zn levels in mussels (*M. galloprovincialis*) attached to ships laid-up at several anchorage sites, in comparison to those from other sites. In mussels attached on a ship laid-up nearby a small ship maintenance facility significant concentrations of Cd, Mn, Pb and Zn ($p<0.05$) were determined. In the case of a sunk ship relatively high concentrations of Co, Cr, Fe, Mn, Ni, Pb, V and Zn ($p<0.05$) in mussels were measured, probably attributed to the faster corrosion of the metallic surfaces of the ship as well as to fuels and oils leakage.

Keywords: trace metals; seawater; mussels; antifouling

Paper ID: CEST2017_00601

Al (III) removal from wastewaters by natural clay and coconut shell

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Abstract

In this study, experiments were carried out with natural clay in dust form, collected from Sakarya's Yenigün district using coconut shell, used as adsorbent once treated with acids such as HCl, HNO_3 and H_2SO_4, washed, and dried. The adsorbents were then used to carry out simultaneous analyses of the adsorption of Aluminium (Al^{3+}), the presence of which in water may cause problems. The batch of experiments performed at a temperature of 293±2 K, at 200 rpm agitation rate, with an adsorbent level of 1 g/ℓ, produced 98.95% (at pH 6) and 92.83% (at pH 7) maximum Al (III) removal efficiency for clay and coconut shell based adsorbents respectively. Furthermore, the process was found to be exothermic for Clay and endothermic for Coconut. XRF and XRD analyses of the clay variety used in adsorption analyses revealed it to be saponite clay, within the larger group of smectite group clay minerals. The application of Langmuir revealed maximum adsorption capacity of 149.25 mg/g for natural clay adsorbent (NCA), and 120.482 mg/g for coconut shell adsorbent (CSA). Moreover, adsorption kinetics were found compatible with the second order kinetics. The result shows that, clay and coconut shell adsorbents are effective adsorbents to remove Al(III) ion from aqueous solutions with good adsorption rate.

Keywords: adsorption, aluminium, clay, coconut, kinetic

Paper ID: CEST2017_00620

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Study of potential availability of heavy metals to phytoremediation to use of fly ash from biomass combustion

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Abstract

Fly ashes, formed as a result of burning biomass are a new class of by-products of combustion and due to the large variety of these materials their chemical composition has not been fully determined. Their use is limited, despite the fact that their production is increased.The this work presents results of studies on the possibility of limiting the potential availability of Cu, Mn, Pb and Zn for plants by use of inorganic stabilizer - fly ash from biomass combustion. In this study was evaluated usefulness of fly ash from biomass to binding mobile fractions of heavy metals (Cu, Mn, Pb and Zn). The investigations executed using three extraction tests in which the use the following extraction solutions: 1 M HNO_3 – acid soluble forms (As), 0.05 M EDTA – bioavailability forms (Bio), 2.5% CH_3COOH – exchangeable forms (Ex). The values of following parameters such as: Mobility Index (MI), Contamination Factor (CF), Pollution Load Index (PLI), Geo – accumulation Index (I_{geo}) and Ecological Risk Index (RI) were definite and determined suitability test soil stabilizer. Furthermore, the multivariate statistical analysis was carried out.It was found, that phytoremediation process using tested fly ash from biomass combustion can be applied to contaminated soil by heavy metals.

Keywords: biomass ash, heavy metals, FAAS

Paper ID: CEST2017_00650

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Polymer inclusion membranes as a new tool for Zn speciation: influence of the membrane composition in diffusional fluxes

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Abstract

In this work we evaluate different polymer inclusion membranes (PIMs) based on cellulose triacetate (CTA) as polymer, to be applied for Zn speciation measurements in waters. Different extractants, for example D2EHPA, an ionic liquid Cyphos IL 104, or a macrocycle Kryptofix 22DD, have been tested as carriers. Important parameters such as preconcentration and membrane stability were considered to determine the optimal membrane composition for Zn transport. Diffusional fluxes were measured and the correlation with free metal concentration was evaluated. The influence of the presence of EDTA in the water sample has also been studied as a mean to get information about speciation of Zn.

Keywords: zinc, polymer inclusion membranes, speciation

Paper ID: CEST2017_00919

Phytotoxicity assessment of soils from industrial areas in varying degrees of contamination with metals

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Abstract

The determination of the impurities presented in the soil not always defines the full hazard and risk to human health and the environment. Bio content of pollutants in the soil environment is an important factor affecting the toxic effect on plants. The aim of the study was to evaluate the phytotoxicity of soils from industrial areas in varying degrees of contamination with metals. This objective was achieved by determination of the total and potentially available to plants content of metals in the soil along with the determination of metal content in the tested plant (*Medicago falcata L.*). Within the work there was analyzed the effect of soils with different degrees of contamination with metals and containing sorbents on tested plant, i.e. on inhibition of germination of seeds and reduction of the growth of roots and stems, based on the microbiotest toxicity Phytotoxkit™ and pot experiment. The studies found that greater sensitivity to metals' exposure was observed for the rate of inhibition of root growth than the parameter of seed germination and inhibition growth of stems. For the most contaminated soil there was observed toxic effect of metals influence on the tested plant. The use of sorbents lessened the phytoavailable forms of metals and thus resulted in a reduction of phytotoxicity of soils. Phytotoxicity tests together with a pot experiment and chemical studies are an integrated approach to obtain information about the potential risks to human health and the environment.

Keywords: metals, soil pollution, phytotoxicity, *Medicago falcata* L., sorbents, industrial areas, environmental risk

Paper ID: CEST2017_01020

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Estimation of the transfer of micronutrient (Cu, Mn, Zn) and toxic elements (Cd, Cr, Ni, Pb) from soils to rice (*Oryza Sativa*) in Evros-ergene river basin

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Abstract

In this study, concentrations of nonessential toxic heavy metals (Cd, Cr, Ni and Pb) and the micronutrients (Cu, Zn, Mn) in twenty brown rice (*O.sativa*) and relevant paddy soil samples were investigated. Soil and brown rice samples from Evros-Ergene river basin were extracted for their total heavy metals content by dry digestion method and then determined using ICP OES. Results of this study revealed that the concentrations of Cd, Cr and Ni in the soils of studied sites were above than the maximum permissible levels. The average concentration of all metals in brown rice samples was below than the maximum permissible levels of WHO guideline. The ranking order of bioaccumulation factor (BAF) for heavy metals was Zn > Cu > Mn > Ni> Cr = Cd = Pb indicating that the accumulation of micronutrients was more than that of nonessential toxic heavy metals. It can be concluded that these rice samples cannot be regarded as a complete source to determine all metals posing threat to human health.

Keywords: heavy metals; rice, paddy soil pollution; Bioaccumulation Factor (BAF); Ergene-Evros Basin

Paper ID: CEST2017_01045

Effects of Thallium stress on photosynthesis, chlorophyll fluorescence parameters and antioxidant enzymes activities of Arundo donax

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Abstract

We studied the influence of soil-water Thallium (Tl) pollution on the seedling leaves photosynthesis, chlorophyll fluorescence parameters and antioxidant enzymes activities based on the energy grass species *Arundo donax* L. The soil-water Tl separately set 0 (CK), 0.2, 0.5, 1, 2.5 and 50μg/L. The amount of Tl accumulation in leaves, stems and roots of *A. donax* increased with increasing Tl (from 0 to 2.5μg/L), and was still higher under high level Tl (50μg/L) than lower level Tl (< 2.5μg/L). However, high level Tl stress (50μg/L) was significantly inhibited chlorophyll synthesis, and thus reduced the primary photochemical efficiency of PSII (Fv/Fm), potential activity of PSII (Fv/Fo), apparent quantum (Yield). Meanwhile, Tl application mainly negatively influenced various photosynthetic parameters like Pn, Tr and Gs and SOD activity. Nevertheless, intercellular CO_2 concentration (Ci) showed a contrary trend with Pn due to the effect of nonstomatal factors, and POD and CAT increased under high lever Tl stress, showing H_2O_2 converts increased after 4-month growing of *A. donax*. This study suggests that *A. donax* was a tolerant plant species to Tl may be mainly through induced antioxidant machinery.

Keywords: Arundo donax,antioxidant enzymes, chlorophyll fluorescence, Thallium

Paper ID: CEST2017_01052

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of elemental and mineralogical composition of car brake pads

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Abstract

The car traffic is an important source of particle emission. The inevitable process of car stopping is related with the particles emission because of break pad waning. High temperature, pressure and friction induces chemical or morphological changes of the initial composition of brake pads. Brake pads are mainly combined of different materials: carbon, silicates and iron oxides. This study presents a summary of elemental and mineralogical composition of different brake pads commonly used in Lithuania. The mineralogical composition of brake pad samples were identified by XRD (X-Ray Diffraction Spectrometry), while the elemental composition was determined by XRF (X-Ray Fluorescence Spectrometry) and EDS (Energy Dispersive Spectroscopy). The texture and morphology was determined with SEM-EDX (Scanning Electron Microscopy). Various particles of heavy elements - Ba, Zn, Co, Ni, Cr, Al, Sb, V, Y, Pb have significant impact on health and environment.

Keywords: heavy metals, particles, brake pads, toxicity, environment.

Paper ID: CEST2017_01188

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Accumulation behavior of mercury in soils, sediments, plants from localities of former mining activities Eastern Slovakia and ecotoxic effects on earthworms

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Abstract

This article deals with quality evaluation of the soils, sediments and plants from three localities, Rudňany, Krompachy, and water reservoir of Ružín, Eastern Slovakia (Europe) in consideration of their toxic effect on the environment. These areas are well - known for its mercury mining and metallurgical activities for several centuries. A 28-day bioassay with the earthworm (*Dendrobaena veneta*) was used to assessing the ecotoxic effect of mercury in study soils and sediments. Within the frame of evaluation it was found that the concentrations of mercury exceeded some of the MPC (Max. Tolerable Risk) and IV (Serious Risk) values. The samples Rudňany tailing-SED (188.5mg/kg), Krompachy a-SED (69.4mg/kg), and Krompachy b-SED (93.4mg/kg) were the most polluted by mercury, which is evident according to it is the highest mortality on the earthworm (*Dendrobaena veneta*). The high mercury concentrations were obtained in the soils of the Rudňany-tailing-S (82.5mg/kg), Rudňany-tailing, valley-S (57.8mg/kg), and Krompachy 4KO-S (20.6mg/kg). A significant positive correlation is found between highest concentrations of mercury Rudňany-tailing SED Hg=188.5mg/kg (r=0.87) with the highest mortality of *Dendrobaena veneta* after 28 days bioassay.

Keywords: soil, sediment, plant, mercury, earthworm

Paper ID: CEST2017_01227

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Tailings: re-processing or safe storage? A proposal of optimization by multi-objective criteria

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Abstract

The disposal of mining waste and tailings is a controversial and frequent object of discussion that becomes especially radical when an accident occurs. Most of the ancient disposals have high contents in sulfides and heavy metals and the storage was designed without taking into consideration the dynamic changes in the chemical composition, as well as the alteration of the structural equilibrium due to the progressive erosion. This is the case of the Cabeço do Pião pile, constituted by tailings from a former processing plant that belonged to the Panasqueira Mine Complex in Central Portugal. Tungsten has been exploited in the area since the end of the XIX century but this tailing and waste rock deposit begun to store materials since 1927 until 1995. The structure has an height around 90 meters. As a component of the European project ERA-MIN "REMinE: Improve Resource Efficiency and Minimize Environmental Footprint" it is intended to compare solutions of re-processing the tailings, with competitive grades in W, Cu and Zn, with other storage destinies. The analysis will take into account an integrated approach considering simultaneously economic, social and environmental features. The overall characterization will be submitted to a multi-objective criteria optimization.

Keywords: Mine waste, tailings, optimization algorithms, re-processing, and tungsten.

Paper ID: CEST2017_01235

Spatiotemporal differences in trace element levels at Douro River and Ave River (Portugal) lower basins

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Abstract

Douro and Ave lower basin water quality was studied regarding a wide panel of trace elements (Li, Be, Al, Ti, V, Cr, Co, Ni, Cu, Zn, Se, Mo, Ag, Cd, Sb, Ba, Tl, Pb, Th and U). To take into account expected spatiotemporal changes and to look for anthropogenic sources of contamination, samples were collected at different sampling sites (9 in Douro; 5 in Ave) in three sampling campaigns.According to widely accepted water quality guidelines for the protection of aquatic life, trace elements mean values were found high for Al, Cu, Se, Ag, Cd and Pb in both Douro and Ave, plus Zn in Ave.Significant spatial differences were found, especially in Ave, where a noticeable trend for higher values from upstream to downstream was observed for several elements. Seasonal differences were also observed, with higher levels in spring for most elements, especially in Douro.

Keywords: Douro and Ave lower basin, river water, environmental monitoring, trace elements, ICP-MS

Paper ID: CEST2017_01334

Level and impact of hydrocarbon in sediment characteristics of Imiringi oil and gas field facilities in the Niger Delta

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Abstract

This study investigated the level and impact of hydrocarbon in Imirigi oil and gas field facilities in the Niger Delta. Sediment samples were collected in four locations viz: upstream, midstream, downstream and control. The hydrocarbon content and total petroleum hydrocarbon ranged from 0.14 – 3.79mg/kg and 0.08 – 2.41 mg/kg respectively. Other results supporting the impact of hydrocarbon in Imirigi oil and gas field include pH (5.45 – 5.58), magnesium (3.57 – 4.79mg/kg), potassium (1.74 – 4.24mg/kg), conductivity (85.33 – 273.33 µS/cm), chloride (15.17 – 22.53mg/kg), nitrate (1.53 – 3.20mg/kg), sulphate (5.49 – 12.59mg/kg), phosphate (1.63 – 3.56mg/kg), total organic carbon (4.54 – 6.71%), total nitrogen (3.86 – 6.43%), calcium (13.57 – 20.66mg/kg), sodium (6.49 – 10.68mg/kg). Analysis of variance showed that there was significance difference ($P<0.05$) in the various location for the various parameters apart from pH, magnesium and potassium. This suggests that the activities of oil and gas and other anthropogenic activities are having a slight impact in sediment of surface water at Imirigi oil and gas facilities.

Keywords: Environmental Contamination, Hydrocarbon, water resources, Sediment

Paper ID: CEST2017_01370

Ecotoxicity of rare earth elements

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Abstract

The effect of REE on seed germination was followed in white mustard (*Sinapis alba* L.). The effect of REE on viability of suspension culture of *Arabidopsis thaliana* was also tested. Toxicity of Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu, at five different concentrations (in the range 0.05 - 5 mM) was tested by standard ecotoxicity test. The root length of white mustard was measured after 72-h incubation. The elongation inhibition, EC_{50} value and slope values were calculated. The exposure of suspension culture of Arabidopsis thaliana took 96 h under dark condition. The tolerance of suspension cultures to REE was assessed using the reduction of 2,3,5-triphenyltetrazo-lium chloride (TTC). The results showed that REE toxicity decreased in the order: Lu > Er > Yb > Sc > Tm > Y > Ce > Ho > La > Nd > Pr > Dy > Gd > Tb > Eu > Sm.

Keywords: heavy metals, phytoremediation, accumulation, stress, rare earth elements (REE)

Paper ID: CEST2017_01378

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Heavy metals accumulation in plant tissues of *Satureja Cretica and Lathyrus Ochrus* grown in contaminated soils

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Abstract

Soil protection is crucial for the environment and is also beneficial for Human health. Among the pollutants found on contaminated sites, heavy metals contaminate a large portion of the biosphere. They are persistent inorganic elements that accumulate in the soils, contaminate aquifers and pose a threat to all living species. In this study, we examined the growth of the aromatic plant *Satureja Cretica*, and the pale pea *Lathyrus Ochrus* in heavy metal-polluted soils. The plants were exposed to different levels of Cd, Pb, and Ni in a soil pot experiment conducted in a green house. Toxic metal levels were determined in the roots and the leaves of the two plants. Both plants accumulated relatively high amounts of metals in their roots, whereas the aboveground parts exhibited lower accumulation capacity. Regarding the macroscopic effects, the roots of *Satureja Cretica* exhibited significant reduction in length and total mass in the concentration levels of Ni 600 ppm and Pb 2500 ppm, whereas the aerial part was reduced for the contamination level Ni 600 ppm. In the case of *Lathyrus Ochrus*, the root system of the condition Ni 600 also showed similar behaviour, so this level of contamination shows toxicity for both plants.

Keywords: Soil contamination, Heavy metals, *Lathyrus Ochrus*, *Satureja Cretica*, accumulation

Paper ID: CEST2017_01406

Heavy metal uptake from the green alga Chlamydomonas reinhardtii: Single and mix-metal exposure

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Abstract

Chlamydomonas reinhardtii, a unicellular photosynthetic alga which is considered as a model organism for multidisciplinary research, was grown in media polluted with three different heavy metals (cadmium, nickel and lead), at several concentrations, either as single pollutants or in mixtures. In this study, the growth rate of the cells in the presence of the pollutant metals in the nutrient solutions was determined, as well as the accumulation of the metals in the cells, for all the pollution levels and mixtures. The synergistic potential of the mixtures of the pollutants on the accumulation of the metals and on the growth of the cells was examined. The activity of several enzymes in the exposed cells was also determined.

Keywords: *Chlamydomonas reinhardtii*, heavy metal pollution, pollution bioindicators

Paper ID: CEST2017_01407

EFFICIENT CONVERSION OF BIOMASS AND WASTE INTO VALUABLE PRODUCTS

Saturday 2 September 2017

Ultrasound assisted alkaline pretreatment to enhance enzymatic saccharification of lignocellulose

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Abstract

Grass clipping and sugarcane bagasse were pretreated with ultrasound (US), $Ca(OH)_2$, NaOH, US-$Ca(OH)_2$ and US-NaOH to enhance the enzymatic hydrolysis. The solubilization of hemicellulose and lignin and crystallinity index (CrI) of cellulose increased after US-alkaline pretreatment, leading to a significant increase of enzyme accessibility to cellulose. US-$Ca(OH)_2$ pretreatment showed the best improvement for reducing sugar yield, compared with the other four kinds of pretreatments, and the grass clipping showed higher potential for the production of reducing sugar than sugarcane bagasse by US-$Ca(OH)_2$. The reducing sugar yield of grass clipping pretreated by US-$Ca(OH)_2$ reached 273.7 mg/g, increasing by 188.7% compared with that of raw grass clipping. The US-$Ca(OH)_2$ pretreatment significantly enhanced the potential of grass clipping as a promising raw material for biofuel production.

Keywords: US-alkaline pretreatment, lignocellulosic biomass, enzymatic hydrolysis, sugar yield potential

Paper ID: CEST2017_00204

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Production of biodiesel from macaw palm (Acrocomia aculeata) oil with high acidity employing hydroesterification process

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Abstract

The hydroesterification process has been investigated as an alternative to alkaline transesterification. This process consists of two associated steps, the hydrolysis step in which the triacylglycerol molecules are hydrolyzed to the respective acids and then the esterification step in which the fatty acids obtained in the first step are esterified with the desired alcohol. In this context, this work shows the results related to the enzymatic hydrolysis step of the macaw pulp oil using the enzyme extract from castor bean seed and subsequent esterification using HPW/Nb_2O_5 catalyst. The results showed that the enzymatic hydrolysis using enzymatic extract presented conversions of 45.81% in the hydrolysis of macaw pulp oil resulting in a hydrolyzate with 83% of free fatty acids (FFA) in 4h. The tests were performed using reaction conditions of 35°C, pH 4.5 and shaking of 1000rpm. The esterification step employing HPW/Nb_2O_5 showed conversions of 97% under the reaction conditions of 250°C, stirring of 700rpm, hydrolyzed ethanol ratio of 1:40 and 15% of the catalyst.

Keywords: Biodiesel, hydroesterifacion, hydrolysis, esterification, macaw oil

Paper ID: CEST2017_00301

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Synthesis of geopolymers on fly ash from biomass combustion

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Abstract

Fly ash from biomass combustion aren't used in numerous economic branches. Their increased production make it necessary for researches to look for synthesis new products. The chemical composition of fly ash from biomass combustion are similar to those of fly ash from coal, they can be used as raw material for geopolymer synthesis.The aim of the research was to assess feasibility of geopolimer synthesis from fly ash from biomass by geopolymerisation method. The effect of temperature, curing time and the ratio of fly ash to alkaline activator (sodium hydroxide and sodium water glass) impact in the formability of geopolymers mass were investigated.On the basic of the research investigations, optimal conditions of geopolimerisation have been determined. We have also found, that optimal conditions for synthesis of geopolymers on fly ash from biomass combustin are following: temperature – 20 °C, curing time 17 hours and the ratio of fly ash [g] to alkaline activator [cm^3] – 50:50. The surface morphology and chemical composition analysis (before and after geopolimerisation) were examined for the obtained geopolymers by SEM-EDS methods. The UV-VIS-NIR spectra (before and after geopolimerisation) were performed. They showed, that received geopolymers possess optical and photocatalytic properties.

Keywords: biomass ash, geopolymer, waste utilization

Paper ID: CEST2017_00649

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Optimization of carotene pigment productionby soxhlet extraction from waste orange peels

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Abstract

People expectations for and knowledge about the foods they consume rise as the society develops and becomes more conscious. How they collect their waste, make use of them for new products, what their economic values are, how healthy they are, their environmental value and so on are all important. Many substances like dietary fiber, antioxidants, pectin, fatty acids, and pigments. all of which are crucial for nutrition are present in fruit and vegetable wastes with these issues in mind the author of this study aims at. The production carotene pigment, a kind of natural flavonoid, from waste orange peels by Soxhlet extraction and hopes to use it as food additives. The production of carotene pigments from dried pulpy, dried pulpless and frozen pulpy waste orange peels were performed by forthlest quad Soxhlet extraction. The effects of type of peel, particle size, liquid/solid ratio, type of solvent and pre-treatment of the peel before extraction on the yield were investigated. In the pigment extraction from frozen pulpy peels with ethanol at 79°C with the particles in the size range of 1.41-3.36 mm and at 40:1 liquid/solid ratio, the highest carotene pigment yield was found as 0.45% (4.5 mg carotene pigment/ g dry peel).

Keywords: Waste orange peel, Carotene pigment, Optimization, Soxhlet extraction

Paper ID: CEST2017_00801

Development of an olive mill waste biorefinery

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Abstract

This study focuses on giving value to the olive mill wastes (OMW) generated from the production process of olive oil. The developed procceses can be applied both on II-phase and III-phase OMW. The treatment and utilisation of such wastes is very challenging mainly due to their high organic loading and the presence of organic compounds which are hard to biodegrade, such as long-chain fatty acids and phenolic compounds. An acidification step is first carried out to extract the residual oil from OMW. The oil is then removed via centrifugation. The aqueous liquid stream passes from an ultrafiltration unit and from an ion-exchage resin unit in order to remove the phenolic compounds. These first two steps not only detoxify the OMW but also produce two high added value products: residual oil and phenolic extract. The remaining liquid contains no inhibitors, and hence, it can be used as substrate in a biological process for the production of biochemicals or bioenergy, together with the retentate stream from ultrafiltration, while the remaining solids enter into a compost production process. The effluent from the anaerobic digestion together with the excess of the sludge can be co-composted with the rest of the solids. The developed biorefinery concept leaves zero wastes and presents an integrated and sustainable approach in treating OMW.

Keywords: OMW Biorefinery, phenolic compounds, residual oil, bioenergy, organohumic fertiliser

Paper ID: CEST2017_00857

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The transesterification of waste cooking oil to biodiesel

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Abstract

At present, the challenges of energy demands and preserving the earth's climate are playing a prominent role in energy and fuel researches. The transesterification of waste cooking oil to biodiesel not only solves the problem of waste oil treatment but also replaces partially or fully nearly one thousand million tons of diesel used annually by the world. In the present work, 94% of waste cooking oil sample is converted to biodiesel. The specifications of synthesize fuel are tested and compared with Iraqi diesel and other biodiesels. The economic side was also studied comparing the cost of producing one liter of biodiesel from the cooking oil used with the price of a liter of domestic diesel fuel.

Keywords: waste cooking oil, transesterification, biodiesel, diesel, earth's climate.

Paper ID: CEST2017_01218

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Biochar reuse as adsorbent for post-treatment of hydrogen sulfide from microwave pyrolysis of sewage sludge

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Abstract

The reuse of pyrolysis byproduct, biochar (BC), as adsorbent for post-treatment of hydrogen sulfide from microwave pyrolysis of sewage sludge was investigated in this study. Its adsorption performance was compared with one commercial activated carbon (AC) in the sealed desulfurization device. The porous structure and surface characteristics were studied using N_2 adsorption and desorption isotherms and SEM analysis. The results showed that BC had comparable adsorption performance with AC, in which the H_2S removal efficiencies of both adsorbents contributed to 78.4% and 90.3%, respectively. The adsorbent prepared by microwave pyrolysis had higher surface area than that of conventional pyrolysis, where SBET of BC reached 476.87 m^2/g in this study. The porous structure analysis found that H2S adsorption was mainly depended on the surface area of adsorbents. SEM characterization confirmed the reuse potential of biochar after H_2S adsorption, which provided a cost-effective way for post-treatment of H_2S from pyrolysis biosyngas.

Keywords: Biochar; Reuse; Hydrogen sulfide; Microwave pyrolysis; Sewage sludge

Paper ID: CEST2017_01252

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Pretreatment and enzymatic hydrolysis of agricultural residues

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Abstract

Production of biofuels from renewable lignocellulosic materials is a good alternative to petroleum based fuels. Important route to convert biomass to biofuel is biochemical, which envisages enzymatic transformation of cellulose and hemicellulose of the wastes to glucose and microbial fermentation to the last to fuel. The goal of the project is development of cost effective biotechnology of fuel bioethanol production from agricultural residues. Different methods were applied for pretreatment of agricultural residues: wheat straw, rice straw and corn stalks. Chemical treatment of the substrates using peroxide solution 1%(w/v) H_2O_2 and adjusted to pH 11.5 with 3 N sodium hydroxide (alkaline peroxide solution) at 30°C and 60°C for 6 h has been conducted. As a result of alkaline peroxide pretreatment of lignocellulosic substrates the increase in cellulose content from 31-34% to 68-69% and corresponding decrease in lignin content from 14-19% to 4.0-4.4% is observed.The biological pretreatment - cultivation of basidial fungi strains *Pseudotrametes* sp. IK-76, *Ganoderma lucidum* GM 04, *Ganoderma applanatum* IN 59resulted in delignification from14% to 11.0% (rice straw) and from 17.3 to 14.0 (corn stalk). As a result of hydrolysis of the alkaline peroxide pretreated rice and wheat straw and corn stalk by cellulases preparations of selected *Penicillium canescence* 85, *Aspergillus* sp.Av10, *Sp.pulverulentum* T5-0 the increase in glucose yield approximately by two -three times as compared to untreated substrates is observed.

Keywords: Agricultural residues, chemical pretreatment, enzymatic hydrolysis, microscopic fungi cellulases

Paper ID: CEST2017_01341

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Effect of the retting process on the life cycle performance of hemp fibre composites

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Abstract

Our study investigates how different retting processes affect the life cycle performance of a hemp fibre composite by carrying out a Life Cycle Assessment (LCA). LCA is applied to compare traditional field retting with enzymatic retting. Enzymatic retting has been proposed as an innovative retting method capable of producing fibres with higher mechanical properties and lower porosity in the resulting composite. Improved fibre properties allow producing lighter composite materials, which at the same time still fulfil the mechanical design constraints. The LCA results show higher impacts for the enzymatic retting (due to increased energy and material consumption for this process) which are not counterbalanced by reductions in other life cycle stages, if the composite is used in static application. Instead, for dynamic application, when lightweighting also implies fuel savings, the enzymatic process helps to reduce the overall environmental impact of the hemp fibre composite.

Keywords: LCA, biobased materials, natural fibre composites, enzymatic process, eco-design

Paper ID: CEST2017_01351

Selection of mycelial fungi producers of stable forms of cellulases, xylanases and laccase

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Abstract

Project is focused on obtaining stable, industrially robust enzymes: cellulases, xylanases and laccases for lignocellulosics effective degradation and further fermentation by yeasts to ethanol. Selection of producers of stable cellulases, xylanases and laccase among the diverse mesophilic and thermophilic mycelial fungi strains collection of DIBB, AUG has been conducted. Screening of microscopic fungi strains of the culture collection according to their ability to produce stable and active extracellular enzymes have been carried. Around 400 strains of genera *Aspegillus, Chaetomium, Cladosporium, Fusarium, Helmintosporium, Mucor, Penicillium, Rhizopus, Trichoderma, Trichothecium Myrothecium, Penicillium, Stachybotrys*and*Sporothrichum* were applied in studies. 48 microscopic fungi producer strains have been selected: 19 mesophilic and 29 extremophilic; 15 strains were distinguished by high activities of cellulase/xylanase, 8 strains – by xylanaseand 15 strains by only cellulase production. Screening allowed to select 21 strains of the basidialfungi laccase producers. With the purpose to increase the biosynthesis of the strainsenzymes physiological parameters of cultivation of the mycelial fungi producers have been carried out.

Keywords: mycelial fungi, basidial fungi, cellulases, xylanases, laccase, submerged cultivation

Paper ID: CEST2017_01399

HYDROLOGY AND WATER RESOURCES MANAGEMENT

Saturday 2 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment of water quality in Mudurnu river basin using regression models

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Abstract

This study was carried out in order to determine the pollutant sources in the area in the Mudurnu River Basin in which the factory discharges and to identify the correlations between the pollutant parameters of the Regression Models.The water samples taken from 6 stations placed on Mudurnu River for 6 months twice a month. The parameters of Temperature (^{0}C), pH, Ammonium Nitrogen (NH_4-N), Nitrite Nitrogen (NO_2-N), Nitrate Nitrogen (NO_3-N), Kjeldahl Nitrogen, Total Nitrogen, Total Phosphorus (TP), Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) were analyzed in the water samples. Moreover, the relationships among water quality parameters were assessed using Regression Models.Model obtained in the regression analysis explained the TKN parameter with the highest rate (86.1%). In contrast, it was observed that the Regression Model had a lower explanation rate for the parameters of NH_4-N, TP and TSS. When these results were examined, it was detected that most of the sources leading to pollution in the Mudurnu River arose from domestic and industrial wastewater discharge.

Key words: Mudurnu river system, Water Quality, Regression Models

Paper ID: CEST2017_00235

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Assessment on applicability of scour depth prediction around pier using formulas

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Abstract

Scours occur when the flow fields around the pier are disturbed due to the installation of structures in any area of river flow, like bridges. River flow causes bed materials like sand and gravel to move, which causes scour formation; such phenomenon is reported as the main cause of bridge failure. Various range of factors like velocity, water depth, discharge, river slope, river width, and bed materials altogether contribute to scour's complexity, thus making it difficult to accurately measure its predictability. In practice, an empirical formula is used to predict scour depth around the pier area. In this study, seventeen represented formulas are utilized to calculate the scour depth. The results are then compared to the results of the hydraulic model test from a previous study to assess the applicability of each respective formula. Results show how that the formulas of Coleman(1971), Froehlich(1987), Breusers(1965) CSU(1993) relatively possess the highest applicability.

Keywords: pier, scour, empirical formula, bridge, river

Paper ID: CEST2017_00416

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Spatial analysis of annual rainfall using ordinary kriging techniques and lognormal kriging in the Cheliff watershed. Algeria.

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Abstract

Spatial analysis of annual rainfall using ordinary kriging techniques is well known to be robust when the data have a normal distribution. But our rainfall data never fully meet these hypotheses. Our study area is centered in the Cheliff watershed, located in northwestern Algeria; It is known by heterogeneous regions in annual rainfall. Data from 58 rainfall stations were also used to interpolate and predict errors by the two kriging techniques. A comparative study of two interpolation methods is presented. Lognormal kriging is very sensitive to extreme values more or less remote from the arithmetic mean (non-normal distribution). The objective of this study is to map annual rainfall and to minimize interpolation errors by the more robust technique. The difference between the accuracy of ordinary and lognormal kriging is well represented on the error estimation map, so the second technique is more robust than the first one in our watershed.

Key words: Cheliff watershed, rainfall, kriging and mapping

Paper ID: CEST2017_00419

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Rainfall distribution as a main factor influencing flood generation in the eastern Slovakia

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Abstract

This paper aims to geographically assess the flood occurrence in eastern Slovakia by using a geographically based multi-criteria analysis for flood risk assessment. Flood risk assessment in this study is conducted in three specific cases: the long term period 1989–2009, the extremely wet 2010 year, and the extremely dry 2011 year. In the analyses, some of the causative factors for flooding in a basin area are taken into account. We use set of causative factors concerning mostly hydrological and physio-geographical characteristic of the target area that can be measured and evaluated such as soil type, daily precipitation (for the years 1989-2009, 2010, 2011), land use, catchment area and basin slope. For recommendation which causative factors should be preferred we use the multicriteria analysis – ranking method. In the ranking method (RM), every factor/criterion under consideration is ranked in the order of the decision-maker's preference. Geographic approach to flood risk assessment provides a descriptive presentation of the results obtained. Geographic information systems as a visualization tool is presented in a manner that aids understanding in a user friendly way.Regarding our task of flood risk assessment, the partial results are three composite maps, which present the comparison of flood risk zones in percentage of the area in years 1989-2009, 2010, and 2011. The composite maps are background for risk assessment of the impact of rainfall on flood generation. This study of hydrological data and physio-geographical characteristic was carried out with the purpose of the identification of flood risk occurrence in eastern Slovakia. Results from our study shows, that rainfall distribution has high influence on flood risk of the area. Area percentage with very high flood risk index was calculated for "wet" year 2010 as 11.73 %, for "dry" year 2011 as 0.01 % and for period 1989 – 2009 as 0.28 %.

Keywords: Geographic information systems, rainfall, flood risk

Paper ID: CEST2017_00442

Investigation of precipitation trends in eastern Slovakia using singular spectrum analysis

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Abstract

Precipitation plays an important role in the water management of any country. Knowledge of the temporal and spatial distribution of precipitation is inevitable for proper integrated water resources management. In the present study, trends of precipitation time series from Košice climatic station situated in eastern Slovakia have been investigating. Analyzed data for period from 1951 to 2013 were provided by Slovak Hydrometeorological Institute. Trend analysis were done by Mann–Kendall (MK) test and the Singular Spectrum Analysis (SSA) method. Method of periodogram analysis has been used in order to select the components corresponding to trend in the grouping stage of SSA. SSA has been applied to daily precipitation time series in Kosice station. MK test is also used to detect trends in monthly series and the performance of SSA and MK test was compared. The result showed that the MK test could detect the presence of a positive or negative trend at a significant level, whereas the proposed SSA method could extract the nonlinear trend present in the series along with its shape. MK test does not prove any significant trends in Kosice climatic station during the evaluated period. The study proves the applicability of SSA for extracting nonlinear trends.

Keywords: precipitation, trend analysis, singular spectral analysis, Mann-Kendall test

Paper ID: CEST2017_00443

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The feasibility of groundwater of Aras river margin for aquaculture in Iran

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Abstract

This study investigated the feasibility of trout fish farming using groundwater at the Aras river margin, Eastern Azerbaijan, Iran. Along with the purpose of the study, the wells at the Aras river margin, river bed and border, location for digging observation wells, different types of water quality in the intended area, soil studies and experiments of water qualitative properties were considered. Experiments conducted on the qualitative properties of the experimental wells during a one-year period (2016) focused on the investigation of the followings: water temperature, dissolved oxygen, carbon dioxide, acidity (pH), total hardness of water, alkalinity, total minerals of the solution, electrical conductivity, carbonate, bicarbonate, chloride, sulfate, calcium, magnesium, sodium, potassium, nitrate, nitrite, ammonia, phosphate, iron, manganese, copper, zinc and lead. The results showed that different anionic and cationic combinations, despite their high concentrations, did not cause uncontrollable limitations for aquaculture. Regarding heavy metals, it was found that the recorded amounts of some heavy metals were higher than the specified standard limit in some measurement locations of the experimental wells and in some seasons. In general, it can be maintained that the groundwater quality of the Aras river margin did not cause uncontrollable limitations for aquaculture.

Keywords: Groundwater, Aras river, qualitative indexes, aquaculture, Observation wells

Paper ID: CEST2017_00592

Using a modelling approach to predict sedimentation and nutrient loading in poorly gauged tropical watersheds.

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Abstract

Many tropical watershed in Africa are undergoing rapid degradation due to human population expansion and unplanned development. The lack of robust systems for stream water quantity and quality monitoring often makes it difficult to predict the health of such watersheds. The Ruiru (439km^2) and Ndarugu (307km^2) watersheds form part of the upper catchments of the Athi River, the second most important river in Kenya. This study utilized the Soil and Water Assessment Tool (SWAT) to simulate sedimentation and sources of phosphorus and nitrates throughout the basins. Results of this study indicate that, under existing land use and management conditions, an average annual sediment load of approximately 305932 tons and 17805 tons enter the Ruiru and Ndarugu rivers and their tributaries respectively. Agricultural dominated sub basins account for 34.9% in Ruiru and 8.8% in Ndarugu respectively compared to forest-dominated sub-basins 8.6 % and 60.3%, urban dominated sub basins 56.4% and 30.8% respectively. Organic phosphate and Organic nitrate loadings were significantly higher than recommended standards for surface water quality ($F=7.98$, $P<0.05$; $F=24.71$, $P<0.05$ respectively). Modeling results are indicative of degrading catchments, a scenario more severe in Ndarugu where sedimentation levels in forest dominated sub basins are higher than agricultural and urban dominated sub basins. A robust watershed monitoring system should be implemented as the first step in developing an Intergrated Water Resources Management (IWRM).

Keywords: SWAT, Water quality, Sediment, nutrient loading, IWRM

Paper ID: CEST2017_00627

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Analysis of possible retention volumes in extinct ponds – case study for the catchment of Bystřice

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Abstract

This paper presents the analyses focused on the variation of total storage volume in fishponds and other water reservoirs since the first half of nineteenth century. The study areas selected for this analysis is the catchment of Bystřice River located in eastern Bohemia (379.2 km^2). The storage volumes were calculated by two approaches: (i) the application of derived relationship between the area of fishpond and its total volume and (ii) and by the GIS application and the analysis of detail elevation data. The results show significant decrease of the storage volume after first half of nineteenth century and mild increase of the volume in recent past.

Keywords: extinct pond; landscape water retention; old maps; detail elevation data

Paper ID: CEST2017_00693

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Calibration and validation of SWMM model in two urban catchments in Athens, Greece

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Abstract

In order to prepare cities for pluvial flooding, it is valuable to be able to simulate extreme events produced by high-intensive rainfall with accuracy. In the present paper, the Storm Water Management Model (SWMM) was chosen for the simulation of a combined drainage network located in the center of Athens (Kypseli), Greece. Metaheuristic optimization algorithm (i.e., Genetic Algorithm) was utilized to calibrate the model. The Nash-Sutcliffe coefficient was used as the objective function and the simulation results were further assessed using the Root Mean Squared Error (RMSE) coefficient, the Mean Absolute Error, the Coefficient of Determination, the Index of Agreement, the Normalized Objective Function and the total runoff volume. The communication between the optimization algorithm and the SWMM model was performed using the Matlab computing environment. The calibration and validation results showed that the SWMM model could simulate quite accurately the shape of the hydrograph, the peak discharge and the time of peak in the combined drainage network, both for the calibration and validation events. Overall SWMM model was found to be a very useful modelling tool, which can be used for the simulation of urban drainage networks.

Keywords: SWMM, calibration, validation, Genetic Algorithms, urban drainage

Paper ID: CEST2017_00709

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Statistical assessment and model for a river flow under variable conditions

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Abstract

Many articles emphasize the impact of dam reservoirs on the environment and river discharge. This aspect is mainly studied using the Indicators Hydrologic Alteration (IHA). Even if IHA is a comprehensive set of indicators, for documented decisions on the management of water resources (including the forecasting), knowledge on the statistical characteristics (as distribution, trend existence, stationarity etc.) are necessary. Therefore, in this article we focus on the study of statistical characteristics of the series of annual liquid flow of Buzău River (Romania), before and after building Siriu Dam. Mathematical models for the river discharge are built using Artificial Neural Networks.

Keywords: statistical analysis, modeling, GRNN

Paper ID: CEST2017_00715

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Limited water resource management using mathematical programming (case study: Arasbaran district)

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Abstract

In the present paper the use of mathematical programming theory is proposed to define optimum allocation of variable limited water resources in Arasbaran district (north-western Iran). Relationships between crop yield and applied water was simulated by Budget model by using multiplicative formula for various crops from year to year which depend on the deterministic component of the process of water exchange soil-crop-atmosphere. Net benefit of each crop yield determined by Mannochi and Mecarelli function and the values necessary for solving the expression were supplied by Moghan Agricultural research center. Cumulative profits (10 years) related to all possible combinations of crop pattern and of water supply using a mathematical optimization approach with linear programming by constrains that defined for farms. Finally finding the optimum solution for planning an optimal crop patterns for this areas and compared the net benefits as function of annual variable net available water volume (NIV=8, 10, 12, 14 and 16 MCM) for patterns.

Keywords: Arasbaran, Budget model, Limited water resources, linear programming

Paper ID: CEST2017_00721

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Mathematical modelling of Krasnoyarsk HPS intake regime influence on the ice and temperature downstream of the dam

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Abstract

Mathematical model was developed for simulation of Krasnoyarsk hydropower station (HPS) intake regime influence on ice and water temperature downstream of the dam. Current reservoir vertical temperature profile and water temperatures of downstream river were used for the verification of the model. Using this model we estimated influence of stratification, withdrawal position and discharge on temperature of water inflow into HPS. It was estimated that changeover to upper-layer intake from current deep-layers intake allows to increase water temperature of Yenisey at Krasnoyarsk city on 6-8 °C at summer period.

Keywords: numerical modelling, hydrophysics, Krasnoyarsk reservoir, stratified flows

Paper ID: CEST2017_00727

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The influence of Krasnoyarsk hydropower station discharge rate on the dynamics of the phytoplankton population downstream of the dam

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Abstract

Using multiyear measurements, we investigated the influence of high flow rates at Krasnoyarsk hydropower station (Krasnoyarsk HPS) on the phytoplankton population of Yenisei River downstream of the dam. We propose the hypothesis that flow rate variations are changing water temperature, which is influencing on phytoplankton dynamics. This hypothesis is verified by measurements of 2008-2016 years. Found relationships could be used for preparation of prognosis of the phytoplankton dynamics downstream of the dam.

Keywords: phytoplankton, hydropower dam, dam flow rate, the Yenisei River, water temperature

Paper ID: CEST2017_00728

Climate change effect on hydrological and chemical parameters of shallow lakes of the Danube Delta (Romania)

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Abstract

The unique mosaic of ecosystems of the Danube Delta Biosphere Reserve, comprising an extensive network of channels, shallow pools and hundreds of lakes, combined with marshes, reed-beds, lagoons, islands and floodplains, form a valuable natural area, sheltering a high biodiversity. One of the main drivers of the functionality of these ecosystems is the climate change, affecting especially the shallow lakes, where increasing temperatures and the reduced precipitation level, particularly in summer, affect the hydrology and chemistry of these lakes, inducing cascading effects at ecosystem level. Due to the very low precipitation ratio in the area, these ecosystems rely almost entirely on the discharge and water quality of the Danube River, who recorded a declining trend in the last decades, accelerating the changes occurred at lakes level. This study aims to present some of the changes driven by climate change in selected shallow lakes and recommend measures to increase their resilience to cope with this impact.

Keywords: Climate change, hydrological regime, Danube Delta, shallow lakes

Paper ID: CEST2017_00826

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Rainwater harvesting tanks' efficiency in Thera Island

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Abstract

The gradual degradation of fresh water reserves, coupled with its essential role in supporting life, is prompting the research for alternative and sustainable methods of supplying water for domestic, irrigation and industrial use worldwide. The harvesting, storage and use of rainwater have been traditionally employed as a water management practice that yields both financial and environmental benefits. In this work, a model of daily water balance has been applied to investigate the efficiency of rainwater harvesting tanks (cisterns) for domestic use on the island of Thera. The amount of rainwater that can be collected from different collection surfaces has been analyzed, in relation with water demand. In addition, the basic parts making up a system for collecting and storing rainwater are considered. These data have been used for the design, costing and optimization of the relevant magnitudes affecting rainwater harvesting systems.

Keywords: rainwater, harvesting, domestic use, Thera Island

Paper ID: CEST2017_00918

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Source apportions of groundwater in arid climate using stable isotopes

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Abstract

The isotopic composition ($\delta^{18}O$ and δD) of groundwater may alter upon interaction with the aquifer body through solid-water reactions and mixing of different water sources. The challenge of identifying groundwater sources in arid environment becomes even more complicated when effects of high atmospheric temperature and rapid evaporation are considered. We have analyzed groundwater collected from carbonates and Quaternary clastics aquifers for ($\delta^{18}O$ and δD) in Al Ain region, UAE. The results indicate range of $\delta^{18}O$ and δD from -1.8 to -2.5 ‰ and -7,4 to -15.6 ‰, respectively. Water samples collected from an open pit and dug well show enrichment in the heavy isotopes. These observations suggest that evaporative effect enhances enrichment of the heavy isotopes, but interactions in the aquifers body may contribute to the adjustment of the fractionation to modulate the evaporation enrichment effect.

Keywords: Groundwater, stable isotopes, carbonates, clastic, UAE

Paper ID: CEST2017_00942

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

High-resolution ensemble flood forecasting: a case study in Höje Å, Sweden

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Abstract

The number and impacts of pluvial floods are likely to increase with the growth of our cities and as extreme weather is anticipated to intensify with climate change. Improved preparedness is needed which may be attained owing to recent development of high-resolution hydro-meteorological observations and forecasts as well as geographical data. This paper investigates the capacity of the HYPE model for rainfall-runoff modelling and ensemble forecasting at hourly resolution. The analysis includes evaluation and application of several new high-resolution data sources: radar-based precipitation (HIPRAD), urban land-use data (EEA Urban Atlas) and high-resolution ensemble forecasts (MEPS). These components are finally integrated in a forecasting prototype for a catchment in southern Sweden.The results showed that HYPE, forced with HIPRAD and with land-use from Urban Atlas, performed well with a long-term Nash-Sutcliffe Efficiency > 0.8 at hourly level. Analysis of selected pluvial-type high-flow events close to an urban area indicated a good representation of fast runoff. The application of MEPS forecasts has been demonstrated for a few single events with promising results. Overall it is concluded that the 1-hour forecasts provide added value compared with the 1-d step and that an increased resolution in time and space is important to accurately forecast pluvial-type events.

Keywords:high-resolution,rainfall-runoffmodelling,HYPE,forecasting,pluvialflooding

Paper ID: CEST2017_01002

Comparison of artificial neural network and state space model for predicting river water quality

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Abstract

The purpose of this study is to investigate appropriate tools for river water quality forecasting as variations in water quality are difficult to predict due to the complicated nature within the range of various water quality factors. In this study, state space and neural network models are employed to mathematically analyze the intricate nonlinearity of processes that affect factors related to water quality. A monthly forecasting model is proposed that can predict water quality parameters, including dissolved oxygen (DO), biochemical oxygen demand (BOD), and suspended solid (SS) at the Miho river station in the Geum river basin (Korea). River water quality is predicted through the learning and the verification processes after applying the neural network theory to the proposed water quality forecasting model. Practical applications for predicting water quality prediction are examined by comparing the proposed model to the state space model (SSM). As a result, the artificial neural network (ANN) is estimated to have the ability to predict water quality more accurately than the state space model for each water quality item.

Keywords: Water quality, back propagation, neural networks, state space

Paper ID: CEST2017_01138

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Space assisted water quality forecasting platform for optimized decision making in water supply services

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Abstract

Drinking water accounts for around 18% of the total fresh water abstractions in the EU, managed by almost 70,000 utilities. The frequency, intensity and distribution of long standing water quality and supply challenges are expected to increase alongside climate change, posing challenges for water treatment plant operators. In response to such increasing pressures, SPACE-O is catalysing innovation with an operational service platform designed to increase interoperability among Earth Observations (EOs) and modelled services to optimize water treatment plant (WTP) operations, reduce resources and energy required to treat water, and enhance water management at the catchment level. By catalysing innovation in the use and access to satellite data by water utilities, SPACE-O aims to offer a powerful Decision Support System (DSS) and risk assessment tool for WTP operators. Such tools will optimise WTP operations through the use of accurate short-term forecasted water quality and quantity information and a better understanding of environmental challenges through integration of satellite, in situ, modelled data and citizens' observations.

Keywords: SPACE-O, earth observations, hydro-meteorological forecasting, water quality forecasting, water supply services, decision support systems

Paper ID: CEST2017_01421

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Highly absorbent polymer/layered double hydroxide composites for the conservation of irrigation water

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Abstract

From the commercial, industrial, and scientific point of views, clay composites are of particular interest especially in the field of water purification and irrigation. At present, even though a great deal of work on clay materials was carried out, still more remains to be done in order to exploit completely their potential applications. The aim of this study is to prepare a highly absorbent polymer–clay materials to control and manage irrigation water. Here, we report the synthesis of polymer–LDH composites through an incorporation/in-situ polymerization process. In addition, we characterize the prepared composites by different spectroscopic techniques, including, X-ray powder diffraction (XRD), FT-IR spectroscopy, thermogravimetric analysis (TGA), and the scanning electron microscope (SEM). Subsequently, we investigate the effect of the prepared composites on water front distribution and moisture content in sandy soils by using subsurface drip irrigation system. The obtained results have confirmed the composite structure of the prepared materials and have showed an improvement in the polymer water absorptivity, indicating a control process of irrigation water. More information will be discussed in the conference site.

Keywords: polymer, LDH

Paper ID: CEST2017_00585

MARINE ENVIRONMENT AND COASTAL MANAGEMENT

Saturday 2 September 2017

First characterization and impact assessment of beach litter in Sardinia (Western Mediterranean)

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Abstract

Marine litter entering the oceans has been estimated to be 4.8-12.7 millions tons per year. The presence of beach litter along the coast is due to the indirect input by waves, wind, rivers and currents and to the direct deposition by beach users. This study, conducted in Sardinia (West-Mediterranean Sea) aims to quantify and characterize beach litter all around the island and to define the main sources of impact. Seven beaches were monitored for 4 years (2013-2016) by means of 33 meters linear transects parallel to the shoreline in which all visible litter items were collected. Abundance evaluation and characterization of litter typologies were performed following the standardized protocol issued for the Marine Strategy. Uni-variate analysis of variance was performed to detect any difference in abundance and typology of marine litter according to time, exposure and site. The factor that better explains the distribution of litter in the study area was exposure: higher values were found on the "exposed" sites respect "non-exposed" ones ($p<0,05$). Moreover, on the most touristic beaches, direct litter deposition was higher. This work provides key information about litter sources, useful to suggest possible mitigation measures.

Keywords: marine litter, plastic, beaches, MSFD, Sardinia.

Paper ID: CEST2017_00662

Preliminary evaluation of microbial fuel cells applicability to bioremediate marine sediments contaminated by polycyclic aromatic hydrocarbons

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Abstract

This study reports a preliminary evaluation of applicability of sediment microbial fuel cells (SMFCs) to bioremediate marine sediments contaminated by phenanthrene, a polycyclic aromatic hydrocarbon (PAH). The anodic compartments of two SMFCs were batch-fed with a slurry (5% w/w real dry sediment in artificial seawater) contaminated with phenanthrene (200 mg/kg_{dw}), while the corresponding cathodic compartments were filled with 0.5 M $K_3[Fe(CN)_6]$. Both anode and cathode consisted of a piece of conductive graphite felt (4 cm^2). A cation-permeable membrane was used to separate the compartments. SMFC-1 was operated in static conditions, whereas mechanical stirring was applied in SMFC-2. Good phenanthrene removals were achieved in SMFC-1 (61%) and SMFC-2 (88.5%) after 20 days of operation; mechanical stirring played a role in accelerating phenanthrene degradation. Biocatalytic activity was characterized by linear sweep voltammetries: maximum power densities and optimal current densities in SMFC-1 and -2 were 9.2 and 38.4 $\mu W/cm^2$, and 26.2 and 142.7 $\mu A/cm^2$, respectively. Such promising results are putatively associated to the capability of electroactive microorganisms to promote phenanthrene degradation at the anodes. The use of electrodes as electron sink in electrochemical remediation of contaminated slurries deserves further investigation, since it represents a cost-effective alternative to conventional treatments requiring energy-consuming aeration.

Keywords: bioremediation, marine sediments, polycyclic aromatic hydrocarbons, phenanthrene, microbial fuel cells

Paper ID: CEST2017_00950

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Human activities and pressures for key European marine habitats; a catalogue of map resources for the restoration project MERCES

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Abstract

Human activities crisscross the urban and coastal fabric, and expand into the off shore and deep sea, deriving numerous associated pressures often impacting marine habitats. A main goal of the ongoing MERCES project (http://www.merces-project.eu/) is to produce a catalogue of available maps for existing activities and pressures in the European Seas. To this end, we compiled a catalogue with mapping sources for maritime activities, as well as endogenous and exogenous pressures that could potentially drive key-habitat changes. It currently includes more than 250 entries covering several key coastal and deep sea habitats, comprising published records, web resources, and grey literature. Fisheries, coastal marine infrastructure and transport are the most featured activities at the broad scale maps. Aquaculture and tourism rank high at the sublittoral habitats maps and research/conservation at the deep-sea records. Chemical pressures and biological invasions rank high at the broad scale followed by litter, abrasion and extraction of species. These last 3 pressures seem to be the most mapped pressures in deep-sea records. Mapping the location and intensity of marine activities has been steadily increasing, and could be valuable when overlaid on key habitats, aiding spatial planning and conservation by linking pressures to mitigation and restoration efforts.

Keywords: mapping, habitat, pressures, restoration, meta-data

Paper ID: CEST2017_00979

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Modelling the dispersion of harmful algal bloom (HAB) in the coastal area of Oman sea

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Abstract

The increasingly growing world population and the contamination of rivers and coasts due to human activities have given rise to serious problems in the marine habitats. One of the most recent and challenging issues involves harmful algal blooms also known as red tides. The algal bloom has geographically spread in the entire coastal areas of the world, and the Iranian southern coast is no exception. However, any potential damage in coastal areas can be prevented by accurately predicting the dispersion and advection of the blooming species.This study intended to examine the dispersion and advection of harmful algal cells through hydrodynamic modules MIKE 3-FM and ECO Lab, which simulated the hydrodynamics and quality of water as well as the distribution of chlorophyll-a across the southeast coast of Iran. After calibration of the model, the results of simulation were adequately consistent with the measured data on variations of chlorophyll-a, i.e. the cause of algal bloom. In fact, the modeling was successful in simulation of currents across the Gulf of Oman in hydrodynamic and quality terms. For validation of model the root mean square error (RMSE) is used. RMSE of calibrated and field data for chlorophyll a values equal to 0.016, obtained under 0.1 indicates that accuracy is very high and also for water level equal to 0.19, which represents the accuracy of hydrodynamic model is good. Since the dispersion of Cochlodinium polykrikoides was first observed at mid-April 2009 in the nearest station to the Strait of Hormuz. The bloom spread toward eastern stations of Chabahar at mid-May and then persisted for two months. The results were consistent with those obtained through software modeling on the dispersion of chlorophyll-a, the major cause of algal boom. The validated model in this study can be employed to provide on-time warning and prevent any adverse social and economic consequences.

Keywords: Harmful algal bloom, Nutrient, Chlorophyll a, Numerical modeling, Distribution

Paper ID: CEST2017_01221

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Sea level rise impact on the beach zone of Katerini region, NW Aegean Sea

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Abstract

The present contribution provides an initial assessment of the impacts of the longterm (climatic, i.e. sea level rise) and episodic (meteorological) on the sandy beach zone along the coast of Katerini region (NW Aegean Sea). Thus, the future retreat of the coastline, due to sea level rise (SLR) induced by climate change, has been estimated on the basis of an ensemble of 5 coastal morphodynamic models. Model's outputs showed that shoreline retreat range between 7.9-27.3 m and 23.5-70.0m for SLR of 0.38m and 1.0m, respectively. An initial assessment of coastal flooding has been examined after consideration of the astronomical tidal range, storm surge estimates and calculations of wave runup for intensive wave conditions (Ho>4 m). The results showed that the locations adjacent to Paralia and Olympiaki Akti residences are the most vulnerable to coastal flooding, whilst in the case of future sea level the study area could be subjected to coastal flooding.

Keywords: coastline retreat, runup, storm surge, sea level rise, coastal hazards

Paper ID: CEST2017_01282

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Evaluation and prioritization of erosion protection measures along the coast of Avlida

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Abstract

A detailed investigation of the extensive erosion phenomenon taking place in the coastal front (coastline) from Avlida beach to Vathi region in the Municipality of Halkida will be performed. Then based on the erosion problems assessment and an evaluation of short/medium-term effects on the terrestrial and marine environment, a prioritization of immediate actions/measures that should be taken to ensure the protection of existing infrastructure will be proposed. Particular emphasis will be given to the study of the erosion phenomenon under climate change scenarios due to high tourist value of the region.

Paper ID: CEST2017_01375

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Combined effect of ocean acidification and fluid turbulence on Puerto Rico coastal barriers: A preliminary study

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Abstract

A wealth of information exists on the effects of ocean acidification (OA) on marine ecosystems. Acidifying oceans not only pose a threat to coral colonies and reef formations, but may also alter dissolution processes of other coastal barriers such as sandstone. In this paper, we examine the combined effect of OA and fluid turbulence on the Puerto Rico north coast barrier (Eolianite). We hypothesize that fluid turbulence adds an additional stressor, whose combined effects on the dissolution processes are yet to be determined. Eolianite samples were subjected to fluid stresses while submerged in seawater with lower-than-usual pH levels (6.5<pH<6.9). For this preliminary experiment, the integrity of the sample was assessed in terms of its mass loss (25.8g average). Future experiments include assessments of mechanical, physical, and chemical properties, including roughness, point load stress, morphology, and carbonate composition. We ultimately aim at developing dissolution models for eventual extrapolation into field conditions. This highly interdisciplinary project supports the basis for more comprehensive efforts aiming to provide estimates of the accelerated loss of coastal barriers, OA threats, aragonite saturation, coastal vulnerability and hazards to public safety.

Keywords: Ocean Acidification, Coastal Barriers, Eolianites, Fluid Turbulence, Coastal Management

Paper ID: CEST2017_01391

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Local coastal governance system development: Municipal participatory social-ecological monitoring

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Abstract

Socio-ecological coastal systems are complex systems based on mutually interconnected elements of nature, culture, socio-economic resources and, especially, often not really taken into account, governance resources. Though, besides mentioned horizontal governance integration, also known vertical integration between governance levels and stake-holders collaboration integration are to be named, but our studies confirm also, that the main driving force for municipal sustainable coastal governance, daring to close the understanding and knowledge gap jeopardizing effective management at the local level, is coastal communication process necessary development - complementary applying instruments for coastal information and education/training, participation and coastal friendly stakeholders' behavior mutual development and coastal governance content and process facilitation. To conclude this listing of the complementary collaborative governance approach components for local coastal governance establishing, there is to be mentioned the most critical and initial one – the assessment of both, coastal resources/status and their management, using necessary local governance innovation: municipal coastal monitoring system, that is adjusted to the specific local circumstances, based on nature-social science and governance factors (particularly, with citizen science contribution) and their interaction assessment. Related research-and-development study was performed using an iterative multi-step manner social-ecological system analysis approach within EU BONUS project frame, applied for the pilot territory - Salacgriva municipality in Latvia.

Keywords: coastal and collaborative governance, municipal monitoring, socio-ecological system.

Paper ID: CEST2017_01442

ELECTRIC AND ELECTRONIC WASTE

Saturday 2 September 2017

Effective metal recovery in the mobile phone waste by chemical and biological treatments

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Abstract

Recycling electronic waste is an important subject not only from the point of view of waste treatment, but also regarding the recovery of valuable metals. This research examined the stepwise recovery of metals in mobile phone waste using chemical treatment via pH swing and biological method using biomineralization. In chemical treatment, the metal fraction attached to the printed circuit board (PCB) and camera parts were separated from the mobile phone waste and were then pulverized into particles with a size less than ~ 2 mm. The metal fraction was dissolved in aqua regia, and the pH of the solution was increased to 10.5 by adding NH_4OH. The first precipitate was iron oxide, produced by raising the pH to 3.1~4.2 with NH_4OH. Sequentially, copper chloride and rare earth-metal complex were produced at pH 5.7~7.7 and 8.3~10.5, respectively. In the biological method, the filtrate at pH 7.7 was added to a metal-reducing bacteria growth medium as precursor. After two weeks of incubation, rhodochrosite and calcite were precipitated as nano-sized minerals. The results indicate that effective metal recovery of mobile phone waste is feasible using chemical and biological treatments, and the recovered metals and rare earth metals can be recycled into raw materials for various industries.

Keywords: Metal recovery, Electronic waste, Urban mining, pH swing process, Biomineralization

Paper ID: CEST2017_00468

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The presence of REM and CM in WEEE: Challenges for recovery

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Abstract

The fastest growing waste stream of WEEE is not only a threat to our environment, but is also creating a supply risk of certain rare earth metals (REM) and critical metals (CM). Hence WEEE are considered as "Urban mines", a source of highly valuable metals. Despite the fact that Directive 2012/19/EU encourages the prevention of WEEE by promoting re-use, recycling and other forms of recovery of such wastes, the recycling of these metals in WEEE is less than 1%. The insufficient data about the composition of REM and CM in EEE, the high recycling costs and the different motivations/interests of the stakeholders, including national authorities, non-profit companies and producers, are some of the main inhibitor factors. However, there is a growing interest in scientific community in sorting out the issues which leads to such a low recovery and in defining the challenges and possible benefits generated from recycling REM and CM. On this basis, this work highlights the characteristics of REM and CM in terms of their economic importance and their presence in EEE. Then, an overview of the supply risk of REM and CM and the challenges related to the recovery are provided, supported by countries examples.

Keywords: Rare Earth Metals (REM), Critical Metals (CM), WEEE recycling, Supply risks

Paper ID: CEST2017_01305

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Identification of current processes and technologies used in the recovery of rare earth elements from WEEE

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Abstract

The increasing production and use of electric and electronic equipment has resulted in the production of a large number of Waste Electrical and Electronic Equipment (WEEE) with significant environmental impact. The volume of WEEE is growing three times faster than the average municipal waste stream in the European Union. According to the European Commission the amount of WEEE produced per EU citizen is about 17-20 kilograms per year and is expected to grow annually between 2.5% and 2.7%. Concerns over the security of supply of a wide range of strategic or critical raw materials (CRMs) are emerged. Many of the CRMs are speciality metals which are essential to the functioning of electronic equipment, albeit used in small concentrations within a few of the components. These materials include the precious metals, gold, silver and platinum as well as metals such as copper, as well as the Rare Earth Elements (REEs) often known as the Rare Earth Metals (REMs). A path for the supply improvement of these materials is to recover as much as possible from the Waste Electrical and Electronic Equipment (WEEE) that is currently processed under the WEEE Directives, which were designed primarily to prevent this waste stream going to landfill. On that background, a study into the capacity and technologies for treatment and recovery of strategic raw materials in the EU, the barriers to increasing this capacity and the actions that could be taken to overcome these barriers was deemed as necessary. In order to understand the current processes and technologies used in the recovery of Critical Raw Materials (CRMs) at treatment and reprocessing facilities in the EU, a European Union wide survey is conducted. This survey is designed to facilitate, the assessment of the currently applied WEEE pre-treatment methods with a clear focus on the fate of critical raw materials (CRM) during processing and the identification of the existing assessment methods of critical materials (CM) recovery rates in order to develop a report outlining the different tools and assessment methodologies that exist today in the EU. The study is conducted within the framework of the COST ReCreew project, with the aim to enable relevant stakeholders to build on its existing understanding of the EU capacity for the recovery of strategic raw materials, by identifying the technologies for recovery and barriers to increasing recovery within the EU and its immediate markets. The focus is on recovery of CRMs from WEEE products that have reached end of life and are recycled.

Keywords: Rare earths, WEEE, EEE.

Paper ID: CEST2017_01411

CLIMATE CHANGE

Saturday 2 September 2017

Short-term effects of elevated temperature and CO_2 on *Pisum sativum*

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Abstract

The concentration of CO_2 is predicted to further increase till the end of this century and the changes in global temperature are also expected. Due to the fact that increasing CO_2 and temperature will change the agricultural environment we investigated photosynthesis, plant productivity and organic carbon (C org.) accumulation of pea (*Pisum sativum* L.) under increasing levels of air temperature and atmospheric CO_2. A closed growth chamber experiment was performed in a controlled environment at ambient [21 °C/400 ppm] and elevated [25 °C/800 ppm] temperature and CO_2 conditions.The results showed that after 4 weeks of treatment aboveground (49 %, $p<0.05$) and belowground (6 %, $p>0.05$) biomass of pea increased, also significantly increased photosynthesis (54 %) and leaf area (37 %) under elevated climate [25 °C/800 ppm] conditions compared to the conditions of [21 °C/400 ppm]. Either it was estimated that organic carbon partitioning in leaves and stems increased ($p>0.05$) under elevated climate conditions [25 °C/800 ppm], but decreased in roots ($p<0.05$). Our results suggest that the effects of increasing levels of air temperature and atmospheric CO_2 were greater for photosynthesis, leaf area and aboveground biomass of pea. Also results demonstrated a promising potential in biomass C accumulation.

Keywords: climate change, photosynthesis, organic carbon, closed chamber experiment, *Pisum sativum*

Paper ID: CEST2017_01118

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Impact of short-term heat wave single and in combination with drought on gas exchange parameters of barley

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Abstract

In this study there were examined the short-term (3-day long) impact of heat wave (31 ºC *vs.* 21 ºC) single and in combination with drought (i.e. fully and not watered during the heat wave period) on gas exchange parameters of barley (*Hordeum vulgare* L.) plants grown in growth chambers at control environment, as well as the recovery following stress. Short-term heat wave by itself has had minor or no effect on soil water content, photosynthetic rate, stomatal conductance and intercellular CO_2 concentration during the heat wave period, although increased transpiration rate and decreased water use efficiency, but all these parameters fully recovered after one-day regeneration period. In contrast, the combination of heat wave and drought brought much more pronounced negative effect on soil water content and gas exchange parameters, whereof not all could return to the control value after one-day regeneration period. Hence, the obtained results showed that at the early development stage barley plants may by capable to cope with short-term heat wave event under future climate, if they would be well watered, but heat wave in conjunction with drought could bring irreversible changes in their leaf physiology.

Keywords: Heat wave, drought, gas exchange, barley

Paper ID: CEST2017_01129

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The response of antioxidative defence system of spring barley (*Hordeum vulgare* L.) and barnyard grass (*Echinochloa crus-galli* L) under elevated CO_2 and temperature

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Abstract

The major components of climate change include warmer temperature and elevated atmospheric carbon dioxide (CO_2) concentrations. Agricultural yields strongly depend on crop competitiveness with weeds. Climate change will have obvious consequences for crop yields as any differential response between crops and weeds to changing climate will alter weed-crop interaction and potential crop yield losses. As C3 and C4 plant species respond differently both to rising CO_2 and rising temperature, this may alter crops ability to compete with C4 weeds. The aim of this study was to investigate the response of antioxidative defence system of spring barley (*Hordeum vulgare* L.) and barnyard grass (*Echinochloa crus-galli* L.) under future climate conditions. Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO_2) and future climate (25 °C, 800 ppm CO_2). The plants were grown in microcosms: spring barley in competition with barnyard grass. The growth and response of antioxidative defence system were evaluated. Antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) were measured. Oxidative stress parameters, such as the concentrations of malondialdehyde were determined. Our results indicated that spring barley and barnyard grass responded in different manner to future climate conditions. It was observed that barnyard grass could become more competitive with barley under future climate conditions.

Keywords: Spring barley, barnyard grass, climate change, antioxidative response

Paper ID: CEST2017_01328

THE 5 DIMENSIONS OF NEXUS: WATER – ENERGY – LAND – CLIMATE – FOOD

Saturday 2 September 2017

Isotopic model for detecting original wine product

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Abstract

This paper presents a study concerning the stable isotopic fingerprint (D, ^{18}O and ^{13}C) of some wines varieties (Xinomavro, Agiorgitiko, Moschato, Syrah) obtained from different regions of Greece. These wines were obtained from different vineyards having a significant role in the wine market: Amyntaio, Orestiada located in Northern Greece and Nemea located in Southern Greece. From the $\delta^{13}C$ and D values we conclude that all the studied wines were authentic. The variations on the $\delta^{18}O$ were well correlated with the different climatic zones of the regions. Specifically, the North and North-East regions of Greece (Amyntaio and Orestiada respectively) showed oxygen values in the range of -1.3‰ to 5‰ and -1.0‰ to 5.5‰ while the South regions of Greece (Nemea) showed values in the range of 2.5‰ to 6.1‰.

Paper ID: CEST2017_00758

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Virtual water flows of the energy sector among chinese provinces: A multiregional input–output approach

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Abstract

The energy industry of China consumes the largest amount of direct water withdrawal and consumption in industry. However, there is a critical spatial mismatch between water demand of energy production and water availability. We used a multiregional input–output model to investigate the virtual water flows embedded in energy-related production among provinces in China. The results reveal that at the national level close to 1/5 of the virtual water use is traded as virtual water embedded in the inter-provincial energy trade, specifically 15.5% of the total water withdrawal and 18.9% of the total water consumption. The virtual water flows of the energy industry present an unsustainable water use pattern that is virtual water flows from the water scare north China to the water abundant south China, which does not match virtual water trade strategy. The more-developed coastal regions are supported by water withdrawal and consumption of the energy industry in the less-developed regions where water scarcity is severe. This study has proved the great importance and urgent need of water-energy nexus studies and also provided an approach to integrating water use management into energy industry planning and management.

Keywords: water use for energy sector, virtual water flow, multiregional input–output analysis

Paper ID: CEST2017_01383

MICROPLASTICS IN THE MARINE ENVIRONMENT

Saturday 2 September 2017

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Adsorption of detergent by microplastics

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Abstract

One of the increasing pollution loads along with the fast consuming growth in the world is microplastics which are left into the environment. 80 % of microplastic pollution in the sea moves from earth to seas. Microplastics spread toxin to water and keep hazardous contaminating chemicals on their surfaces. As a result of the ingestion of microplastics they undergo bio accumulation in the tissues and organs of organisms and they can be transfered along the food chain in the sea. In this study, detergent adsorption was investigated by using microplastic pellets in laboratory condition. To examine detergent adsorption in lab environment 0.5-2mm PP,PS and PE pellets were chosen and detergent adsorption was examined and evaluated upon pellets by preparing detergent solutions (LAS) on different conditions. As a result of these laboratory studies, it was observed that microplastics have adsorbed detergent.

Keywords: Microplastics, Adsorption, Detergents, LAS,Isoterms

Paper ID: CEST2017_00062

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Eco-sustainable functionalization of polyamide fabrics to mitigate microplastic release

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Abstract

The global textile production is mainly based on synthetic fibres like polyester, polyamide, polyacrylic and polypropylene. Recently, the washing process of synthetic clothes has been identified as a source of microplastics, plastic fragments smaller than 5 mm, that pollute marine ecosystems. In fact, the mechanical stresses and the friction of the detergent cause the detachment of microfibres from the yarns. In such scenario, the aim of this work is to develop functional finishing treatments that can protect the fabric during the washing, preventing in this way the release of microplastics. As alternative to synthetic polymers, pectin, a natural polysaccharide, was used to create a coating on polyamide fabrics. Pectin was chemically modified by the reaction with glycidyl methacrylate (GMA), whose vinyl groups were used to graft pectin on the surface of the fabric. A key point was the realization of a homogeneous coating, that did not modify the hand of the textile. For this aim, different ratios of pectin:GMA were tested and the treated fabrics were analysed by scanning electron microscopy (SEM), solid state nuclear magnetic resonance spectroscopy (NMR) and Attenuated Total Reflectance (ATR) Fourier Transform InfraRed (FT-IR) spectroscopy, in order to evaluate the effectiveness of the finishing treatments.

Keywords: microplastic, functionalization, finishing treatment, polyamide, pectin

Paper ID: CEST2017_00696

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

Microplastic pollution in marine sediments surrounding Iceland

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Abstract

Microplastic pollution is widespread throughout the marine environment and is increasingly recorded in marine sediments. However, the depth and distribution of microplastics in varying depositional environments remains uncertain. Specifically, it remains unknown whether differences in sediment size, organic content, or oceanic surface and bottom water currents affect the deposition and burial of microplastics in marine sediments. Here we present a distribution analysis of microplastics in marine sediments collected from the Icelandic Shelf. Sites were specifically chosen to reflect the complex oceanography surrounding Iceland and the unique depositional environments and sediments present on the Icelandic Shelf. The top 0-5 cm of eight box cores (1cm intervals) were examined for microplastics using a dry-sieving method. Sediment size distribution for each sample was determined using a Mastersizer 2000 and the polymer origin of recovered microplastics was determined using Fourier Transform Infrared Spectroscopy. To reconstruct a history of microplastic deposition for each site, we calculated sedimentation rates using AMS radiocarbon dating (AMS 14C).

Keywords: Microplastic, Marine Environment, Marine Pollution, Plastic Pollution

Paper ID: CEST2017_00903

Contamination of the Italian Minor Islands by micro-plastics pollution: survey of the clearest Italian sea waters

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Abstract

Abundance and distribution of microplastics (MP) were evaluated in 6 "clear" sites (Italian minor Islands), and in 3 "polluted" areas (near the mouth of rivers). Samples of MP and plankton were collected using a Manta Trawl (MA) and a WP2-FAO (WP), both lined by a 333 µm mesh net. The Manta Trawl sampled the top 25 cm of the sea surface while WP2 was forced to work horizontally at around 20m of depth. MP were found on each site, with average density of 0.3±0.04 items/m^3. According to the preliminary results, Ischia was found to be the most polluted area by microlitter, while Asinara the least affected one. Shape composition analysis showed a higher abundance of synthetic filaments (50%) followed by fragments (30%), thin plastic films (17%) and spheres (2%). ATR-µFT-IR analysis highlighted that the most abundant polymers, collected by MA and WP, were Polyethylene (PE–26%), Polypropylene (PP–11%), Polyethylene-Terephthalate-Polyester (PET-PEST–8%) and Ethylene-vinyl-acetate (EVA–5%). MP were also analyzed to evaluate the amount of POPs and their spatial distribution among different sites.

Keywords: microlitter, Mediterranean, polymers, POPs, Manta trawl.

Paper ID: CEST2017_01247

Proceedings of the 15th International Conference on Environmental Science and Technology
Rhodes, Greece, 31 August-2 September 2017

The impact of PS microplastics on green algae *Chlorella vulgaris* Growth

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Abstract

Even the mostly introductory studies carried out in recent years serve as proof of the diverse threat microplastics may pose for water sources, environment, and biota. That is why microplastics (MPs) pollution is starting to look like a puzzle almost beyond any solution. Microplastics in the aquatic ecosystem could lead to substantial damage on the growth as well as digestion, reproduction, and excretory systems of organisms. The present study investigates the negative impact microplastics cause on the growth of an algae species (*Chlorella vulgaris*) grown in the experiment environment where PS microplastics were introduced alongside the medium. The state of the algae was investigated, with reference to photosynthetic pigment (chlorophyll-a) and optical density (OD) values, and with a view to understanding the impact of microplastics on the growth and development of cellular biovolume of algae. The analyses revealed that MPs inhibited biovolume growth from day one on; the larger the MP dose applied, the higher the level of inhibition. The bioexperiments ran with microplastics of various doses including 1, 2, 4, 6, and 8 mg/L produced an overall increase in the algae biomass values as of the end of the 7th day; yet the biomass figures were found to fall as the experiments were sorted by MP concentration levels, from the lowest to the highest.

Keywords: algal growth, biota, *Chlorella vulgaris*, inhibition, microplastics

Paper ID: CEST2017_01395

The impact of PS microplastics on green algae *Chlorella vulgaris* Growth

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Abstract

Even the mostly introductory studies carried out in recent years serve as proof of the diverse threat microplastics may pose for water sources, environment, and biota. That is why microplastics (MPs) pollution is starting to look like a puzzle almost beyond any solution. Microplastics in the aquatic ecosystem could lead to substantial damage on the growth as well as digestion, reproduction, and excretory systems of organisms. The present study investigates the negative impact microplastics cause on the growth of an algae species (*Chlorella vulgaris*) grown in the experiment environment where PS microplastics were introduced alongside the medium. The state of the algae was investigated, with reference to photosynthetic pigment (chlorophyll-a) and optical density (OD) values, and with a view to understanding the impact of microplastics on the growth and development of cellular biovolume of algae. The analyses revealed that MPs inhibited biovolume growth from day one on; the larger the MP dose applied, the higher the level of inhibition. The bioexperiments ran with microplastics of various doses including 1, 2, 4, 6, and 8 mg/L produced an overall increase in the algae biomass values as of the end of the 7th day; yet the biomass figures were found to fall as the experiments were sorted by MP concentration levels, from the lowest to the highest.

Keywords: algal growth, biota, *Chlorella vulgaris*, inhibition, microplastics

Paper ID: CEST2017_01395

ISBN: 978 - 960 -7475 - 53 - 4
ISSN: 1106 - 5516