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# Session 1 – Wastewater treatment

## *Thursday 5 September 2019 - morning*

# Phosphorus and nitrogen recovery from wastewater in the form of struvite: alternative magnesium sources

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## ABSTRACT

Recovery of phosphorus and nitrogen from municipal and other types of wastewater may be achieved through the direct crystallization of struvite (magnesium ammonium ph ph h x h d $\cdot NH_4\cdot PO_4\cdot 6H_2O$). Wastewater deficiency in magnesium makes it necessary for the external addition of magnesium to make up for the supersaturation needed. In the present work we have tested artificial seawater and saturated with respect to calcined magnesia (MgO) aqueous solutions as magnesium sources, as both sources are low cost and readily available. Both the spontaneous precipitation and the seeded crystal growth have been investigated at constant supersaturation (pH 9.0- 0 0 25°C) S w accelerated the precipitation of struvite and narrowed the stability domain of the supersaturated solutions. Saturated magnesia solutions were shown to broaden the stability domain of the struvite supersaturated solutions. Magnesia suspensions were also tested with respect to their ability to induce crystallization of struvite. Measurement of the kinetics of crystal growth by potentiometric methods maintaining solution supersaturation, and AFM observations showed that the solid particles in magnesia saturated suspensions, provide favorable substrate for the overgrowth of struvite in combination with the appropriate supersaturation conditions.

**KEYWORDS:** struvite, precipitation of, artificial seawater, magnesia, crystal growth

**PAPER ID:** CEST2019_00169

# Challenges in biological treatment plants: the approach of zero sludge waste

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## ABSTRACT

The current trend in operation of biological Wastewater Treatment Plants (WWTPs) is the minimization of sludge wastage due to its labor and cost intensive management process. Minimization of sludge can be achieved by increasing the solids retention time (SRT) in a WWTP, up to an almost complete retention of solids. This operational modification can induce problems that compromise effluent quality, such as: (a) excessive accumulation of sludge, (b) Dissolved Oxygen availability, (c) changes of C:N:P nutrient ratio, (d) changes of microbiological and morphological characteristics of biomass and (e) insufficient treatment. By imposing specific WWTP design and operational conditions, the SRT related problems can be resolved. The current study presents results based on monitoring five full scale industrial and municipal WWTPs, operating towards "complete solids retention". The results showed that under high SRT and after the modification in the design and operation of a WWTP, successful microbial manipulation can be achieved. This leads to (i) excess sludge minimization, up to 95%, (ii) good sludge settling characteristics, with SVI < 120 ml/g, (iii) sufficient wastewater treatment, with removal efficiencies, up to 99%, 98% and 99% for COD, TN and TP respectively.

**KEYWORDS:** biological treatment, sludge minimization, complete solids retention

**PAPER ID:** CEST2019_00251

# The use of Biochar from Waste Wooden Biomass for Removal of Emerging Pollutants

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**ABSTRACT**

The aim of presented research is to use biochar produced from waste biomass for removal of veterinary antibiotic tiamulin from model wastewater. Produced biochar was activated using different chemical methods (KOH treatment under various conditions). It was characterised using BET method for the determination of the pore size distribution and pore volume fraction as well as SEM microscopy. Results indicated importance of biochar activation to achieve applicable adsorption characteristics. In 180 minutes of batch experiment up to 78% of tiamulin was removed. Kinetic parameters were also determined by Lagergren model while for determination of adsorption isotherm Freundlich model fitted obtained data. It was concluded, that adsorption characteristics of produced and activated biochar are comparable to those of commercially available activated carbons and thus its feasibility for removal of tiamulin from model wastewater was confirmed.

**KEYWORDS:** adsorption, antibiotics, biochar, kinetics, isotherm

**PAPER ID:** CEST2019_00273

# Printing ink wastewater treatment using electrocoagulation

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## ABSTRACT

Packaging paper wastewaters, stemming mainly from the dyeing sector of the production process (where printing inks are utilized), are characterized by large concentrations of organic matter, deep, strong color and almost zero biodegradability factor. These attributes, in combination with the presence of some toxic compounds (heavy metals, VOCs etc.) make further treatment necessary, before releasing the wastewater to the environment. The present study deals with the treatment of these effluents using Electrocoagulation (EC). During the EC process, metallic species are electrochemically dissolved in the wastewater solution, resulting in coagulation, flocculation and subsequent separation of the pollutants via flotation or sedimentation. The efficiency of this method was evaluated, by examining the organic matter removal and decolorization of the wastewater under a wide range of operating parameters (current density, initial pH and electrode material). Moreover, the physical and chemical phenomena taking place during the process, as well its environmental footprint were investigated. It was observed that this process is efficient under most of the operating conditions used, as the chemical oxygen demand removal ranged between 65 and 85 % and all the experiments managed high color removal, ranging between 98 - 100%. Additionally, secondary pollution was minimized, as concentrations of soluble metallic species remained below the regulated limits.

**KEYWORDS:** printing ink wastewater; electrocoagulation; chemical oxygen demand; color

**PAPER ID:** CEST2019_00302

# Session 2 – Life cycle analysis (LCA)

## *Thursday 5 September 2019 - morning*

# Conventional and organic rice production in Northern Italy: What is the (environmentally) best?

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## ABSTRACT

In this study, using the Life Cycle Assessment (LCA) approach, the environmental performances of rice production in Italy considering both conventional rice production (CRP) than organic rice production (ORP) was evaluated. Inventory data were collected by means of surveys in 69 farms located in Northern Italy, 20 for ORP and 49 for CRP. The best cultivation practice depends on the evaluated impact category and by the specific cultivation practices. On average the impact for ORP are higher than for CRP but, above all for ORP, there is a wide variability of the environmental performances.

**KEYWORDS:** Life cycle assessment, Agricultural systems, Cereals, Environmental impact

**PAPER ID:** CEST2019_00083

# Improvement of calculations of the total characterization factor in the Usetox Model including a regional approach

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## ABSTRACT

The USEtox model as one of LCIA models is an instrument to characterize the human toxicity impact. The model measures the intake of metals by population with meat products. The USEtox is the only model including geographical separation and wide database with organic and nonorganic chemicals. However, the USEtox does not provide any regional information, as ecological or geological specifications of areas included into the model. There is also a lack of data about metals concentrations in the database. Current investigation proposes an approach to reduce these limitations using results of bioindication studying– chemical composition of pork meat samples. Results of bioindication express assessing and forecasting changes in biotas under the anthropogenic influence locally in 3 settlements of “Central Asia” district. We extrapolate them into the USEtox model database, to extend it with concentrations of heavy metals Cr, Zn and As in the meat of pork. Characterization factor is proposed to assess their potential toxicity in soil and air in the region “Central Asia”.

**KEYWORDS:** LCIA, the USEtox, Bioindication, Heavy metals, Human health impact assessment

**PAPER ID:** CEST2019_00109

# The role of life cycle assessment to measure progress towards the circular economy

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## ABSTRACT

The circular economy (CE), as opposed to the current linear economy, is seen as a sustainable economic system where the economic growth is decoupled from the resources use, through the reduction and recirculation of natural resources. In the shift towards the CE, quantifying the circularity of products and services (or their contribution to the CE) is crucial in designing policies and business strategies, and prioritizing sustainable solutions based on evidence. This study explores the role of Life Cycle Assessment (LCA) in assessing the circularity of products and services. A review was made on current LCA case studies assessing progress in the CE, attending to the following aspects: the goal of the studies, the modelling and allocation approaches, the assessment methods used, and their alignment with the CE goals. The results indicate that LCA is one of the most used and comprehensive tools to assess CE. However, the multifunctional and multidimensional nature of the CE strategies impose methodological challenges that are still not solved.

**KEYWORDS:** Circular economy, LCA, circularity, methodologies, review, sustainability

**PAPER ID:** CEST2019_00152

# Early-stage LCA of a novel fuel flexible CHP technology based on biomass gasification and a SOFC


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## ABSTRACT

To mitigate climate change and reduce the consumption of fossil fuels, more efficient energy production is necessary. Combined heat and power systems (CHPs) are a key technology to reach such an objective, due to its higher energy efficiency than the separate production of heat and electricity. These environmental benefits can be enhanced by using a versatile energy source, such as biomass. The H2020 Hieff-BioPower project is developing an innovative medium-scale biomass CHP technology based on biomass gasification combined with solid oxide fuel cells (SOFC). This technology shall reach a high gross electric and overall energy efficiencies (40% and 90% respectively) and is expected to achieve equal-zero gaseous and PM emissions. This study analyses the expected environmental performance of producing heat and electricity with such a technology, using environmental Life Cycle Assessment (LCA). The analysis investigates the cradle-to-gate impacts considering different biomass feedstocks and including the manufacturing of the main power plant components (gasifier, gas cleaning unit, SOFC). The preliminary results indicate environmental improvements when compared with state of the art technologies such as internal combustion engines and organic Rankine cycle CHPs.


**KEYWORDS:** LCA, biomass, CHP, Gasification, SOFC

**PAPER ID:** CEST2019_00156

# Life cycle evaluation of production and utilisation pathways of coupled anaerobic digestion (AD) and gasification/pyrolysis systems using the anaerobic biorefinery concept

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## ABSTRACT

Life Cycle Analysis modelling has been applied to an operational Anaerobic Digestion (AD) plant, (utilising Cattle Slurry/Grass Silage), currently producing biogas for electricity and heat production, with digestate going to land-spreading. The aim of the research was to evaluate the environmental costs and benefits of coupling the existing plant with Gasification or Pyrolysis systems for the utilisation of digestate from the plant, producing either predominantly Syngas (Gasification) or Oils/Tars (Pyrolysis). Utilisation pathways evaluated as part of the research include the following: Gasification: Syngas to Methanation to Synthetic Natural Gas (SNG); and Pyrolysis: Syngas and bio-oil to dual-fuel electricity production. While the focus of the evaluation will be the potential GHG-eq emissions reductions achievable from the different processing and utilisation pathways, the full range of impact areas are included in the analysis. The analysis will include reflection on the challenges of applying LCA to complex biorefinery/bioenergy systems to inform future methodological developments and guidance.

**KEYWORDS:** Life-cycle analysis, biogas, biochar, bio-oil, syngas, gasification, pyrolysis

**PAPER ID:** CEST2019_00364

# Energy and environmental aspects of distributed generation and electric-vehicle integration from a LCA perspective. A case study in Mendoza, Argentina

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## ABSTRACT

The energy sector is moving from a rigid, concentrated system towards a flexible, decentralized one enabling the exchange of energy between many actors. Distributed renewable energy generation is a key element in this new system, offering many (potential) technical, environmental and economic advantages, but their intermittent character and the lack of synchronicity between demand and supply introduce new challenges to the utilities. Storage systems could help mitigating these negative issues, but they require additional costs, and incorporate new environmental problems. Another key factor in the new energy sector is represented by the growing number of electric vehicles which are populating the urban space, which will need to charge their batteries, thus challenging the electric system's capacity. However, these vehicles will remain idle most of the time, thus offering an opportunity to electricity storage on their underutilized batteries. In this paper the environmental consequences of distributed FV generation and storage in electric vehicles in Argentina are explored, following a life cycle perspective. Results show that the Vehicle-to-Grid and Grid-for-Vehicle management strategies will play an important role on demand curve peak-shaving. The scenarios analysis show that the transition to the electric vehicle alone does not ensure lower emissions, if advances in the electricity decarbonization are not accomplished.

**KEYWORDS:** Distributed generation, electric vehicle, storage, Life Cycle Assessment

**PAPER ID:** CEST2019_00413

# Session 3 - Soil and groundwater contamination and remediation

## *Thursday 5 September 2019 - morning*

# Screening of polar pesticides in groundwater in Hebei Province, China

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## ABSTRACT

As a big agricultural country, China has a relatively high pesticide usage in unit area, which is three times higher than developed countries. About 80% of pesticides directly enter the soil and the water through leaching or surface runoff during the usage of pesticides. In particular, some of the polar compounds are easier to migrate than other compounds, causing pollution of surface water and groundwater. The groundwater samples in Hebei Province, a major agriculture province in China, were screened by multi-residue liquid chromatographytandem mass spectrometry for two consecutive years in 2014 and 2015. The results showed that among 44 polar compounds, 27 pesticides were detected in 2014 and 19 in 2015. Atrazine-desethyl-desisopropyl, 2,4-D and fomesafen were 434.3 ng/L, 711.5 ng/L and 508.2 ng/L respectively, which were significantly higher than those in other provinces in China. Atrazine and its metabolites were detected in both years. Except for Atrazinedesethyl-desisopropyl, other components were detected in high concentration in 2014. The detected concentrations of bentazone, hexaconazole, triadimenol, and triazolone were similar in the two years. Pesticides such as methomyl, isopropyl, diniconazole and imazethapyr were detected in 2014, but not in 2015, which is presumably related to the actual use of pesticides.

**KEYWORDS:** Screening, polar pesticides, groundwater, liquid chromatography-tandem mass spectrometry.

**PAPER ID:** CEST2019_00113

# Thermal degradation of perfluorooctanoic acid (PFOA)

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## ABSTRACT

Per - and polyfluoroalkyl substances (PFAS) are a group of environmental contaminants, that are dispersed throughout the world. A number of areas have been affected by their persistence and biomagnification. PFAS remediation of contaminated material requires extensive knowledge of the species involved. A method to simplify the study of the thermal degradation of PFAS is presented in this paper, providing a solution to experimental and analytical challenges. A three-zone furnace allowed manipulation of both reaction temperature and gas flowrate (and consequently residence time). The PFAS compound could be charged and vaporised in a separate zone. Adopting this experimental methodology, a kinetic model describing the decomposition of the PFAS can be devised. When reacting under an inert nitrogen atmosphere, perfluorooctanoic acid (PFOA) degraded at temperatures above 450 °C. The products observed were found to be hydrofluoric acid (HF) and carbon dioxide ($CO_2$), along with a perfluoro-1-heptene species. Additional products of 1H-perfluorohexane or 1Hperfluoroheptane were also observed when residence times were increased. The effect of water vapour was also investigated, with similar behaviour to pyrolysis being observed, where a significantly higher concentration of HF was detected under otherwise similar reaction conditions. These preliminary results suggest water vapour accelerates the rate of PFAS decomposition.

**KEYWORDS:** Perfluorooctanoic acid, Kinetics, Thermal Decomposition, Pyrolysis, Water vapour

**PAPER ID:** CEST2019_00155

# Thermal Decomposition of Chlorpyrifos - an Experimental Investigation

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## ABSTRACT

Organophosphate compounds are a group of chemicals that are commonly used in pest control. One widely used organophosphate is chlorpyrifos (CPF), which has been associated with acetylcholinesterase inhibition (AChE), an acute neurotoxin. Further, under thermal decomposition conditions, such as those that occur in bushfires, CPF has been shown to produce a dioxin-like compound 2, 3, 7, 8-tetrachloro-[1, 4]-dioxinodipyridine (TCDDpy). To assist in understanding the reaction of CPF, an experimental methodology was developed which enabled the study of its thermal decomposition. CPF was pyrolysed in a three-zone furnace, leading to the formation of its major degradation product, 3, 5, 6- trichloro-2-pyridinol (TCP). The study revealed that ethylene gas and a solid sulfur/phosphorous compound were also generated with the TCP product. TCP undergoes further thermal decomposition to form several chlorinated products. Experiments undertaken under oxidative conditions revealed that TCP (at temperatures above 900 K and at a residence time of 9 s) also produced HCl and cis and trans forms of TCDDpy. The results of this study compare favourably with our previous theoretical work.

**KEYWORDS:** Chlorpyrifos, Thermal Decomposition, Kinetics, Pyrolysis, Oxidative

**PAPER ID:** CEST2019_00159

# Geochemical modelling as a tool to investigate chromium contamination in groundwater

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## ABSTRACT

Geochemical modelling is an essential tool to understand the water-rock interaction processes. In this work has been used the reaction path modelling to investigate the release and fate of geogenic Cr in ophiolitic Italian areas. During the water-rock interaction the geogenic trivalent Cr hosted in Crbearing minerals (serpentine minerals, spinels, pyroxene, etc.) of serpentinites rocks is oxidized in Cr(VI) highly toxic, resulting largely dangerous for environment and human health. This geochemical modelling was performed varying $Fe_2O_3/(FeO+Fe_2O_3)$ weight ratios considering the trivalent Fe the main oxidant present in suitable amounts in serpentinite rock. The reaction paths reproduces the analytical concentrations of relevant solutes, including Cr(VI), in the Mg-$HCO_3$ groundwaters hosted in the ophiolitic aquifers of Italy.

**KEYWORDS:** Geochemical modelling, hexavalent chromium, groundwater

**PAPER ID:** CEST2019_00572

# Technology Critical Elements in industrial wastes as the source of soil contamination

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## ABSTRACT

The intensive development of industry, especially the mining and metallurgy, automotive and electrical industries, affects the increasing amount of Potentially Toxic Elements (PTE), including Technology Critical Elements (TCE) in the environment. This preliminary study focuses on the following TCE: Ga, Ge and Tl. The main thing they have in common is that they have not been much studied and the level of knowledge concerning the environmental impact of their use is quite slight. Additionally, content of more common PTE (As, Cd, Cu, Pb, Sb, Zn) was determined in order to discover some relationships between these both group. Soil samples were collected from topsoil (0-5 cm) and subsoil (25-30 cm) in industrial area influenced by metallurgical slag dump and road traffic. Concentrations of elements were determined with HighResolution Inductive Coupled Plasma-Mass Spectrometry (HR-ICP-MS) after HNO3 microwave digestion. Results revealed that almost all studied elements were in higher amount in the topsoil suggesting the anthropogenic pollution as a source of their content in soil.

**KEYWORDS:** potentially toxic elements, technology critical elements, magnetic susceptibility, topsoil, subsoil

**PAPER ID:** CEST2019_00530

# Origin of the salinity in the groundwater of the El Attaf alluvial aquifer

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## ABSTRACT

The choice of this research theme was guided by the desire to better understand environmental issues, namely salinity and its origin, through the use of geophysical data from various surveys carried out between 1969 (CGG) and 2002 (IFES), to highlight the impact of the geological and structural upheavals that occurred during the earthquake of October 10, 1980, on the hydrodynamic processes. The interpretation of the resistivity data revealed that water salinity is highly variable and generally high near Jebel Temoulga. Chemical analyzes of all wells in the region confirm this. The hydrochemical study has shown the influence of local geology on the chemistry of the waters of the neighboring aquifer, and raises the question of the importance of gypso-saliferous facies in the region of El Attaf. The multifunctional statistical analysis revealed two chemical profiles within the same aquifer, but it should be noted that the highest concentrations were recorded on the Hay Bel Abbes - Bir Saf Saf axis.

**KEYWORDS:** El attaf, geophysics, hydrochemistry, salinity, Triassic, Aquifer.

**PAPER ID:** CEST2019_00481

# Groundwater Quality and Hydrogeochemical Characterization of Khetri Copper Mining Region, India

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## ABSTRACT

The impact of copper mine on groundwater quality in the semi-arid region is evaluated, and also characterized for hydrogeochemical processes. Groundwater samples (post monsoon and pre monsoon) from Khetri copper mine region of Rajasthan, India were studied. In majority of groundwater samples, the values of analyzed parameters such as EC, $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $HCO^{3-}$ and Clexceed the WHO (2011) and Bureau of Indian Standards (2012) permissible limits. Higher concentrations of ions were observed near the mining activities (mines, tailings, overburden rocks and abandoned mine) and in the downstream of groundwater flow from mines suggesting significant influence of mines on water quality. High concentration of major ions is attributed to oxidation of sulfides or acid mine drainage (AMD). The Gibbs plot for cations and anions as a function of TDS indicates the evolution of groundwater from rock-water interaction in both seasons. Thus, increased major ions concentration is due to dissolution of minerals by AMD.

**KEYWORDS:** Groundwater quality; Hydrogeochemistry; Anthropogenic processes; Khetri copper mines

**PAPER ID:** CEST2019_00500

# Session 4 - Microplastics in the marine environment

## *Thursday 5 September 2019 - morning*

# A small overview of the current, natural & affected environments by Microplastics

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## ABSTRACT

There is a growing concern and increasing evidence that microplastics in the World's rivers and oceans are having an affect on marine environments; and ultimately into the food chain. Infrared Spectroscopy and Microscopy are well- established analytical techniques for defining, identifying and categorising of plastic materials. However, it is also good to remember that microplatics is a term that consists of diverse chemicals of all shapes, sizes, coulour etc. Increasingly collating research and information on these materials has become of great importance as they are been added as priority contaminants to monitor by various governments. This presentation reviews the recent scientific findings in the microplastics applications in order to sharpen our understanding of their affects in our marine environments.

**KEYWORDS:** microplastics

**PAPER ID:** CEST2019_00984

# Identification and Quantification of Microplastic in Sewage Systems by TED-GC-MS

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## ABSTRACT

The number of publications reporting the amount of microplastic (MP) all over the world increased rapidly. Methods used so far are very time consuming and not able to provide information on total contents. As harmonised sampling, sample preparation and analysis strategies are missing different studies can hardly be compared and quantitative data, including identification and mass contents of the polymers found, are missing. This leads to a lack of comprehensive understanding of MP occurrence, source and entry pathways into the environment. We developed a method, Thermal Extraction/Desorption Gas chromatography-Mass spectrometry, as a fast screening method for MP analysis. Solid residues of water samples are heated up to 600 C under a N2 atmosphere without any sample preparation. The collected decomposition gases are separated in a gas chromatography system and detected in a mass spectrometer. Mass contents of the identified polymers can be calculated. In this presentation we will show first results from the influent of the wastewater treatment plant Kaiserslautern (Germany) and its combined sewage system as possibly entry pathway. In order to determine the relevance of wastewater split streams analysis of grey water will be conducted. Samples are fractionally filtered by a sieve cascade with mesh sizes of 500, 100, 50 µm.

**KEYWORDS:** microplastic, TED-GC-MS, analysis, grey water, waste watertreatment plant

**PAPER ID:** CEST2019_00233

# Multivariate Analysis of Large μ-FTIR Data Sets in Search of Microplastics

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## ABSTRACT

μ-FTIR spectroscopy is a widely used technique in microplastics research. It allows to simultaneously characterize the material of the small particles, fibers or fragments, and to specify their size distribution and shape. Modern detectors offer the possibility to perform two-dimensional imaging of the sample providing detailed information. However, data sets are often too large for manual evaluation calling for automated microplastic identification. Library search based on the comparison with known reference spectra has been proposed to solve this problem. To supplement this 'targeted analysis', an exploratory approach was tested. Principal component analysis (PCA) was used to drastically reduce the size of the data set while maintaining the significant information. Groups of similar spectra in the prepared data set were identified with cluster analysis. Members of different clusters could be assigned to different polymer types whereas the variation observed within a cluster gives a hint on the chemical variability of microplastics of the same type. Spectra labeled according to the respective cluster can be used for supervised learning. The obtained classification was tested on an independent data set and results were compared to the spectral library search approach.

**KEYWORDS:** Microplastics, μ-FTIR, Multivariate Data Analysis

**PAPER ID:** CEST2019_00292

# OMCEC: A Novel Method for Simultaneous Detection of Composition, Geometry and Motion of Suspended Particles

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## ABSTRACT

Here, we introduce OMCEC, a laboratory-based system that simultaneously measures the material composition, geometric properties, and motion of individual suspended aggregates in a non-invasive and non-destructive way. OMCEC consists of a full-color high-resolution optical system and real-time algorithms for material segmentation based on light spectra emission analysis, quantification of various geometrical properties, and motion detection with particle tracking velocimetry (PTV). We show applications of OMCEC for the composition analysis of aggregates made of biological matter and (i) mineral and (ii) microplastics.

**KEYWORDS:** biomass fraction, cell colonization, microplastics, settling velocity, optical measurement.

**PAPER ID:** CEST2019_00782

# A Model of Marine Litter in Sustainable Fisheries


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## ABSTRACT

This paper studies the dynamics of an economy specialized in fisheries facing a rising marine litter problem. We present a dynamic optimization model to explain the mechanism through which marine litter causes inefficiencies in the fishery sector. We study the dynamic properties of the model when the externality of marine litter is not taken into account and when it is internalized via the price of fish. We find that when the litter is internalized through the price of fish, the ocean quality is improved but fish catch decreases. We explore the possibility of introducing an incentive scheme where marine litter can be traded on a hypothetical market. The introduction of a market removes the inefficiencies caused by marine litter and provides the right incentive for fishermen to maximize the overall welfare.


**KEYWORDS:** marine litter, plastics, fishery sector, dynamic optimization, incentive scheme

**PAPER ID:** CEST2019_00502

# Adsorption of silver on virgin and aged Microplastics

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## ABSTRACT

When microplastics enter aquatic ecosystems they are submitted to environmental aging which change their properties. Especially colonization by microorganisms alter their properties in term of density and adsorption properties. Hence the aim of the study was to evaluate the adsorption and leaching properties of virgin and aged microplastics. Silver (in form of silver nitrate) was selected as a model metal used for adsorption study. Results showed that silver is quickly adsorbed on both types of microplastics while aged microplastics adsorbed significantly more silver than virgin ones. However, also leaching of silver from aged particles proceeds much faster - after 48 hours in Steinberg medium (pH = 5.8), only 23.7% of silver was leached out from virgin microplastics in comparison to 45.6% leached out from aged microplastics. In OECD medium (pH = 7.3) leaching was minimal. Our results showed that aging of microplastics and development of biofilm can significantly alter their properties and thus it is necessary to enhance our knowledge about microplastics' aging in the aquatic environment, which is still far from wellunderstood.

**KEYWORDS:** aging, adsorption, biofilm, microplastics, silver

**PAPER ID:** CEST2019_00289

# Investigating the Potential of UV-excited Photoluminescence Spectroscopy for the Identification of Plastics

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## ABSTRACT

In this study, we investigate photoluminescence (PL) spectroscopy with UV excitation as an alternative method for the detection and identification of plastic materials. The PL is excited at 266 nm. Spectra of the most widely used plastic materials are analyzed. Based on these results, it should be possible to develop a method to reliably identify different plastic materials in environmental samples solely based on their PL emission. In addition, this technique is inherently non-destructive and fast.

**KEYWORDS:** Plastics, Photoluminescence, Microplastics

**PAPER ID:** CEST2019_00805

# A Method for the Extraction of Microplastics from Solid Samples Using Olive Oil

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## ABSTRACT

Microplastics (MPs) extraction from sediment, sand and soil samples is a challenge that the scientific community is facing nowadays; currently there are no standardized and validated protocols and the most common methods rely on density separation techniques, often unable to separate high density polymers. The aim of the present work was to develop a non-density based, efficient and cost effective method. We tested an oil based extracting technique exploiting the oleophilic properties of plastic. Soil and marine and freshwater sand samples were spiked with 11 different kind of polymers: Polypropylene (PP), low density Polyethylene (LDPE), high density Polyethylene (HDPE), Polyurethane (PU), Polyethylene terephthalate (PET), Polystyrene (PS), Polycarbonate (PC), Polyamide (PA), Polyvinyl Chloride (PVC), Polymethyl Methacrylate (PMMA) and Polytetrafluoroethylene (PTFE). FTIR preliminary results show high recovery rates for almost all polymers except for PTFE. Further developments of this promising method are currently in progress.

**KEYWORDS:** Microplastics, Sand, Soil, Microplastics extraction, Microplastics quantification

**PAPER ID:** CEST2019_00898

# Session 5 - Advanced oxidation processes

## *Thursday 5 September 2019 - morning*

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# Micro-pollutants, Oxidants, Catalysts and the Water Matrix: A Harmonic Quartet or the War of the Roses?

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## ABSTRACT

Advanced oxidation processes (AOPs, e.g. heterogeneous and homogeneous photocatalysis, electrochemical oxidation, ozonation, ultrasound irradiation, Fenton and alike reactions, and many more) have been investigated for the treatment of emerging pollutants over the past 20 years (Klavarioti et al., 2009). In particular, the occurrence of persistence micro-pollutants in various water matrices, such as pharmaceuticals and personal care products, raises serious environmental concerns since these xenobiotics can re-enter the water cycle, i.e. escaping intact from the conventional wastewater treatment plants and finally ending up in surface and ground waters (Verlicchi et al., 2012).AOPs can effectively degrade organic pollutants typically found in environmental matrices (secondary treated effluents, surface waters, ground waters) at concentrations ranging from the ng/L to low mg/L level. This said, the specific treatment cost (i.e. the cost per unit mass of removed pollutant and/or per unit volume of effluent), as well as the environmental footprint are generally high; both are usually related to the treatment performance, which, in turn, depends on the specific treatment conditions and the quality of the water matrix.

**KEYWORDS:** competition; matrix; performance; synergy; wastewater

**PAPER ID:** CEST2019_00766

# US/$H_2O_2$ combined technology applied to the paracetamol oxidation

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## ABSTRACT

This study analyzes the colour acquired by oxidizing paracetamol aqueous samples through the combined US/$H_2O_2$ technology. When operating with only the action of the waves [US]=1.0 kWh/mmol $C_8H_9NO_2$, the water acquires progressively hue according to a ratio of 0.0004 AU/min, with a degradation output of 14%. Working under these conditions, the presence of hydroquinone, muconic acid and formic acid is evaluated. Colour formation presents a maximum intensity when water containing paracetamol is degraded using molar ratios of 1.5 mol $H_2O_2$/mol $C_8H_9NO_2$. This dosage leads to the formation of benzoquinone, as well as muconic and formic acids, reaching an efficiency of 30%. Oxidizing with 6.0 mol $H_2O_2$/mol $C_8H_9NO_2$, colour formation occurs slowly during the first hour of reaction, leading to the formation of benzoquinone, hydroquinone, acetamide, phoroglucinol and formic and muconic acids. This last one presents a molecular structure that is prone to reacting with other species that are present in the system forming complexes.

**KEYWORDS:** paracetamol; colour; hydrogen peroxide; reaction intermediates; ultrasounds waves

**PAPER ID:** CEST2019_00015

# Comparative Analysis of Chlorinated Intermediates Formed During Electrochemical and Photo(electro)catalytic Degradation of 4-Ethylphenol in Saline Media

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## ABSTRACT

Formation of toxic by-products, such as chlorinated intermediates, is one of the major drawbacks of advanced oxidation processes for saline wastewater treatment. Here a comparative analysis of electrochemical oxidation and photocatalytic degradation of 4-Ethylphenol, a nonchlorinated starting model compound of the group of alkylphenols, is presented. Main intermediates have been identified and quantified for brackish [0.03 mol*$L^{-1}$] and sea water [0.6 mol*$L^{-1}$] salt concentrations representative for the salt levels in various industrial effluents. Our comparison indicates that photocatalytic treatment (using $TiO_2$ photocatalysts) might be favorable over electrochemical treatments with Pt or BDD anodes due to the minor role of chlorination and the limited formation of chlorinated compounds in photocatalysis. Finally, using photoelectrochemical degradation an external surface recombination mechanism of photogenerated charge carriers will be presented explaining the absence of chlorinated compounds during photocatalytic wastewater treatment.

**KEYWORDS:** advanced oxidation process, photocatalytic degradation, electrochemical oxidation, chlorination, intermediates

**PAPER ID:** CEST2019_00206

# UV/$H_2O_2$ coupled with adsorption for decolorization of dye mixtures in water and phytotoxic effects

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## ABSTRACT

The present study reported the decolorization by UV/$H_2O_2$ of three dyes and their binary and ternary mixtures in water, simulating colored effluents of the textile industry. The effect of the initial concentration of $H_2O_2$, the initial concentration of dyes and the reaction kinetics in the decolorization of textile dyes in water was studied. The efficiency of decolorization of three treatment processes was compared (UV, $H_2O_2$ and UV/ $H_2O_2$). Moreover, after decolorization of the simulated waters by UV/$H_2O_2$ the effluents were then treated by adsorption using a commercial aluminosilicate and a silica gel (waste from industry). The phytotoxicity of the effluents was determined before and after adsorption treatment using the Raphanus sativus bioassay.

**KEYWORDS:** phytotoxicity, dye mixtures, decolorization, mineralization, AOPs.

**PAPER ID:** CEST2019_00227

# Electrochemical Treatment of Landfill Leachate under Cold Climate Conditions

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## ABSTRACT

This study shows that electrochemical oxidation of landfill leachate (LL) is significantly affected by cold temperatures prevailing in Nordic climate areas. As hypothesized, the degradation of common wastewater parameters (TOC, COD) exhibited lower efficiency when low average temperature (13°C) was applied than compared to room temperature (25°C). At low temperature, 35 % of COD and 64 % of TOC were removed, compared to 69 % of COD and 74 % of TOC removal at high temperature. Electrochemical oxidation of ammonium ($NH_4$) has also been observed, whereas only 1 % was removed at 13°C compared to 11 % at 25°C. In addition, the formation of three hazardous trihalomethanes (THMs) has been confirmed when a high current (7A) was applied, but THMs remained below the quantification limit of 3 ppb at low current (0.3 A). Even though kinetics decrease when cold temperatures are prevailing, electrochemical oxidation is considered still a suitable choice for the treatment of landfill leachate in areas with Nordic climate.

**KEYWORDS:** Electrochemical oxidation, pollutant removal, organic disinfection by-products, temperature, applied current

**PAPER ID:** CEST2019_00259

# Session 6 - Solid waste management

## *Thursday 5 September 2019 - morning*

# The role of End of Waste Criteria in the Framework of Circular Economy Strategy

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## ABSTRACT

More than 1.8 billion tonnes of waste are produced each year in Europe. This equals to 3.5 t per person and are mainly produced from commercial activities (e.g. shops, hospitals, restaurants), industry (e.g. clothes manufacturers, pharmaceutical companies), agriculture (e.g. slurry), construction and demolition projects, mining and quarrying activities from energy production as well as from household activities. Waste can be divided into several categories: municipal waste (including household and commercial), industrial waste (including manufacturing), hazardous waste, construction and demolition waste, mining waste, waste from electrical and electronic equipment (WEEE), biodegradable municipal waste, packaging waste, end-of-life vehicles and tires, agricultural waste. Article 6 in WFD (2008/98) defines that those wastes must be reduced as well as contain provisions to define end-of-waste criteria (EWC) that provide a high level of environmental protection and an economic benefit. Qualifications and requirements should be established in agreement with certain conditions described in the directive to check if specific waste streams have reached an end-of-waste (EoW) status. The main goal of EWC is to remove and eliminate the administrative loads of waste legislation for safe and high-quality waste materials, thereby facilitating and assisting recycling. The target is to produce effective with high quality of recyclables materials, promoting product standardisation and quality and safety assurance, and improving harmonisation and legal certainty in the recyclable material markets. At the same time EWC aim to develop a strategy plan in order to improve the expansion, progress and wider use of environmental technologies, which reduce pressure on environment and at the same time address the three dimensions of the Lisbon Strategy on growth, jobs and environment. EWC could be useful toll in the framework of circular economy strategy as affect several management systems, industrial processing, clean technologies. The presentation will analysis the role of EWC in the framework of Circular Economy through several case studies such as Tire Pyrolysis Oil, Compost etc.

**KEYWORDS:** end of waste, solid waste

**PAPER ID:** CEST2019_00980

# A Detailed Characterization of Household Municipal Solid Waste

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## ABSTRACT

Reliable data on Municipal Solid Waste composition are paramount for the development of environmentally sound, sustainable and economically viable integrated waste management systems. However, no standardized universally accepted waste characterization protocol has been developed, as there are various methodologies described in the relevant literature (Edjabou et al., 2015). In the present study, a generic and easy-to-apply waste sampling and sorting approach is developed and presented. The area of interest of the characterization was the Municipality of Halandri in Attica, Greece. The MSW composition characterization was necessary for the development of an innovative waste management strategy in the 670 sorting facility, where bins' material was sorted into 40 fractions and weighted. The results indicated a recycling rate up to 75% and a level of impurities in the recycling bins (blue and yellow) no more than 12%.

**KEYWORDS:** MSW characterization, MSW management, recycling rate

**PAPER ID:** CEST2019_00264

# An overview of the plastic waste and recycling status in Qatar

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## ABSTRACT

It has been estimated that the average Municipal Solid Waste (MSW) generation rate per capita in the Gulf Co-operation countries (GCC) is approx. 1.5 kg/person/d, with Qatar reaching almost 1.4 kg/person/d, as it was recently reported, thereby ranking the Gulf States in the top places of the most waste generating countries globally. Plastics, accounting for approx. 13–14% of the total MSW (in these countries), constitute both a significant amount and a valuable resource to be recovered. In the current work, an attempt is made towards delineating the plastic waste and recycling status of the country, based on recent governmental reports.

**KEYWORDS:** Plastic waste, Recycling, Recovery, Qatar, Circular Economy

**PAPER ID:** CEST2019_00670

# On the positive influence of Pd species on low-density polyethylene cracking

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## ABSTRACT

Microporous 12-ring zeolite Beta was impregnated with palladium and evaluated in the cracking of low-density polyethylene (LDPE) cracking. In addition to the catalytic measurements the materials were characterized by X-ray diffraction, chemical analysis and nitrogen adsorption, electron microscopy, and FT infrared spectroscopic studies pyridine and CO adsorption. In addition to TGA catalytic studies, the operando IR studies were furthermore performed to follow the aromatic species formation. Deposition of palladium on microporous zeolite BEA improved the catalytic activity and selectivity towards C2-C4 fraction.

**KEYWORDS:** LDPE cracking, zeolite, in situ and operando IR spectroscopy

**PAPER ID:** CEST2019_00694

# Bottom-up synthesized hierarchical Beta zeolites as the catalysts for low-density polyethylene cracking

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## ABSTRACT

Improving mass transport in zeolites Beta by bottom-up hierarchization was aimed at preserving their native microporous acidic characteristic and finally demonstrating their applicability in LDPE catalytic pyrolysis, in contrast to top-down modified analogues.

**KEYWORDS:** hierarchical zeolites Beta, LDPE cracking, IR spectroscopy

**PAPER ID:** CEST2019_00695

# Compost Quality Assessment of Various Agricultural Wastes and Organic Manures

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## ABSTRACT

Today the quality of compost is the most essential criterion in recycling organic wastes, as well as its marketing and utilization in agriculture. Environmentally safe recycling of organic waste to agricultural land could be crucial to sustaining soil productivity in Mediterranean areas, where soil organic matter content is very low. The present study discusses variations in some quality parameters of compost produced using various organic combinations. Over a period of 120 days, special attention was given to monitoring compost quality parameters, including: temperature, dry matter, pH, electrical conductivity (EC), microbial counts, organic matter (OM), organic carbon (OC), $NH_4$, $NO_3$, C:N ratio, macronutrients (NPK), and micronutrients (Fe, Mn, Zn, and Cu). The results revealed that almost all of the investigated parameters showed remarkable changes during compost formation. Agricultural wastes in the presence 10% poultry manure was comparatively of superior quality in terms of the availability of macro and micronutrients as well as microbial activity. However, agricultural wastes with 10% mixture of sheep and camel manure was found to be superior in terms of OM, OC, C:N ratio and yielded the highest bacterial counts. Compost quality depended on the base materials used, the duration and conditions of decomposition.

**KEYWORDS:** Compost, Degradation, Manure, Organic Wastes

**PAPER ID:** CEST2019_00146

# Session 7 - Wastewater treatment

## *Thursday 5 September 2019 - morning*

# Aerobic degradation of tetramethyl ammonium hydroxide (TMAH) from effluents of semiconductor industries: kinetic studies of laboratory and pilot experiments

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## ABSTRACT

Aerobic degradation of effluents contains tetramethylammonium hydroxide molecules (TMAH), coming from an electronic industry, was studied at laboratory and pilot scale. At the first, the preliminary experiments were conducted using a lab scale reactor inoculated with activated sludge coming from urban wastewater treatment. Several batches have been performed on real effluent, in which TMAH concentration was about 1800 mg/L. The results showed that after acclimation, the microorganisms removed 99% of TMAH in seven days. Kinetic studies have provided the following kinetic parameters able to describe the trends of TMAH, ammonium ions and biomass concentration as a function of time in the reactor: KS = 0.8 g/L; μmax = 0.042 $h^{-1}$. Then, in a second phase the experiments were conducted at pilot scale using a pilot plant realized within Life Bitmpas project (LIFE15 ENV/IT/000332). The plant has three biological reactors of 1 m3 and it is possible to feed up to 25 L/h of TMAH effluent. The experiments were conducted in a continuous mode and the results showed that in 8 days the total degradation of TMAH was 99%; moreover, from kinetic study have been determined the following kinetic parameters: Ks = 0. 83 g/L and μmax = 0.0074 $h^{-1}$.

**KEYWORDS:** TMAH, Aerobic process, Biological degradation, Kinetic modelling, pilot experiments

**PAPER ID:** CEST2019_00337

# Tuning of an Advanced Control System on a Membrane Process for Tannery Wastewater Purification and Chromium Recovery Purposes

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## ABSTRACT

Tannery wastewater represent a hazard to the environment due to its high content of chromium. Conventional methods to purify this wastewater stream are available, but not capable to recover back chromium to the tannery process. Membranes appears to be a promising technology to achieve both targets of water purification and recycling of chromium. The economic feasibility of the here proposed process relays on fouling minimization, in order to maximize the life of the employed membrane modules and as a consequence to keep the operational costs low. The use of an advanced control system capable to predict fouling incurrence and to adapt the operating conditions to sub-boundary ones appears to be the best strategy. In this work, the proposed process, including the advanced control system, was simulated within HYSYS. By means of performed simulation runs, it was possible to avoid irreversible fouling operating conditions, still obtaining an adequate level of tannery wastewater treatment and relevant chromium recovery rates. Both the predictive and the adaptive part of the control system exhibits high reliability. The developed strategy appears therefore promising to encourage the use of membrane technologies for this application with feasibility from a technical and economic point of view.

**KEYWORDS:** advanced control system, tannery wastewater, membranes, fouling, chromium recovery

**PAPER ID:** CEST2019_00356

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# Unbiodegradable Soluble COD Removal from Industrial Wastewater by a Hybrid Moving Bed Biofilm Reactor

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## ABSTRACT

In this study, plastics industry wastewater (PIWW) characterized by high total and soluble chemical oxygen demand (tCOD and sCOD, up to ~2200 and ~1500 mg/L, respectively) and remarkable unbiodegradable soluble COD (usCOD, 508±224 mg/L, 31±14% of tCOD) concentrations was treated at laboratory scale using a hybrid moving bed biofilm reactor (MBBR). Interestingly, the MBBR showed average tCOD, sCOD and usCOD removal efficiencies of 26±6, 32±11 and 36±11%, respectively, which were comparable to those achieved by the coagulation/flocculation pre-treatment currently applied at full-scale. Such results encourage the application of MBBR as a cost-effective option for the removal of recalcitrant soluble organics from PIWW and other similar industrial wastewaters.

**KEYWORDS:** industrial wastewater, MBBR, plastics industry, recalcitrant organics, usCOD

**PAPER ID:** CEST2019_00483

# Characterization of Activated Carbon Prepared from Aegina Pistachio Shells for Hg Removal

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## ABSTRACT

Preparation of activated carbon from agricultural bioproducts is a promising way to produce useful adsorbents for Hg removal. In this study Aegina pistachio shells were used as raw materials and the activation was carried out by impregnation with $ZnCl_2$ and heating at 750 °C under $N_2$ atmosphere. Three different levels of impregnation ratios (IR) were used for the chemical activation procedure, i.e. IR 1.0, 1.5 and 2.0 grams of $ZnCl_2$ per gram of raw material. Further sulfurization treatment of the chemically activated carbons was also examined as a means to improve the adsorption capacity of activated carbons toward Hg. Overall six different types of activated carbons were produced and characterized regarding their physicochemical properties and their capacity to adsorb mercury. The specific surface area was determined by the BET method. The amount of acidic and basic function groups was determined with Boehm method and the surface chemical characteristics of activated carbons were investigated using the FT-IR spectroscopic method. Preliminary Hg adsorption experiments indicated that the sulfur modified carbons were much more efficient for the removal of Hg from aqueous streams compared to simple chemically activated carbons.

**KEYWORDS:** activated carbon, sulfur modification, characterization, mercury adsorption

**PAPER ID:** CEST2019_00539

# Monitoring of Treated Domestic Wastewater Quality

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## ABSTRACT

Cyprus is experiencing severe water supply deficiency. Particularly in summer months the situation is aggravated mainly due to low precipitation, high evaporation and increased demands for irrigation and tourisms. The use of treated wastewaters for environmental purposes such as recharging aquifers, agricultural irrigation and municipal landscape is highly contributing in the scarcity problem. In Cyprus there are 8 large urban plants and 25 small community plants for domestic waste treatment. Various chemical analysis including Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), suspended solids, anions, total phosphorus, total nitrogen, toxic metals, pesticides and polycyclic aromatic hydrocarbons (PAHs) are contacted to ensure the quality of the treated wastewater. Instrumental techniques like ion chromatography, ICP, GC-MS and HPLC-fluorescence are used to determine ions, metals, pesticides and PAH,'s. In this study, the results of these analyses are presented for treated urban wastes. Heavy metals, boron, pesticides and PAHs are found in low concentrations ranging from low micrograms to milligrams per liter.

**KEYWORDS:** treated wastewater quality, monitoring, organic pollutants, inorganic pollutants

**PAPER ID:** CEST2019_00235

# Impregnated Resins as Novel Sorbents for Removal of Toxic Metal Ions from Aqueous Solutions

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## ABSTRACT

In this study the performance of impregnated resin was evaluated as the sorbent for the removal of lead ions from aqueous solutions. It was observed that the lead removal efficiency depends on the sorbent dose, initial concentration of metal ions, pH of water and the contact time. The results of batch experiments showed the highest removal efficiency of Pb(II) ions from water (>99%) at L:S =100:1 for the following conditions: initial concentration of metal ions of 10 mg/dm$^3$, pH = 6, and contact time of 60 min. The experimental equilibrium data were also described by sorption isotherms. Impregnated resin as novel sorbent has been found efficient and easily regenerable and can be used several times.

**KEYWORDS:** impregnated resin, sorption, macrocyclic ligand, lead ions

**PAPER ID:** CEST2019_00245

# Membranes Removal of Toxic Metal Ions through Polymer Inclusion Containing Macrocyclic Ligands as Carriers

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## ABSTRACT

More strict environmental regulations on the discharge of toxic metals require developing various technologies for their removal from polluted streams. The separation of toxic metal ions using immobilized membranes with doped ligands, due to their high selectivity and removal efficiency, increased stability, and low energy requirements, is promising for improving the environmental quality. Cellulose triacetate-based polymer inclusion membranes (PIMs), with macrocyclic ligands as ion carriers, were studied for their ability to transport of toxic metal ions from aqueous solutions. The effect of concentration of ion carrier, pH of source aqueous phase, stripping agents on the effective transport of toxic metal ions have been assessed. All studied parameters were found to be important factors for the transport of toxic metal ions. The initial flux was determined for different conditions of transport through polymer inclusion membranes. The newly developed PIM containing macrocyclic ligands were found to be stable and highly permeable. Moreover, the prepared membranes could be potentially suitable for multiple use process for efficient removal of toxic metal ions from aqueous solutions.

**KEYWORDS:** macrocyclic ligands, polymer inclusion membranes, toxic metal ions

**PAPER ID:** CEST2019_00254

# Session 8 - Life cycle analysis (LCA)

## *Thursday 5 September 2019 - morning*

# Regional Variability and Future Trends in Carbon Footprints of Electric Vehicles in China Based on THEMIS Model

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## ABSTRACT

This study analyses how carbon footprints of electric vehicles (EVs) in China vary across regions and how they may evolve with power decarbonisation. It is understood that carbon footprints of battery electric vehicles (BEVs) depend largely on electricity mixes, but few studies have quantified their interregional divergence and future changes in China. Using THEMIS model as an integrated LCA framework, together with future electricity mixes from MESEIC, a cost optimisation model for the power sector, we calculate current and future carbon footprints of passenger vehicles in China. Results show that, carbon footprints of BEVs across all the 6 regions will drop from 265-419 $gCO_2e/km$ in 2017 to 116-383 $gCO_2e/km$ in 2050, or 141-266 $gCO_2e/km$, with stringent carbon constraints applied to the power sector. The interregional divergence of BEV carbon footprints will shrink by 20% in the latter scenario. Under carbon constraints, BEV carbon footprints in East, Central, Northwest, and South will have their best-case reduction potentials, by 55%, 55%, 46%, and 5% respectively. Stringent carbon constraints lead to increased share of coal-based generation in North and Northeast, whose most favourable reduction potentials will be 42%, and 69%, respectively, when no carbon constraints exist.

**KEYWORDS:** Integrated hybrid life cycle assessment, MESEIC energy scenarios, carbon footprint, electric vehicles, regional variations

**PAPER ID:** CEST2019_00479

# Sustainability analysis of a bean stew using Environmental LCA and Life Cycle Cost Assessment

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## ABSTRACT

This investigation aims to investigate the sustainability of an industrially produced bean stew, as a representative example of the ready-made food industry. The analysis covers the environmental and economic dimensions of the products, which were evaluated using Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), respectively. Key results have shown that most of the environmental impacts and economic costs of this product are attributable to the ingredients, primarily those of animal origin.

**KEYWORDS:** LCA, LCC, cooked food, sustainability, bean stew

**PAPER ID:** CEST2019_00812

# Environmental, economic and socio-economic life cycle assessment of the Spanish electricity system

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## ABSTRACT

This paper investigates the sustainability of the Spanish electricity system under four different scenarios for 2030 and 2050 published by a reputable think tank assessing the Spanish Government. The analysis was performed using a life cycle approach and evaluates five sustainability indicators: overall carbon footprint, carbon footprint per MWh, overall economic costs, LCOE and job creation. The results evidence that the most ambitious scenarios (100 % share of renewables) produced the best results in terms of environmental and socio-economic performance (10-fold reduction of GHG emissions and 15-fold increment in employment compared to 2015) but involved higher costs (15 €/ MWh more expensive).

**KEYWORDS:** LCA, electricity, sustainability, carbon footprint, employment, LCOE.

**PAPER ID:** CEST2019_00813

# Methodology development for implementing Life Cycle Analysis of energy production in the Czech Republic

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## ABSTRACT

Energy mix of the Czech Republic includes various types of fossil energy sources, which currently do not have comprehensive methodology for assessing their environmental impacts. Life Cycle Assessment (LCA) is important tool for assessing such impacts through the whole life cycle of the sources. Ongoing national project "LCA of energy production in the Czech Republic" is focusing on implementing LCA on several case studies to analyze and compare different national energy sources and technologies from environmental point of view through the three phases of the life cycle – construction, operation and decommissioning. Such an extensive study requires development of methodology which covers necessary technological boundaries and parameters, as well as general principles of LCA methodology. The paper depicts the procedure of the methodology development for implementing LCA tool for energy production of various fossil, nuclear and renewable sources. Methodology will focus on technological and inventory criteria, LCA boundaries for various sources, selection of functional unit and identification of specific problems regarding LCA of energy sector.

**KEYWORDS:** Energy sources, life cycle assessment, energy production, sustainability

**PAPER ID:** CEST2019_00199

# Approaches to Tackle Emerging Challenges in European Aquaculture

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## ABSTRACT

The word demand for fish is increasing. Whilst on one hand, fishing is carried out in a not sustainable ways in the main fishing areas (e.g., overexploitation of natural stocks, remarkable fuel and energy consumption), on the other hand, aquaculture, above all when not performed inland, involves environmental concerns related to the emissions of pollutants in the sea, low resource efficiency and the high consumption of chemicals. Thus, aquaculture should aim to reduce its environmental impact and to produced fish and seafood in a circular economy perspective. This contribution focuses on different approaches to tackle two environmental issues related to aquaculture in Europe: 1) the reduction of impact due to aquaculture farming of edible species and 2) the improvement of the farming of a cleaner fish species to reduce the overexploitation of natural stocks and to solve the dramatic problem of sea lice in Atlantic salmon farming. The first approach aims at developing selfsufficient multi-trophic systems for inland aquaculture in Mediterranean areas. The second approach aims at optimizing the farming of the lumpfish that is used in sea net pen as a killer of salmon sealice. The description of the planned approaches and preliminary results of the SIMTAP (Self-sufficient Integrated Multi-Trophic AquaPonic) project and lumpfish aquaculture, including future challenges and research directions, are reported.

**KEYWORDS:** Aquaculture, salmon, environmental impact, multi-throphic system

**PAPER ID:** CEST2019_00704

# Environmental and Economic Life Cycle Inventory of Brussels Sprouts

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## ABSTRACT

This investigation describes de material, energy and monetary inventories required to evaluate the environmental and economic performance of Brussel sprouts produced in Mexico and consumed in the USA. This data was supplied by a company operating in Mexico as a first step in the production of a LCA and LCC analysis according to ISO 14040-14044: 2006. The inventory covers the following stages in the life cycle of the product: seeding, soil preparation and conditioning, cultivation (fertilization, fumigation and irrigation), harvesting, processing, packaging, internal transport and distribution.

**KEYWORDS:** Inventory, LCA, LCC, Brussel sprouts, sustainability, cabbage.

**PAPER ID:** CEST2019_00837

# Life cycle assessment analysis for remediation technology choice: a case study

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## ABSTRACT

Life Cycle Assessment (LCA) may be helpful in the choice of a remediation technology, because remediation itself entails impacts. Presently, government and public institutions involved in the decisional workflow focused their attention on minimizing risks at site and for the receptors but do not consider environmental effects. The aim of this study was to compare the estimated Global Warming Potential (kgCO2eq.) for dig&dump vs off site soil washing configuration, from a site contaminated by heavy metals. For a significant comparison, all the obtained values were normalized for the m3 of soil to treat. The analysis, conducted with a cradle to grave approach, showed a clear advantage in soil washing technology with an associated GWP of 29,36 $kgCO_2$ $eq/m^3$ versus 1724 $kgCO_2eq/m^3$ associated to dig & dump.

**KEYWORDS:** Soil washing, Life Cycle Assessment, Global Warming Potential

**PAPER ID:** CEST2019_00690

# Environmental and Economic LCI of a micro-CPV module

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## ABSTRACT

Despite the renewable nature of solar energy, the sustainability of photovoltaic (PV) systems needs to be evaluated in order to minimize adverse environmental impacts and optimize economic performance. This piece of research represents a first approach to produce an environmental and economic assessment of a 1.0 m 2 (350 W) micro concentrator PV (microCPV) module designed at Institute of Solar Energy (IES-UPM) in Spain. The incorporation of concentrating lenses allows this technology to produce electricity from direct solar radiation at higher efficiencies than conventional PV cells. The aim of this work is to propose a representative architecture for the micro-CPV system that allows the quantification of a material, energy and economic Life Cycle Inventory (LCI), as the basis to conduct a Life Cycle Cost Assessment (LCC) and an Environmental Life Cycle Assessment (LCA).

**KEYWORDS:** LCI, LCA, LCC, microCPV, sustainability.

**PAPER ID:** CEST2019_00931

# Session 9 - Soil and groundwater contamination and remediation

## *Thursday 5 September 2019 - morning*

# Isolation and optimization of microbial consortia for the biodegradation of two persistent fluorinated fungicides

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## ABSTRACT

Microbial consortia capable of completely removing and defluorinating two persistent fluorinated fungicides, epoxiconazole (EPO) and fludioxonil (FLU), were enriched from an estuarine sediment and an agriculture soil. The enrichments were conducted along 6 months, during which the fungicides were supplemented individually to the cultures every 21 days at 5 $mgL^{-1}$, using sodium acetate as a co-metabolite (fed twice a week at 400 $mgL^{-1}$). Biodegradation of EPO and FLU was detected early on the enrichment phase and a gradual increase on their performances was observed throughout this period. After ca. 5 months, the complete removal and defluorination of EPO and FLU was observed for all cultures in a period of 10-15 days. These biodegradation efficiencies were found to be similar in the absence of a co-metabolite. The two pesticides were efficiently biodegraded at concentrations up to 10 $mgL^{-1}$. By estimating the biodegradation kinetics of the enriched consortia, it was possible to determine half-life values significantly lower than those reported in the literature for these pesticides, rendering EPO and FLU as non-recalcitrant under these experimental conditions. 16S rDNA analysis showed that these consortia harbor bacteria belonging to the Proteobacteria phylum. Current work is focused on the optimization of the degrading consortia and on the elucidation of the metabolic pathways of these pesticides.

**KEYWORDS:** biodegradation, defluorination, fungicides, microbial consortia, persistent organic pollutants

**PAPER ID:** CEST2019_00628

# Per-and polyfluoroalkyl substances (PFAS): an emerging contaminant

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## ABSTRACT

PFAS compounds are ubiquitous in the environment and in consumer products. Unlike other emergent contaminants this is a family of compounds with, literally, thousands members. Our knowledge of toxicological and environmental fate and transport properties is an evolving field. On the other hand, regulatory limits (when they exist) are extremely low and address only a limited handful of compounds. Because of their physical-chemical properties there are unconventional migration pathways, such as sewer exfiltration and biosolids residuals, that complicate site assessment and site closure. Surveys to date in Greece are fragmented and very limited in scope and focus. The objective of this study is to discuss how professional judgement should be used to collect appropriate data to both define the nature and extent of impact and to assess whether receptors may be adversely impacted and how to select an appropriate remedy, if mitigation of those impacts is warranted.

**KEYWORDS:** Drinking water, PFAS, conceptual site model (CSM), Greece

**PAPER ID:** CEST2019_00463

# Lessons from long-term field phytostabilisation studies

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## ABSTRACT

Smelter waste deposits or soils near smelters that are heavily polluted pose a threat to environment and human health worldwide. There is limited availability of long term phytostabilization field studies evaluating and documenting persistence of tested remediation methods. The paper combines experience from greenhouse testing of most effective soil amendments and long-term field experiments aimed at optimizing phytostabilisation of toxic smelter waste deposits. We compared the impact of novel soil amendments and their combinations with traditional materials on metal solubility and the response of plants, soil organisms and microbial activity. Field evaluations involved long-term smelter wasteland site reclaimed with biosolids and by-product limestone combined with implementation of resistant grass species. The data on metal extractability and bioavailability, plant cover, microbial activity, abundance and biodiversity is presented.

**KEYWORDS:** gentle remediation, smelter wasteland, soil amendments, trace elements

**PAPER ID:** CEST2019_00577

# Analysis of hydrochemical time series


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## ABSTRACT

Agricultural activity of spreading fertilizers may, in case they are washed away to an aquifer, result in a groundwater contamination. There was a research conducted in Croatia on the lower part of the Danube Sava canal which is occupied by extensive agricultural production to measure the groundwater pollution by nitrate nitrogen, ammonia nitrogen and phosphate. Amounts of these nutrients were measured six times per year over the period of fifteen years (2004.-2018.) by installed hydrogeological piezometers. The obtained data, given for a relatively long period of time, were analysed by methods of time-series to determine trends. It was established that although concentrations of nitrate and ammonia nitrogen occasionally exceeded the value of maximum allowable concentration, long term trends of all pollutants are still slightly decreasing.



**KEYWORDS:** groundwater contamination, nitrate and ammonia nitrogen and phosphate concentration, time series analysis

**PAPER ID:** CEST2019_00116

# In-Situ Removal of Antibiotics in Soil by Cold Plasma

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## ABSTRACT

Cold atmospheric plasma (CAP) was examined for the remediation of antibiotic ciprofloxacin-polluted soil. Experiments were conducted in two different electrode configurations of dielectric barrier discharge (DBD) reactors (i.e. cylinder-to-cylindrical grid and plane-togrid) driven by a high voltage nanosecond pulse generator. The aforementioned DBD reactor configurations correspond to ex-situ and in-situ soil remediation, respectively. Initial concentration of ciprofloxacin in soil was 200 mg/kg, and the effect of CAP operating conditions such as treatment time, applied voltage and pulse frequency were investigated and optimized. Increase of pulse frequency, applied voltage and plasma treatment time resulted in the increase of degradation efficiency of ciprofloxacin. In the plane-to-grid reactor, ciprofloxacin was completely removed after 5 minutes of CAP treatment in the optimized conditions. In addition, preliminary results showed that complete removal of ciprofloxacin can be also achieved in the cylinder-to-cylindrical grid reactor, indicating that DBD can be also applied for the in-situ remediation of ciprofloxacin-polluted soils.

**KEYWORDS:** Soil remediation; DBD plasma; Ciprofloxacin; Antibiotics

**PAPER ID:** CEST2019_00603

# Bioaugmentation process for PAHs contaminated soil remediation through microbial inocula from anaerobic treatment of lignocellulosic substrate

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## ABSTRACT

In the present work, an anaerobic bioremediation treatment was investigated for reclamation of polycyclic aromatic hydrocarbons (PAHs) contaminated soil. The PAHs contaminated soil was artificially prepared and seven different contamination conditions were tested. In particular, four soils were contaminated solely by naphthalene (A), anthracene (B), pyrene (C) and benzo[a]pyrene (D), respectively, whereas, three soils were contaminated by benzo[a]pyrene coupled with one of the other investigated PAHs (i.e. A+D, B+D, and C+D tests). Such conditions were tested in order to study the possible degradation kinetic for the single involved PAH (with aromatic rings ranging from 2 to 5) as well as for PAHs mixed with a 5-aromatic rings contaminant (i.e. benzo[a]pyrene). The investigated treatment was carried out in bioaugmented condition through two microbial inocula obtained from anaerobic digestion tests on lignocellulosic substrate. In more detail, the two inocula were differently enriched through experiments characterized by sequential re-inoculation on new substrate, for its subsequent treatment, every 24 h and 96 h, respectively. The present study focused on the PAHs degradation efficiency and pathways, and microbiological abundance characterization, thus providing a comprehensive and interdisciplinary view to assess the feasibility of the suggested treatment in the field of PAHs contaminated soil remediation.

**KEYWORDS:** Polycyclic aromatic hydrocarbons, Contaminated soil reclamation, Bioaugmentation, Anaerobic bioremediation

**PAPER ID:** CEST2019_00208

# Cooperation of bacteria and fungus on polycyclic aromatic hydrocarbons degradation

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## ABSTRACT

Polycyclic aromatic hydrocarbons are diverse family of hydrophobic organic pollutants. They can be removed from environment by bacterial degradation. One of the process which could limit biodegradation is transfer of hydrophobic contaminants in to aqueous phase were degrading microorganisms live. In this work we would like to evaluate possible role of fungi in increasing transport of hydrophobic pollutants such as polycyclic aromatic hydrocarbons in to the aqueous phase. Increased transport should result in increased degradation of contaminants in our case polycyclic aromatic hydrocarbons.

**KEYWORDS:** bacterial degradation, mycelia, transport, PAH

**PAPER ID:** CEST2019_00815

# Origin of Cr in alluvial sediments and ultramafic rocks in Sultanate of Oman. Magnetic fractionation and sunlight effect

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## ABSTRACT

The present study attempts to identify the sources of Cr(VI) in a coastal alluvial fan soil and soil from a chromite mine. In addition investigates the effect of photochemically oxidized organic matter in the Cr(VI) mobilization in soil. The alluvial bulk soil samples contain several evidence of weathered products of the ophiolite nappe like serpentine and amphiboles. For better characterization we separated different soil fractions with magnetic separation. The results showed that magnetic fraction exhibits high amount of serpentine. The XRFanalysis showed Mg and Cr to be enriched on average by 2.5 and 6 times, respectively. The produced fractions were mixed with glucose to simulate organic carbon and then leached with $KH_2PO_4$ /$Na_2HPO_4$ for the exchangeable Cr in all fractions before and after the exposure of the samples in the sun for several days. The results showed that soils from chromite mine were influenced by oxidation of organic matter with 20-30% reduction in Cr(VI) release, while alluvial fun soils showed very high capacity to immobilize Cr(VI) without any effect from organic matter oxidation.

**KEYWORDS:** Geogenic chromium, serpentine, ophiolite, oxidation.

**PAPER ID:** CEST2019_00817

# Quntitative PCR as a tool for analysis of diversity in soil microbiome

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## ABSTRACT

Majority of terrestrial soils are used primarily for agricultural production. The main factor of soil fertility is mediated by soil microorganisms and invertebrates. Soil microorganisms plays crucial role in ecosystems nutrient cycling and therefore any change in their diversity could have serious consequences on soil fertility and agricultural yields. Silver nanoparticles as novel potentially nontoxic compounds are nowadays used in many daily use products and also as pesticides. But based on their antimicrobial activity, they can adversely influence structure of soil microbiome. Our work is focused on qPCR analysis of soil microbiome diversity with and without silver nanoparticles treatment. Phylogenetic analysis revealed concentration dependent shifts in microbial diversity, usually in the favor of one phylogenetic group of bacteria or fungi and analysis of melting curves showed changes inside individual phylogenetic groups.

**KEYWORDS:** nanoparticles, soil microbiome, phylogenetics

**PAPER ID:** CEST2019_00818

# Complex approach for analysis of changes in soil microbiome

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## ABSTRACT

In the few past decades, genetic approaches for analysis of soil microbiome, e.g pyrosequencing, gained major attention and cultivation techniques were pushed into the background. The combination of several techniques could be useful and cheap approach for analysis of changes in soil microbiome. In our study of effect of silver nanoparticles on soil microbiome we exploited classical microbiological and biochemical methods for assessment of microbial structure. Effect caused by addition of silver nanoparticles was concentration dependent, the highest concentration of silver nanoparticles caused, besides the others, significant decrease in dehydrogenase activity of soil microorganisms. Concentration dependent changes in soil microbiome were also detected, e.g. in total numbers of cultivable microorganisms, cellulolytic or peroxidase. CLPP indicated significant shift in microbial diversity in all levels of substrate utilization.

**KEYWORDS:** nanoparticles, soil microbiome, toxicity

**PAPER ID:** CEST2019_00819

# A pilot test in Eastern Bohemia for chlorinated aliphatic hydrocarbons groundwater remediation

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## ABSTRACT

The bioremediation of chlorinated solvents is considered as cheap and eco-friendly approach, among the bioremediation techniques the stimulation of organohalide-respiring bacteria by adding substrates is considered as one of the most popular methods. Application of cheese whey was performed in three separate rounds via direct-push technique. Monitoring of groundwater was performed once before the first injection of cheese whey in November 2017 and then monthly until April 2019. Groundwater samples were analyzed for chlorinated ethenes, its bioremediation byproducts and this analysis were correlated with the biological activity on the site that was assessed with the use of PCR and next-generation sequencing tests.

**KEYWORDS:** Bioremediation, Cheese whey, BMT, Groundwater

**PAPER ID:** CEST2019_00918

# Session 10 - Heavy metals in the environment

## *Thursday 5 September 2019 - morning*

# Biomarkers responses in Salmo salar exposed to multicomponent metal mixtures

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## ABSTRACT

Pollution of freshwater from industrial, domestic and agriculture sources is one of the major factors responsible for the decline of Atlantic salmon (Salmo salar) populations in Europe. Biomarkers responses (bioaccumulation, glucose content, cytogenetic and behavioral endpoints) elicited by the most common metal contaminants at Maximum-Permissible-Concentrations (MPC: Zn – 0.1, Cu – 0.01, Ni – 0.01, Cr – 0.01, Pb – 0.005 and Cd – 0.005 mg/L) accepted for the inland waters in EU was assessed in fish after 4 h, 1, 2, 4, 7, 14 or 28 days of exposure. Experimental studies were performed using whole mixture approach and by reducing environmentally realistic concentration of single metal in the mixture by 10-times (represents background exposure in the aquatic environment). Bioaccumulation of metals was assessed in gills, liver, kidneys and muscle tissues. In the most of the investigated tissues, steady-state metals concentrations were reached within 14 days. All metals have attained steady-state in muscle. Metal mixture at MPC and 10-fold reduction of single metal in the mixtures significantly affected cytogenetic, behavioral endpoints, blood glucose content and bioaccumulation of several metals in analysed tissues of fish. Therefore, discharges of metals at MPC into the aquatic environment can lead to health problems of juvenile S. salar.

**KEYWORDS:** bioaccumulation, steady-state, genotoxicity, cytotoxicity, behavioral alterations.

**PAPER ID:** CEST2019_00106

# The effect of the presence of zinc on the precipitation of CaCO3 from supersaturated solutions

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## ABSTRACT

Precipitation and dissolution processes of calcium carbonate in natural aquatic systems, are responsible not only for the regulation of pH but also for the transport of pollutants to and from sediments. Of interest in these processes, is the role of the presence of heavy metals in the aquatic environment. In the present work the mechanism of calcium carbonate formation from supersaturated solutions in the absence and presence of zinc (II) was investigated at 25°C, pH 8.50, 0.1M NaCl, at conditions of constant supersaturation. Kinetics analysis suggested that the precipitation of calcium carbonate both in the absence and in the presence of zinc over a concentration range 10-30 mM, is controlled by surface diffusion. The presence of zinc in the supersaturated solutions reduced the rate of crystal growth of the calcite seed crystals and the rate reduction was smaller the higher the solution supersaturation. The inhibition was probably due to the adsorption of zinc species to the active sites of crystal growth of the seed crystals. Provided that the adsorption could be described according to the Langmuir model, the assumption was justified both by fitting kinetics data of calcium carbonate crystal growth and by independent equilibrium adsorption studies.

**KEYWORDS:** calcium carbonate, precipitation of, inhibition of, zinc, adsorption

**PAPER ID:** CEST2019_00168

# Nano-Iron Based Coated Biomass as Packing Material in Fixed-Bed Reactors for Lead Removal from Wastewater: Experimental and Mathematical Modelling

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## ABSTRACT

The lead pollution of natural environments is considered a severe issue due to the high toxicity and mobility of lead ionic species. The present study deals with the removal of Pb(II) ions from synthetic wastewater by means of iron-based coated hazelnut shells, used as packing material in lab-scale fixed bed columns. The biomass was coated through the direct precipitation of nano-iron oxide nanoparticles and demonstrated a notable Pb(II) sorption capacity. In detail, the continuous experiments showed a Pb(II) removal efficiency of 80% at an initial Pb(II) concentration of 50 mg/L, a bed height of 6 cm and an inlet flowrate of 4 mL/min. Different operating parameters values were varied (initial Pb(II) concentration, inlet flowrate and bed height) at pH>pH of zero charge of the packing material. The obtained breakthrough curves were fitted by suitable dynamic models, to obtain the regressed model parameter values for a subsequent pilot-scale process simulation and scaleup.

**KEYWORDS:** Lead; fixed-bed reactor; continuous-process; laminar-flow; nano-iron coating.

**PAPER ID:** CEST2019_00334

# Research on the ability of urban trees to retain heavy metals. A silvicultural approach


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## ABSTRACT

The purpose of the present research was to study the ability of urban trees' leaves to retain heavy metals. Three major heavy traffic streets of Thessaloniki were chosen. Two tree species were studied: Ailanthus altissima (Mill.) Swingle and Catalpa bignonioides Walt. and 360 leaf samples were collected from 20 trees. The selection of the species was carried out according to their leaf morphology and silvicultural characteristics. Also, for each tree were measured: breast diameter, tree height, crown height, crown's diameter and then crown volume was calculated. Two treatments were applied (washed and unwashed leaves). The following heavy metals were measured: iron (Fe), zinc (Zn), manganese (Mn), copper (Cu), cadmium (Cd), cobalt (Co), chromium (Cr), nickel (Ni) and lead (Pb) and the metal concentration was determined with the use of ICP-OES inductively coupled plasma optical emission spectrometry. The concentrations of heavy metals were significantly related to the species for the heavy metals: iron (Fe), manganese (Mn), cobalt (Co), chromium (Cr), nickel (Ni), lead (Pb). Catalpa bignonioides captured the highest concentrations of heavy metals. Finally, the morphological characteristics of leaves and not the silvicultural characteristics of species are the factors that influence their ability to retain heavy metals.



**KEYWORDS:** urban trees, air pollution, heavy metals, morphology of leaf, silvicultural characteristics

**PAPER ID:** CEST2019_00494

# Cobalt and Phosphorous Recovery from Semiconductor Wastewater through Homogeneous Crystallization of Cobalt Phosphate in a Fluidized-bed Reactor

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## ABSTRACT

Semiconductor manufacturing involves distinct processes that generate complex wastewater streams that require treatment before it proceeds to the main wastewater effluents. The present study utilized fluidized-bed crystallization to recover resources from the combined synthetic wastewater of chemical-mechanical polishing and etching processes. The study aims to determine the operational conditions to achieve optimum recovery and removal. Maximum removal and granulation of ~99.0% and 96.07% were realized at pHi range of 7.75 – 8.0 and $[PO_4^{3-}]/[Co^{2+}]$ ratio of 2.0, respectively. Phosphate concentration in etching stream was reduced from 14.0 mM to $[PO_4^{3-}]$d of 1.02 mM at optimal conditions. Uniform crystal size of 0.7 mm diameter was attained at hydraulic retention time of 15 min, upflow velocity 34.38 – 40.11 m $h^{-1}$ and surface loadings of 1.18 kg $Co^{2+}$ $m^{-2}$ $h^{-1}$. The granules recovered were cobalt phosphate octahydrate mineral $Co_3(PO_4)2.8H_2O$ as main products as analyzed through XRD analysis. Moreover, SEM-EDS analysis showed ~34.0% Co, ~21.0% P and ~45.0% O having a petal-like structure.

**KEYWORDS:** Resource recovery, cobalt phosphate, fluidized bed reactor, homogenous crystallization, semiconductor wastewater

**PAPER ID:** CEST2019_00584

# Effects of heavy metals accumulation on the growth and essential oil content of Rose Geranium (Pelargonium graveolens L'Her)

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## ABSTRACT

The objective of this study was to investigate the accumulation of Cd, Ni and Pb in the aboveground and underground parts of Rose Geranium (Pelargonium graveolens L'Her), as well as the effect on the plant's content of essential oil. A pot experiment was conducted using four different levels of Cd, Ni or Pb, in five replications. Analyses of the aboveground tissues were conducted after 10 and 14 weeks of exposure. At the end of the experiment, aboveground and underground biomass of the plants was air dried until constant mass. Samples were analysed with ICP for their heavy metal content. Essential oils were extracted by hydrodistilation and GCMS analyses were carried out. Results show metal- and pollution level- dependent accumulation of the three metals in the roots and the aerial parts of the plants. Essential oil profiles show rather minor effects of heavy metal exposure on the essential oil composition.

**KEYWORDS:** accumulation, essential oil, heavy metals, rose geranium, Pelargonium graveolens

**PAPER ID:** CEST2019_00964

# Elevated $CO_2$ in air changes photosynthetic response of *Hordeum vulgare* and *Bromus secalinus* to cadmium pollution in soil

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## ABSTRACT

The aim of this study was to investigate the response of photosynthetic system and growth of summer barley (Hordeum vulgare L.) and rye brome (Bromus secalinus L.) to different cadmium concentrations effect under elevated $CO_2$ in atmosphere. The growth and response of photosynthetic system were evaluated. The results showed that barley was more sensitive to Cd impact under all investigated $CO_2$ concentrations. Increasing $CO_2$ concentration increased photosynthetic rate and decreased the negative effect of Cd. The effect of Cd increased stomatal conductance of barley under elevated $CO_2$, while for brome it decreased. Photosynthetic pigments of barley also were more sensitive to Cd effect, but the losses were lower under elevated $CO_2$.

**KEYWORDS:** climate change, cadmium, photosynthesis

**PAPER ID:** CEST2019_00024

# Neuro-, geno- and cytotoxicity responses in mussels *Anodonta cygnea* after six metals mixture treatment

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## ABSTRACT

Concerning toxicity, bioaccumulation and persistence in the aquatic environment, six metals such as Zn, Cu, Ni, Cr, Pb and Cd are attributed to priority hazardous substances in many countries throughout the world (Water Framework Directive 2008/105/EC; US EPA 2009). In this study, time-dependent and tissue-specific induction in geno- and cytotoxicity was determined in haemocytes and gills cells of Anodonta cygnea after treatment with six metals (Zn-0.1, Cu-0.01, Cr-0.01, Ni0.01, Pb-0.005 and Cd-0.005 mg/L, at Maximum Permissible Concentrations (MPC), accepted for the inland waters in EU) mixture at various time points (1, 2, 4, 7, 14 and 28 days). The highest genotoxicity levels in gill cells and haemocytes were determined after 4 days exposure. After 2 days treatment in gill cells of exposed mussels, there was found the highest and statistically significant induction of cytotoxicity level. Neurotoxicity studies have shown, that prepared metals mixture has ability to inhibit AChE activity in mussel's hemolymph after 4 days and 28 days exposure. Time-depended metals accumulation in A. cygnea gills and statistically significant relations between Cu, Cd, genotoxicity (in gill cells) and cytotoxicity (in gill cells) demonstrates bioavailability of used trace metals for the bioindicator and time-related DNA damage.

**KEYWORDS:** trace metals, genotoxicity, cytotoxicity, Anodonta cygnea, AChE

**PAPER ID:** CEST2019_00089

# Effect of oxygen functional groups on mercury retention in activated carbons

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## ABSTRACT

Two commercial activated carbons (F400 and RWE) were tested for their Hg° retention capacity, in order to elucidate shortcomings that still exist, with respect to the oxygen functional groups. The number and the nature of oxygen containing functional groups were altered by heating under $H_2$ at 1100°C or treatment with $HNO_3$. The activated carbons tested were found suitable for mercury retention and the observed differences are attributed to their diversified characteristics (surface chemistry and pore structure). Acidic activated carbons promptly adsorb Hg°, since it behaves as a Lewis basis. When oxygen groups were almost completely removed, by H2 thermal treatment, the Hg° retention ability became practically zero. Acid treatment increased both the number and the acidic oxygen groups; resulting in increased Hg° retention. The Langmuir isotherm equation was used to describe the adsorption (physisorption and chemisorption) of Hg°, occurring in activated carbons. The fitting curve of the Langmuir equation and the correlation coefficient R2 indicate quite fair linear approximation (R2=0.9773). Reflecting the spontaneous nature of the adsorption reaction, the Gibbs free energy change calculated is negative (-23.5 kJ/mol and -30.9 kJ/mol, for the RWE and F400 respectively).

**KEYWORDS:** mercury, oxygen groups, active surface area, Langmuir equation

**PAPER ID:** CEST2019_00328

# Acid generation and heavy metal leachability from waste lignite disposal sites, Oropos basin, North Attica. An assessment on preliminary data.

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## ABSTRACT

Lignite mining in the Oropos Neogene basin (North Attica), especially in the areas of Milesi and Markopoulo, operated since last century and ceased in the late 1960's. Piles of complex waste material consisting of lignite tailings and waste rocks are dispersed in the area between the above mentioned mining sites. Environmental characterization of waste piles is performed by applying leaching tests (EN12457, EN15875) as well as bulk geochemical analysis. Mineralogical study revealed that pyrite is the dominant sulfide phase in local wastes. The high sulfur content and low paste pH and Net Neutralization Potential, i.e. values < -20 $CaCO_3$ kg/t in most analyzed samples, all clearly indicate that the waste is prone to acid generation. The analysis of water leachates showed high concentrations in Ni, Zn and Cd, exceeding the EU regulatory limits for the non-hazardous wastes. The preliminary results suggest that the lignite waste pose a potential threat for ground water contamination close to the waste disposal fields due to acid generation and heavy metal mobilization from the lignite matrix or the waste rock.

**KEYWORDS:** waste lignite, Acid-Base accounting, Nickel, Zinc, Oropos basin

**PAPER ID:** CEST2019_00428

# Mercury in Eisenia fetida and soil in the vicinity of a natural gas treatment plant in northern Croatia during the last ten years

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## ABSTRACT

In this study total mercury concentrations in earthworms and in different soil types at the same locations from the surroundings of four boreholes were analyzed by ICP-MS method, as a part of a comprehensive monitoring of the eco-system in the vicinity of the natural gas production and treatment plant Molve in northern Croatia. The aim of this study was to determine the concentration of mercury in the collected samples from 2009 to 2019, monitor its changes over a last ten years period and determine the bioaccumulation of total mercury in earthworms from the soil. During the last ten years total mercury concentrations in earthworms (boreholes Molve 9-12) ranged within 0.118 and 0.675μg $gDW^{-1}$ depending on the location and time of sampling, while total mercury concentrations in different soil types at the same locations ranged within 0.020 and 0.515 μg Hg $g^{-1}$ of soil. The calculated mercury bioaccumulation factor ranged between 0.6 and 16.9. Comparing our results with those from the previous research period and also with results published in available literature it can be concluded that investigated area near Molve belongs to low mercury contaminated region.

**KEYWORDS:** total mercury; bioaccumulation; earthworms; soil quality; natural gas

**PAPER ID:** CEST2019_00476

# Tissue-specific TfR Expression in Organs of Immature Mice after Chronic Exposure to $CoCl_2$

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## ABSTRACT

Cobalt (Co) has significantly increased its concentration in the environment in the last years due to anthropogenic and industrial activities. The present study was designed to elucidate the effect of chronic cobalt chloride ($CoCl_2$) exposure on transferrin receptor 1 (TfR1) in various organs of immature mice. Pregnant ICR mice were subjected to daily dose of 75 mg/kg body weight $CoCl_2x6H_2O$ 2–3 days before they gave birth and treatment continued until day 25 after delivery. The compound was dissolved and administrated with drinking tap water. Age-matched mice obtaining regular tap water were used as a control group. On days 18 and 25 pups were sacrificed, blood plasma, livers, kidneys and spleens were obtained and processed for analysis. The results show altered tissue-specific TfR expression in the studied organs of $CoCl_2$-treated immature mice. A significant time-dependent increase in tissue Co levels was observed. Our data on the effects of chronic $CoCl_2$ exposure on TfR expression contribute for the elucidation of the complex regulatory mechanism of iron homeostasis.

**KEYWORDS:** cobalt chloride, in vivo model, transferrin receptor 1, tissue specific expression, iron homeostasis

**PAPER ID:** CEST2019_00583

# Comparative Effects of Salinomycin and Meso-2,3-Dimercaptosuccinic Acid (DMSA) on Lead-Induced Impairment of Reproductive Function in Male Mice

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## ABSTRACT

Lead (Pb) directly targets testicular spermatogenesis and also the sperms in the epididymis inducing reproductive toxicity. In our study we compare the effects of meso-2,3- dimercaptosuccinic acid (DMSA) and tetraethylammonium salt of salinomycinic acid (Sal) on testis morphology, sperm count, Pb content, endogenous levels of calcium, copper, zinc and iron in testis of mice, subjected to Pb intoxication. Both chelating agents considerably reduced Pb content in the testis compared to the toxic control. The administration of Sal ameliorated Pb-induced alterations in Cu homeostasis and significantly restored endogenous Ca and Zn concentrations levels unlike DMSA. Testicular morphology of Pb-intoxicated mice recovered to control after salinomycin treatment but sperm count remained 21% lower compared to the untreated mice. The results suggest the potential application of salinomycin as antidote for treatment of lead intoxications.

**KEYWORDS:** Pb intoxication, Salinomycin, Chelation therapy, essential elements, Spermatogenesis

**PAPER ID:** CEST2019_00588

# Arsenic uptake in bean and cabbage grown in silty and sandy soil and irrigated with arsenic containing water

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## ABSTRACT

The uptake of arsenic was studied in bean (Phaseolus vulgaris L.) and cabbage (Brassica oleracea L. var. capitata L.) in an open greenhouse pot culture with sand and silt soil as substrate. The plants were irrigated with water containing sodium arsenate at concentrations 0.05 and 0.2 mg As $L^{-1}$. The total arsenic concentration of the different plants parts was determined by ICP-MS, following microwave-assisted acid digestion. The As concentration in the bean was in the order: root>shoot>bean pod and in cabbage: root>leaves. Increasing As concentration in the irrigation water resulted in decreased edible biomass production in bean, while in cabbage the edible biomass production increased. At the highest dose (0.2 mg As $L^{-1}$) if a person consumes about 450g of bean then their As intake will be: 0.9 µg from bean grown in sand and 0.72 µg from bean grown in silt. If 450g of cabbage is consumed then the As intake would be: 22.5 µg from cabbage grown in sand and 12.15 µg from cabbage grown in silt. Considering the WHO recommended MTDI limit of 2 µg $kg^{-1}$ body weight, both bean and cabbage can be consumed at the highest As treatment level of 0.2 mg $L^{-1}$.

**KEYWORDS:** irrigation, arsenic uptake, sandy soil, vegetables

**PAPER ID:** CEST2019_00816

# Sources and Transfer of Cu, Hg and Pb into Marine Food Webs using Innovative Tracers (Metal Stable Isotopes, Trophic Markers): Results of a Pilot Study in a French Coastal Area

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## ABSTRACT

Copper (Cu), mercury (Hg) and lead (Pb) are elements and contaminants of historical and emerging concerns in coastal environments. Although Cu is considered essential for living organisms, it is bioactive in a narrow range of optimal concentrations. Hg and Pb have no known biological role and are considered toxic towards organisms. Marine consumers incorporate and bioaccumulate these metals mainly through trophic pathways, which are then important to delineate. Since recently, metal stable isotopes are promising to trace origin and processes of the contamination of marine matrices, including biota. As part of the present study conducted within the SCOTTTI and Pollusols programs, we merged integrated trophic markers (carbon and nitrogen stable isotopes, lipid profiles) and metal stable isotopes to investigate i) the trophic transfer of Cu, Hg and Pb within a model food web of a French human-impacted coastal area (Toulon Bay, NW Mediterranean); and ii) the potential sources of food web contamination. Whenever possible, samples included sediment, suspended organic matter, size fractions of plankton, filter-feeding bivalves (mussels, oysters) and planktivorous fishes, collected at different seasons. Metal- and species-specific patterns throughout the food web were observed, highlighting the role of biological/physiological processes on the observed metal levels and isotope distributions.

**KEYWORDS:** trace elements; metal isotopes; trophic transfer; food web; NW Mediterranean Sea

**PAPER ID:** CEST2019_00720

# Session 11 - Advanced oxidation processes

## *Thursday 5 September 2019 - morning*

# Ozonation, advanced oxidation and hydrodynamic cavitation for removal of persistent pollutants

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## ABSTRACT

Ozone is commonly used in advanced oxidation processes (AOPs) in combinations with hydrogen peroxide ($H_2O_2$) and UV radiation (UV). Hydrodynamic cavitation (HC) has been experimentally proven to result in effects, typical of AOPs. Combinations of AOPs with $O_3$, $H_2O_2$ and UV, and HC (with cavitation numbers less than 0.2, generated by various orifice plates and nozzles, with number of passes up to 12) were experimentally assessed on model water, containing organic matter. Various synthetic organic micropollutants (iohexol, diatrizoic acid and metaldehyde with concentrations of 10 µg $L^{-1}$) were selected as the target compounds. At dosages of $O_3$, $H_2O_2$ and UV above 2 mg $L^{-1}$, 4 mg $L^{-1}$ and 450 mJ $cm^{-2}$, respectively, herein applied HC had no beneficial effect on target pollutants removal. At lower dosages of the aforementioned oxidants, HC was able to improve the removal rate of the target pollutants by as much as 15 %. Moreover, in terms of electrical energy consumption, the hybrid process with HC was found to be as efficient per order (90 %) of removal (EEO, kWh $m^{-3}$ order–1).

**KEYWORDS:** Hydrodinamic cavitation, hydrogen peroxide, micropollutants, ozone

**PAPER ID:** CEST2019_00350

# Cavitation Based Advanced Oxidation Processes for Wastewater Treatment – Comparison of Hydrodynamic and Sonocavitation Systems

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## ABSTRACT

Cavitation based advanced oxidation processes (CavAOPs), are a promising alternative to currently used wastewater treatment technologies. Amplified interest in this “hot” topic results in increased number of research on several aspects relating to formation of cavitation phenomena and its utilization for wastewater treatment as well as hybrid processes based of application of external oxidants effectively converted to radical species in cavitation conditions. The paper discusses a state of the art of cavitation based AOPs, as well as presents recent developments in this field of our research group. The principles of cavitation combined with AOPs will be presented followed by evaluation of their effectiveness in oxidation of organic contaminants and comparison of hydrodynamic and acoustic cavitation processes used for same type of pollutants. An examples of degraded particular pollutants will include chlorinated and nitro derivatives as well as other emerging environmental pollutants. Applications for disinfection of water will be also addressed. The paper will present also results of studies on degradation of pharmaceuticals as well as pre-treatment of real postoxidative effluents formed during bitumen production as an examples of possible implementation of cavitation based processes in real industrial scenario.

**KEYWORDS:** AOP; wastewater treatment; hydrodynamic cavitation; sonocavitation; acoustic cavitation

**PAPER ID:** CEST2019_00497

# Degradation of Cylindrospermopsin using Advanced Non-Thermal Plasma Technologies

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## ABSTRACT

The application of non-thermal plasmas in wastewater and air purification received a lot of attention, but their potential application in drinking water treatment has scarcely been investigated. Classified as Advanced Oxidation Processes, plasmas ignited in water or at the air-water interface generate a vast range of reactive species capable of removing water contaminants. The efficiency to degrade cylindrospermopsin (CYN, cyanobacterial toxin) was compared for six different plasma sources. A spark discharge showed the most energy-efficient degradation, followed by the other investigated systems, which showed similar trends. Two approaches were selected for further in-depth study of the degradation efficiency and underlying mechanisms. For a follow-up detailed study, a coronalike and a dielectric barrier discharge were selected based on the CYN degradation efficiency, usability of the reactors and plasma-chemistry. For the corona-like plasma, the degradation efficiency increased with increasing voltage and solution pH. After 15 min of plasma treatment at pH $\geq$ 7.5, degradation of CYN even progressed without further plasma application. The pHdependency was not observed for the dielectric barrier discharge (DBD), whose degradation efficiency increased with decreasing operating voltage. The corona-like plasma promotes degradation primarily via OH, whereas the DBD produces mainly $O_3$ and $NO_x$. The application of non-thermal plasmas (NTPs) appears to be an innovative and promising approach for effective removal of cyanotoxins such as cylindrospermopsin from drinking water.

**KEYWORDS:** non-thermal plasma, advanced oxidation process, cylindrospermopsin, cyanotoxin

**PAPER ID:** CEST2019_00518

# Changes of dissolved oxygen during the caffeine oxidation by photo-Fenton

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## ABSTRACT

The aim of this work is to analyse the changes of dissolved oxygen ([DO], mg/L) during the oxidation of caffeine waters by photo-Fenton treatment. The concentration of dosed hydrogen peroxide would be the addition of the stoichiometric $[H_2O_2]$, which reacts with organic matter ($[H_2O_2]_{esteq}$=2.0 mM), plus the concentration in excess of $[H_2O_2]_{exc}$ that decomposes, generating $O_2$ through radical processes, according to a ratio R=0.8164 mmol $H_2O_2$/mg $O_2$). Operating at doses lower than the stoichiometric value $[H_2O_2]_0$2.0 mM, oxygen is released, and regeneration of $Fe^{3+}$ to $Fe^{2+}$does not occur. The highest oxygen generation output is obtained when dosing $[Fe]_0$=10.0 mg/L, conducting at pH=3.0 and 25ºC. The evolution of DO formation is adjusted to zero-order kinetics, the kinetic constant of oxygen generation being kf=29.48 $[Fe]_0^{-1.25}$ (mg $O_2$ $L^{-1}$ $min^{-1}$ ) and oxygen consumption kd=-0.006 $[Fe]_0^{2.0}$ + 0.244 $[Fe]_0^{-3.7}$ (mg $O_2$ $L^{-1}$ $min^{-1}$).

**KEYWORDS:** caffeine; dissolved oxygen; ferrous ion; kinetic modelling; photo-Fenton

**PAPER ID:** CEST2019_00071

# Fenton reagent in combination with UV light and ultrasound waves applied for caffeine oxidation

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## ABSTRACT

The oxidation of aqueous caffeine solutions ($[Ca]_0$=100.0 mg $L^{-1}$) was analyzed, operating at pH=3.0 and 25 ºC using different AOPs, which combine the Fenton reagent ($[H_2O_2]_0$=15.0 mM and $[Fe^{2+}]_0$=20.0 mg $L^{-1}$) with low power UV light (15W,), medium (150W), and high (720 W). The Fenton reagent, combined with 150W UV light, was the most energetic treatment, proving that at 20 min it completely degrades caffeine and 80% of the water aromaticity. This hard oxidative process is accompanied by a high oxygen consumption, up to concentrations of [DO]=0.9 mg $L^{-1}$ at the time when the caffeine contained in the water is completely degraded. On the other hand, 150W UV light is the only treatment capable of decreasing the concentration of total solids dissolved in water, according to a ratio of 0.0035 $min^{-1}$. US waves allow degrading caffeine by 35%. This treatment leads to the emission of high oxygen concentrations ([DO]=20.0 mg $L^{-1}$), which subsequently decreases along time. The UV lamp of 15W allows degrading caffeine by 12%, but does not affect the rest of the parameters analyzed.

**KEYWORDS:** AOPs; caffeine; Fenton reagent; ultrasounds waves; ultraviolet light

**PAPER ID:** CEST2019_00014

# Evaluation of phytotoxic effects and decolorization of simulated and real textile wastewaters by UV/$H_2O_2$

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## ABSTRACT

In the present study textile dyes (Methylene Blue, Eliamine Blue F, Indigo) were used as model pollutants in water (ranging from 5 – 5000 mg/L) and real wastewater containing the Indigo dye was studied. The dyes in solution and the wastewater were treated by UV/$H_2O_2$ to study the influence of the type of dye, the initial concentrations of dye, the initial concentration of $H_2O_2$, the initial pH of the solution and the irradiation time in the dye decolorization of the treated solutions. The phytotoxic effect in Raphanus sativus of the treated and untreated dyes and wastewater in solution were evaluated.

**KEYWORDS:** Wastewater, textile industry, UV/$H_2O_2$, phytotoxicity.

**PAPER ID:** CEST2019_00228

# Effect of iron catalyst on caffeine oxidation by sono-Fenton technology

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## ABSTRACT

Oxidation of waters containing 100.0 mg L -1 of caffeine was conducted by a sono-Fenton treatment employing an ultrasound power of 720W at pH=3.0 and T=25°C. The catalytic action of ferrous ion was studied in a range of $[Fe^{2+}]0$=0-100.0 mg $L^{-1}$, using oxidant ratios of $[H_2O_2]0$=250.0 mM. The oxidation of caffeine was fitted to second order kinetic model, with the oxidation kinetic constant showing a linear dependence with iron dosage. During oxidation, the water acquired yellow-brown colour, along with an increase of turbidity and aromaticity degree. This is due to byproducts formation of uric acid derived that has strongly aromatic structures that contain chromophore groups. Iron could give rise to a reaction mechanism with organic matter through the formation of (hydro) peroxo iron complexes. The molar ratio of 1 mol $Fe^{2+}$: 0.5 mol $C_8H_{10}N_4O_2$: 250 mol $H_2O_2$: 720W promotes the formation of coloured species that generate high turbidity in the water.

**KEYWORDS:** aromaticity, caffeine, colour, sono-Fenton, turbidity

**PAPER ID:** CEST2019_00064

# Effect of hydrogen peroxide on caffeine oxidation by sono-Fenton technology

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## ABSTRACT

Oxidation of waters containing 100.0 mg $L^{-1}$ of caffeine was conducted by a sono-Fenton treatment employing an ultrasound power of 720W at pH=3.0 and T=25°C. The oxidizing action of hydrogen peroxide was studied in a range between $[H_2O_2]_0$=0-250.0 mM, using iron ratios of 0.7 mol $Fe^{2+}$/mol $C_8H_{10}N_4O_2$. The oxidation of caffeine was fitted to second order kinetics, obtaining removals of 98% when dosing 485 mol $H_2O_2$/mol $C_8H_{10}N_4O_2$. During the oxidation, the water acquired a strong brown colour at the same time as there was a strong increase in turbidity and degree of aromaticity. The interaction of (hydro)peroxo-iron complexes with the byproducts of caffeine degradation (1,3,7-trimethyluric acid, theobromine, paraxanthine, theophylline) generated supramolecular structures responsible for this phenomenon, being 116 mol $H_2O_2$/mol $C_8H_{10}N_4O_2$, the relationship that induced colour and aromaticity, while the formation of turbidity was favoured by using 29 and 116 mol $H_2O_2$/mol $C_8H_{10}N_4O_2$.

**KEYWORDS:** aromaticity, caffeine, colour, sono-Fenton, turbidity

**PAPER ID:** CEST2019_00070

# Colour changes during the carbamazepine oxidation by photo-Fenton

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## ABSTRACT

Oxidation of waters containing 50.0 mg $L^{-1}$ of carbamazepine was conducted by a photo-Fenton reagent employing a UV lamp of 150W, at pH=3.0 and T=40°C. The oxidising action of hydrogen peroxide was studied in a range between $[H_2O_2]_0$=0-15.0 mM. When applying stoichiometric ratios of 2 mol $C_{15}H_{12}N_2O$:20 mol H2O2:1.8 mol $Fe^{2+}$, the maximum formation of colour (0.381 AU) is promoted. The colour may be generated by by-products of degradation of carbamazepine that have chromophore groups in its internal structure, such as oxo and dioxo-carbazepines, which would generate colour during the first minutes of oxidation, while the formation of acridones would slowly induce colour to the water.

**KEYWORDS:** acridone, carbamazepine, colour, oxo-carbazepine, photo-Fenton

**PAPER ID:** CEST2019_00079

# Session 12 - Solid waste management

## *Thursday 5 September 2019 - morning*

# Application of Risk Analysis to landfills: the experience of Brescia (Italy)

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## ABSTRACT

This contribution describes the experience of the Province of Brescia, public body responsible for managing applications for landfill authorization, and its collaboration with the University of Brescia for the specific activity of risk analysis applied to landfills. After a reference to the current national legislation and a summary of the technical documents available for the topic (guidelines and instructions drawn up by technical bodies), the technical-preliminary approach applied by the Province of Brescia is outlined. This is complemented by a detailed description of the methodological approach followed for the evaluation of Risk Analysis documents and of the critical aspects that emerged within several administrative procedures. Finally, some issues on the topic of interest that emerged within a technical task force, involving Lombardy Region and its provinces, are introduced.

**KEYWORDS:** authorization, critical issues, environmental risk, solid waste, waste landfilling

**PAPER ID:** CEST2019_00734

# Pyrolysis of Waste Plastic Laminates and Coconut Husk: Optimization of Fuel Oil Yield, Higher Heating Value and Energy Value

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## ABSTRACT

Alongside increasing use of single-use plastics, especially in developing countries is increasing mismanaged solid wastes. There is great need for economically viable processes such as pyrolysis that can convert waste to energy resource. Coconut husk, which is also an abundant waste in tropical countries is a good material for copyrolysis with single-use plastic, as both have high energy content. Thus, this study determines the potential of plastic laminates and coconut husk pyrolysis as feedstock for production of pyrolystic oil. It aimed to determine the effects of feedstock mixture composition (percent coconut husk: (32%, 42%, 51% coconut husk), process temperature (500 ºC, 600 ºC, 700 ºC) and particle sizes (1cm, 3cm, 5cm) on the percentage yield, gross calorific value and energy value of the output pyrolytic oil. Using RSM response optimizer, optimum oil yield is 32.5%, which is at feedstock of 50.42% coconut husk, 5- cm partcle size and 700oC. Feedstock of 32% coconit husk, 5-cm particle size and 700 ºC will give the highest HHV of 34.1142 MJ/Kg. Maximum energy of 6.0032 MJ will be obtained at feedstock of 51% coconut husk, 5-cm particle size and 700 ºC. ANOVA analysis showed that all the three parameters tested are significant factors affecting oil yield and energy yields. Temperature and percentage coconut husk have greater influences on yield, HHV and energy value than particle size.

**KEYWORDS:** coconut husk, plastic laminates, co-pyrolysis

**PAPER ID:** CEST2019_00750

# Co-Pyrolysis of Plastic Wastes: Effects of Temperature and Feedstock Ratio on Chemical Composition of Liquid Product

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## ABSTRACT

Co-Pyrolysis of Low Density Polyethylene (LDPE) and Polystyrene (PS) was carried out in a semi-batch glass reactor system. Effects of temperature and feedstock ratio on pyrolytic product yields (gaseous, liquid and solid residue) and chemical composition of the liquid were investigated. All experiments were performed with 15 g feedstock in 25 mL/min nitrogen atmosphere and 60 min duration at specified temperature. Temperature was changed from 470 to 620 °C with 50 °C break by utilizing PID controller which was setted 10 °C/min heating rate. PS in the feedstock was varied as 0, 33, 67, 100 wt. %. The liquid products were characterized by GC-MS. When PS and LDPE were mixed equally by weight at 570 °C, liquid product yield was found 85 wt. %. More PS adding in the feedstock did nearly not affect this value. It was detected that hydrocarbons which were aromatic, cyclic and aliphatic formed the peak areas's majority of the copyrolytic liquid. Specifically styrene was found dominant component in that liquid. Besides that, it was observed that with increasing temperature, peak areas' percentage of alkanes decreased while temperature rising didn't affect olefines' peak areas.

**KEYWORDS:** Polystyrene, Polyethylene, Co-Pyrolysis, Chemical recycling, Plastic waste management

**PAPER ID:** CEST2019_00775

# Development of Porous Carbon Nanomaterials from Petroleum Waste for $CO_2$ Capture and Mineralization

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## ABSTRACT

Development of *in situ* preparation method of porous low-density carbon materials from industrial waste is important. Alkali earth metal doped porous carbon materials can serve as a support for $CO_2$ mineralization in pores to generate the final carbonate enriched porous carbons, $MCO_3$-PC, as a composite for potential applications in $CO_2$ capture and sequestration. Herein we report on developing mineral carbonization technology using porous carbons from vacuum residue to generate products that are best suited economically for $CO_2$ sequestration. Activating of vacuum residue (VR) using activation reagent as $Ca(OH)_2$ and MgO mixed with KOH gives a porous structure and metal particles that can react with CO2. The study of the synthesized material showed the presence of nonporous carbon and alkali earth metal ions.

**KEYWORDS:** $CO_2$ mineralization, industrial waste, $CO_2$ sequestration, porous carbons, Activating of vacuum residue

**PAPER ID:** CEST2019_00821

# Utilising Pay as you Throw Systems and Autonomous Composting Units in Balkan Med countries

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## ABSTRACT

In this paper a European Union and National funded project activities are described. The project “BIOWASTE” promotes the transfer and application test of innovative technologies (PAYT and ACUs), aiming to enhance managing efficiency in solid wastes related issues, such as source separation schemes and treating systems emphasizing in organic wastes. The proposed systems will be introduced in three different types of touristic municipalities, Municipality of Yermasoyia (intensified touristic area with prolonged touristic summer), Municipality of Katerini (less intensive touristic area, with short summer period directly related with the sea cost) and Municipality of Probistip (less intensive touristic area with a very large number of small and decentralized communities with significant number of tourists). In the framework of the BIOWASTE, each municipality will: a) develop a detailed Pay as You throw (PAYT) system, b) provide the appropriate equipment for the implementation of the PAYT system (weighing units for waste collection trucks, bins with identification systems), and c) install an Autonomous Composting Unit (ACU) at the sites of a hotel or hospitality units or decentralized communities to receive the bio-waste produced directly without the need to collect them. ACUs are small closed integrated composting units, with zeroing of effluent and expanding liquids.

**KEYWORDS:** PAYT, Autonomous Composting, Units, Identification system, Local Authorities

**PAPER ID:** CEST2019_00197

# A novel types of compound for surface treatment of carbon nanotubes for more effective application in polymers

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## ABSTRACT

Nowadays, beneficial management of plastic and rubber waste from different sources and environmentally friendly ways of recycling is becoming an increasing challenge. A possible solution for that problem could be to produce plastic composites usually consisting of heterogeneous phases. That fact and the interface between phases, and characteristics of components all play important roles in development of properties of end-product. By using a compatibilizing additive a chemical bridge can be created between the plastic composite components requiring reactive functional groups. In case of carbon nanotube containing composites particular attention must be paid to the formation of suitable interactions between the dispersed material and the matrix that can be carried out by impregnating the surface of carbon nanotubes with dispersed additive in hydrocarbon solution or in aqueous surfactant containing composition. We have applied O/W typed emulsion techniques for carbon nanotube impregnation, bearing in mind the importance of environmental regulations for the conditions of treatment. Compatibilizing additives have been classified by various analytical measurements (total acid number, saponification value measurement, size exclusion chromatography, FT-IR measurements, adhesive strength, conditions of emulsification) to identify the possible structure of the additive and to study interactions with the reinforcing material.

**KEYWORDS:** rubber waste, compatibilizing additives, emulsification, carbon nanotube

**PAPER ID:** CEST2019_00521

# Remarkable role of experimental olefin-maleic-anhydride copolymer based compatibilizing additives in PET bottle recycling

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## ABSTRACT

Over the past 50 years demand for plastics drastically increased worldwide resulting in plastic wastes causing serious environmental problems. The main market sector of european plastics industry is the packaging industry most of which is polyolefins and poly(ethythylene-terephtalate). Polymer blends based on waste resources can solve the issues of recycling. We have studied rheological and tensile properties of three types of PET/engineering thermoplastic blends (PET/PC, PET/PA and PET/ABS) produced with different processing techniques. Miscibility of components of blends is limited leading to weak mechanical properties such as low tensile strength and/or elongation at break. Due to that phenomenon compatibilizing additives are also required. As compatibilizing additives olefin-maleic-anhydride copolymer based additives have been used in our experiments. Structure of additives differed from each other both in ratio and length of carbon chains of compounds linked to maleic-anhydride groups . Blends have been studied with PET content ranging from 10 % to 90 %. As an outstanding result we have managed to achieve improving mechanical properties, for example almost 400 % growth was observed in elongation at break of extruded 80/20 PET/PA blends in the presence of 0.2 % compatibilizing additive compared to the sample without additive, meanwhile its strength has also improved.

**KEYWORDS:** compatibilizing, PET, recycling, olefinmaleic-anhydride copolymer, polymer processing

**PAPER ID:** CEST2019_00526

# Hyperspectral imaging based cascade detection applied to paper, cardboard, plastics and multilayer packaging sorting

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## ABSTRACT

Recycling of post-consumer packaging wastes involves a complex chain of activities, usually based on three main stages, that is: i) collection from households or recovery from municipal solid waste (MSW), ii) sorting and, finally, iii) mechanical recycling. This paper investigates sorting logics, hyperspectral imaging based, to design, implement and set up with the specific aim to perform an automatic separation of paper, cardboard, plastics and multilayer packaging.

**KEYWORDS:** hyperspectral imaging, near infrared spectroscopy, plastic packaging, sorting

**PAPER ID:** CEST2019_00508

# Urban Strategies for Waste Management in Coastal Areas

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## ABSTRACT

Europe is the most visited region in the world, the destination for half (49.8%) of the 1.24 billion international tourist arrivals in 2016. Almost half (47.4%) of European tourist visits occurred in coastal regions, defined "on the basis of and consist of local administrative units or municipalities that border the sea, or have at least half of their total surface area within a distance of 10 km from the sea." In 2015, 9 out of 10 nights spent at Tourist Accommodation Establishments (TAE) in Malta, Cyprus, Greece, Croatia and Denmark were located at coastal areas, while the overall flow of tourism in the EU is primarily concentrated on Mediterranean coastal regions. Within this research, the concept of urban metabolism will be used to understand and analyses how tourist areas that are influenced by tourism use their resources and how touristic activities are linked to waste management and resource conservation. Furthermore, a waste compositional technique has been performed in order to relate the waste production in coastal areas as well as the level of the pollution link to the sea and moreover to evaluate the existing infrastructure and waste management plan.

**KEYWORDS:** Area Metabolism, key permeance indicators, waste strategies, accumulation rate, waste compositional analysis.

**PAPER ID:** CEST2019_00701

# Benchmarking indicators to assess the level of Circular Economy Strategy in Local Level

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## ABSTRACT

Several tools are available for evaluating the environmental level and/or performance of waste management in an area using several benchmarking indicators, such as life cycle assessment, multi-criteria decision analysis, compositional analysis etc. Often these tools are the simplifications of the actual facts as the waste management systems are complex and difficult to generalise from case studies This research implement several benchmarking indicators such as compositional analysis of household waste, level of recycling index, participation in home composting, awareness activities, prevention activities in order to assess the level of the circular economy strategy in a Municipality (located in Cyprus). The results indicate that the more than 75% of the citizens are participated in the recycling door to door program. However, the recyclable waste that are been collected are not clear as include other impurities. For example, the impurities in PMD is more than 20% indicated that a door to door training program is needed. Also, the concentration of PMD and Papers in the household waste count more than 18% indicated that the waste sorting at source needs further attention. Home composting seems to be a promising method to treat leftovers and other yard wastes and minimized the volume of organic waste that are dumped in landfills. The results of the compositional analysis highlighted the need to develop actions to divert specific waste streams such as recyclable, green and food waste, as well as the development of awareness activities.

**KEYWORDS:** circular economy, bench marking indicators, SWOT analysis, strategy development, environmental performance

**PAPER ID:** CEST2019_00702

# A Simple and Flexible Flowsheet Process for Efficient and Selective Metal Recycling from Spent Fluid Cracking Catalysts

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## ABSTRACT

This paper investigates the recovery of the main metals (La and Al) present in a spent fluid cracking catalyst (FCC) through the hydrometallurgical processes of leaching and selective precipitation. Complete La leaching (99±1)% was achieved under microwave assisted leaching with the use of 1 M HCl and a liquid-solid (L/S) ratio of 5 for 90 s. Since the main impurity presented in the leachate was Al, an initial process was developed to selectively recover Al by alkaline precipitation. At pH 6, almost total Al (98%) was precipitated with purity of 88.7% while La coprecipitation was insignificant (2.8%). The second approach consisted of La recovery as lanthanum oxalate [$La_2(C_2O_4)_3$], using low oxalic acid concentration (0.1 M). The results indicate high La recovery (99.7%) with very high purity (99.9%) when applied on the solution pre-purified and free of Al. Results strongly demonstrated that the simple and universal approach created is beneficial in terms of high metals recovery and final product quality from spent FCC without the need of highly concentrated chemicals and time-consuming processes.

**KEYWORDS:** Fluid cracking catalysts, simple and nearlyclosed process, recovery of La, recovery of Al

**PAPER ID:** CEST2019_00498

# Biorecovery of metal sulfides from leachates obtained through zinc-carbon battery recycling

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## ABSTRACT

One of the most commonly used methods of recycling of spent zinc-carbon (alkaline) batteries is hydrometallurgical leaching with sulfuric acid. The technology is highly efficient and enables the recovery of the majority of deposited metals. Unfortunately, it also generates highly acidic wastewaters containing significant amounts of sulfates and metal ions, which have typically been considered off-balance material. The aim of the study was to develop a biotechnology for the recovery of metals (in the form of sulfides), based on the activity of sulfate-reducing bacteria (SRB). SRB reduce sulfates to sulfides, which bind with metal ions to produce an insoluble precipitate. To maximize the efficiency of metal sulfide biorecovery by SRB, the acidic wastewaters were pretreated with sodium hydroxide and then with biogenic ammonia (produced by urea-degrading bacteria) to reach pH 5.0. Further alkalinity was generated during organic compound decomposition carried out by SRB in cultures containing appropriately diluted, pretreated leachates. As a result of the proposed biotechnology, metal ions and sulfates, were almost completely removed from the leachate. This way new raw materials: metal sulfides and treated (industrial-quality) water with circumneutral pH were produced.

**KEYWORDS:** zinc-carbon (alkaline) batteries, recycling, acidic leachate, sulfate reducing bacteria, metal sulfide

**PAPER ID:** CEST2019_00536

# Contribution to the exploitation of oil by-products for use in the production of quality feed through the fermentation with the fungal strain LGAM P123 of basidiomyces Pleurotus ostreatus

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## ABSTRACT

In Greece, large quantities of by-products are produced annually from urban and industrial activities among them very high olive oil production by-products. Thus, the interest of the scientific community has focused on the utilization of olive oil waste mainly as a feed using various microorganisms and fungi, of which only a small number can biodegrade the waste. In the present study the effect of solid fermentation of olive mill waste (OMW)- straw (in various proportions) mixture using the LGAM P123 strain of Pleurotus ostreatus under the conditions of experiments on the quality of the olive pomace is investigated. LGAM P123 strain was grown in solid and liquid substrates as well as in a mixture of the hay and olive-pomace substrate. The results obtained from the experimental procedure resulted in an increase in the proportion of proteins in straw and OMW mixtures. In addition, the content of fibrous matter in the fermented samples showed a significant decrease whereas total polyphenols appeared an extremely strong decrease.

**KEYWORDS:** olive mill waste(OMW), Pleurotus ostreatus, fermentation, straw ,polyphenols

**PAPER ID:** CEST2019_00838

# Determining a Probability of the uncontrolled landfills emergence in Georgia's Rural Areas using Integrated Methodology

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## ABSTRACT

In this work, with the support of the local municipality, we've collected for each highland region the data showing: the number of population, existence of the main sources causing waste, the quantity of the dumpster, the frequency of the waste removal with the relevant technic etc. Based on all these data by applying our methodology, we count a probability of existence of the uncontrolled landfills that can exist in the particular region. We also use the pictures from a drone. In the present research we also made a comparative analysis of our theoretical conclusion concerning the particular rural areas and the results of the real data received after the expedition on the same place.

**KEYWORDS:** Waste management, Pollution, Rural Environment, Uncontrolled Landfills

**PAPER ID:** CEST2019_00882

# Negative role of uncontrolled landfills in Georgia in environmental pollution processes

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## ABSTRACT

In the laboratories the special research were carried to determine the pollution level in the samples collected, which due to the direct impact of these types of landfill sites on the surrounding areas, are often the main polluters of environment. The pollution conditions were studied based on modern methodology and techniques (ISO methods). The received results allow concluding: •The pollution is different for the West and East Georgia. The analysis of the water and soil samples showed that the territories and water bodies adjacent to the landfills located in western Georgia are relatively less polluted than similar areas in the East Georgia; •In the analysed samples concentrations of various polluting ingredients (heavy metals- Pb, Cu, Zn, Cd and biogenic elements- total coli forms, Fecal streptococci, and E. coli) determined from the soil and water samples exceeded the maximum permissible concentrations.

**KEYWORDS:** uncontrolled landfills, heavy metals, maximum permissible concentrations, microbiological indicators

**PAPER ID:** CEST2019_00883

# The possibility of recycling of multilayer packaging waste: Reducing Environmental impacts

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## ABSTRACT

Multilayer Packaging Waste (MPW) represents the largest fraction of packaging waste and is mainly composed of multiple plastic films laminated with Al foil (Ec.europa.eu. (2018). Packaging waste statistics). The most produced multilayer film is based on the different polymers, such as polyester (PET), polypropylene (PP), and polyethylene (PE) as main components, and an aluminum layer (European Commission JRC Technical reports). According to Eurostat Statistics Explained, the amount of packaging waste generated in the EU between 2007 and 2016 was estimated at 79 ± 1.25 million ton per year. Because of that, this type of waste is difficulty recyclable, its representative one of the biggest polluter in the environment. Research aims were to recover valuable materials from MPW in order to reduce the waste stream and reduce environmental pollution.

**KEYWORDS:** Plastic; Environment Pollution; Recyclability Al

**PAPER ID:** CEST2019_00858

# Session 13 - Wastewater treatment

## *Thursday 5 September 2019 - afternoon*

# Fouling-resistant membranes prepared via fully biobased layer-by-layer self-assembly

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## ABSTRACT

A fully biobased layer-by-layer deposition method, containing kraft lignin and chitosan as the polyelectrolytes, was employed to improve the antifouling properties of polyethersulfone membrane. Results revealed that the water in air contact angle decreased from 70° ± 2° for the pristine membrane to 34° ± 1° for the modified double-bilayer membrane, indicating enhanced hydrophilicity. The synthesized film was ultrathin and caused a slight decrease in permeation flux of the modified membrane compared to the pristine membrane. Additionally, the deposited film showed excellent stability after 6 hours running water test using a dead-end filtration cell.

**KEYWORDS:** Lignin, chitosan, layer-by-layer deposition, polyethersulfone

**PAPER ID:** CEST2019_00658

# Hybrid zero liquid discharge (ZLD) membrane/chemical process for the treatment of oil sands produced water

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## ABSTRACT

In this study, the applicability of a hybrid chemical/membrane process for the treatment of the boiler blow-down (BBD) water from steam assisted gravity drainage (SAGD) operation was explored. For the chemical pre-treatment prior to the membrane filtration, another waste stream of SAGD, i.e., ion exchanger regeneration wastewater (IERW), was used as a coagulant to reduce the concentration of organic matter and silica. The proposed method involved the direct use of the NF process for the purification of BBD water, followed by an integrated IERW conditioning and nanofiltration (NF) to purify the concentrated retentate. This process could operate with a zero-liquid discharge (ZLD) configuration and it was found to be an efficient method in terms of water recovery and water product quality.

**KEYWORDS:** Wastewater treatment; Membrane; Nanofiltration; Process integration

**PAPER ID:** CEST2019_00659

# Treatment of Slaughterhouse Wastewater Utilizing Cogon Grass (Imperata cylindrica) in a Subsurface Flow System Constructed Wetland in Zamboanga City, Philippines

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## ABSTRACT

Natural treatment systems are gaining preference as a wastewater treatment option since it is a form of ecosystem-based adaptation to climate change. The study investigated the performance of a laboratory scale horizontal, subsurface flow constructed wetland (SSFCW) planted with cogon grass (Imperata cylindrica) in reducing the pollutant concentration of slaughterhouse wastewater in Zamboanga City, Philippines. Results showed that the mean efficiency of $BOD_5$ removal at seven (7) and 14 days detention time were 94.49 percent and 89.31 percent, respectively; while the average TSS removal efficiency were 97.8 percent and 99.9 percent, respectively. Statistical analysis of the $BOD_5$ removal efficiencies revealed significant difference; which means that higher $BOD_5$ removal is achieved at seven (7) days detention time. Analysis of the TSS removal efficiencies likewise revealed a significant difference, proving that longer detention time results in higher suspended solids removal. Therefore horizontal, SSFCW planted with cogon grass can be used to treat slaughterhouse wastewater at seven (7) days detention time. A pilot study is recommended to validate laboratory-scale finding. Future reseach should also investigate the performance of horizontal, SSFCW using other wastewater sources, different parameters, other endemic hydrophytic grasses, and to consider meteorological and climatological factors.

**KEYWORDS:** Constructed wetlands; Slaughterhouse Wastewater; Environmental Engineering; Ecosystem based Adaptation; Natural Wastewater Treatment

**PAPER ID:** CEST2019_00679

# Anaerobic MBR Technology for treating Municipal Wastewater at Ambient Temperatures

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## ABSTRACT

An innovative way to treat municipal wastewater and produce energy at the same time is anaerobic treatment. Anaerobic processes are traditionally used for high strength wastewater or municipal sludge treatment and only recently have been applied for the treatment of low strength municipal wastewater. To investigate the performance of anaerobic wastewater treatment through the incorporation of membrane technology, a 40 L laboratory scale Anaerobic Membrane Bioreactor (AnMBR) with a flat sheet submerged membrane along with a 40 L reservoir for trapping and measuring the biogas produced have been installed and set in operation. The operation of the AnMBR unit with real wastewater is an important step for data generation, since most of the studies related to AnMBR have been performed with synthetic wastewater offering no insight to problems that a real-world unit might face. This paper presents the start-up of the unit and operating results from the first phase of laboratory scale experiments, conducted at temperatures between 14- 18oC. More experiments will be held in the near future at different temperatures and also different operating conditions in order to examine the efficiency of the reactor under realistic conditions, by identifying the possibility of integrating the technology into WWTPs.

**KEYWORDS:** anaerobic treatment; AnMBR; circular economy; biogas production

**PAPER ID:** CEST2019_00761

# Wastewater treatment with agricultural by-products: An investigation with date pit powder

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## ABSTRACT

Water is very precious and inevitable for every living objects including human beings. Huge quantity of wastewater is generated by us every day and there are various methods to regenerate safe and pure drinking water from these waste waters. Researchers all over the world are continuously trying to develop low-cost filtration system using various adsorbents. Agricultural waste products are being used as adsorbents and gaining momentum because of various attractive factors such as easy availability, low cost, non-toxic nature etc. In the present investigation, date pit (date stone) powder is used an adsorbent to remove Pb (II). The analysis revealed that date pit powder can be successfully used in a column filtration set-up to remove Pb (II) ions from the wastewater streams with high efficiency.

**KEYWORDS:** Date pit powder; adsorbents; column filtration; Thomas model

**PAPER ID:** CEST2019_00763

# Biotreatment of Brewery Wastewater using the Filamentous Cyanobacterium Leptolyngbya sp.

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## ABSTRACT

Brewery wastewater is generated from the beer brewing process in large amounts (4-8 m3 per m3 of beer produced). Brewery wastewater consists of high organic matter content, significant nitrogen and phosphorus concentrations and easily biodegraded compounds. Even though most biological treatment technologies applied to brewery wastewaters include the use of bacteria, cyanobacteria (photosynthetic microorganisms) constitute attractive means for sustainable and low cost wastewater treatment producing high biomass concentration. In this study, the capacity of a filamentous cyanobacterium Leptolyngbya sp. for the pollutants removal from brewery wastewater was investigated coupled with objective to determine its proteins, carbohydrates and lipids content after wastewater treatment. The experiments were conducted in batch mode under non-sterile conditions in lab-scale photobioreactors. The removal rates of nitrate, ammonium, orthophosphates, total phosphorus and chemical oxygen demand (COD) were almost 49.2%, 100%, 57.1%, 57.9% and 24.3%, respectively, within the first 7 days of cultivation. The maximum biomass concentration was 350 mg/L, while the biomass produced was consisted of approximately 53.5% carbohydrates, 20.2% proteins and 10% lipids. Therefore, the treatment of brewery wastewater using cyanobacteria species could be effective, while the cyanobacterial biomass could be used in numerous fields for diverse applications.

**KEYWORDS:** Brewery wastewater; cyanobacteria; Leptolyngbya sp.; cyanobacterial biomass

**PAPER ID:** CEST2019_00304

# Treatment of various agro-industrial wastewaters using electrocoagulation

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## ABSTRACT

Greece, although not over-industrialized, faces issues connected to pollution of its water resources, as conventional wastewater treatment methods often proved ineffective at removing some pollutants such as suspended solids and pigments. Therefore, the need of developing efficient, modern anti-pollution techniques for the preservation of a viable environment is urgent as ever. Electrocoagulation (EC) is one of these widely studied, promising methods. EC consists of generating coagulant species by electrolytic dissolution of sacrificial anode materials triggered by electric current applied through the electrodes, leading to the removal of different pollutants.In the present study EC was studied for the treatment of various agro-industrial wastewaters (table olive, cheese whey and printing ink),examining its efficiency under a wide range of operating parameters (current density, initial pollutant concentration, pH, electrode material).According the results EC proved efficient in most of the experimental sets performed, achieving significant removal efficiencies of color and organic matter. Also,acost analysis of the process that was conducted to evaluate the economic feasibility of the process showed that EC can be a viable and realistic choice for agro-industrial wastewater treatment.

**KEYWORDS:** agro-industrial wastewaters, electrocoagulation, color, suspended solids

**PAPER ID:** CEST2019_00307

# Use of the microalgae *Chlorella Sorokiniana* for municipal wastewater treatment: batch experiments

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## ABSTRACT

Batch experiments were conducted in order to investigate the use of microalgae *Chlorella sorokiniana* for the treatment of different types of municipal wastewater (raw sewage, anaerobically treated wastewater, aerobically treated wastewater) and investigate the role of light and addition of ammonium on its growth. All experiments were conducted in triplicates and lasted for 7 days. Several parameters were monitored during the experiments in order to check the experimental conditions (pH, temperature, DO), the growth of biomass and the removal of major pollutants (COD, $NH_4$-N, $PO_4$-P, $NO_3$- N) from wastewater. According to the results, the target microalgae can be sufficiently developed in raw and anaerobically treated sewage, while it can remove an important part of the major pollutants found in raw sewage, reaching up to 94%, for COD, 99% for $PO_4$-P and 94% for $NO_3$-N. The addition of $NH_4$-N in aerobically treated does not enhance growth of biomass, while the application of mixotrophic conditions (16h light/8h dark) enhanced microalgae growth and major pollutants' removal.

**KEYWORDS:** wastewater treatment, Chlorella sorokiniana, removal, nutrients

**PAPER ID:** CEST2019_00417

# Membrane distillation treating a petrochemical reverse osmosis concentrate

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## ABSTRACT

This study investigated the applicability of Direct Contact Membrane Distillation (DCMD) process for the treatment of a petrochemical industry effluent, intending to recover water from the concentrate produced by reverse osmosis (RO). In DCMD, the experiments were accomplished with a feed and permeate-inlet temperature of 60 °C and 20 °C, respectively. Four commercial microporous hydrophobic flat-sheet membranes made of polytetrafluoroethylene (PTFE), with or without a support layer, laminated or not with butylated hydroxyanisole (BHA), having different thickness, pore size, effective porosity and contact angle, were evaluated. All evaluated membranes presented a very satisfactory water recovery ratio (~90%), getting high rejection factors (above 99.5%) for all analysed parameters and producing a high-quality water having a very low electrical conductivity (around 2 µS $cm^{-1}$). The membrane with BHA in its composition presented the lowest permeate flux decay that occurred gradually along the experimental runs, representing a productivity loss of only 14% for a water recovery ratio near 90%. These results indicate that this membrane has a low propensity to fouling and scaling when treating a wastewater with characteristics like the ones evaluated in this work.

**KEYWORDS:** Membrane Distillation; Petrochemical Wastewater; Reverse Osmosis; RO Concentrate.

**PAPER ID:** CEST2019_00434

# Method Development for the Determination of Heavy Metals such as Copper, Iron, Manganese and Zinc in Aluminum Alloys by ICP-OES, based on wastewater analysis method

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## ABSTRACT

The determination of Heavy Metals such as Copper, Iron, Manganese and Zinc in Aluminum alloys is usually achieved following ASTM E3061-17 Method. Alternatively, for time and cost saving, the laboratory's EN ISO 11885:2009 method for wastewater analysis was appropriately modified producing satisfactory results. Parameters such as matrix effect, wavelength, plasma conditions, calibration standards and dilution conditions of the alloy were examined for the accurate measurement of these elements in Aluminum alloys (e.g. CRMs, according to their Certified Values).

**KEYWORDS:** Aluminum alloys, Heavy Metals, ICP-OES, Modified Wastewater Method, Matrix Effect.

**PAPER ID:** CEST2019_00450

# Magnetite nanoparticles activated coal fly ash zeolites with application in wastewater remediation

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## ABSTRACT

In this study, fly ash zeolites (FAZ) were synthesized by a double stage fusion-hydrothermal treatment. Magnetite nanoparticles were added to FAZ between the two synthesis stages. The obtained nanocomposites (MNPFAZ) and their parent FAZ were studied with respect to their surface characteristics and were tested for decontamination of polluted waters. The experimentally obtained equilibrium adsorption isotherms were described applying different computational models.

**KEYWORDS:** Fly ash zeolites, Magnetite nanoparticles, Adsorption isotherms, Wastewater remediation

**PAPER ID:** CEST2019_00560

# Session 14 - Efficient water resources management in Cr(VI) impacted water bodies

## *Thursday 5 September 2019 - afternoon*

# CrVI contaminated groundwater in the Mediterranean: Case study from Mersin, Turkey

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## ABSTRACT

Increasing population, industrialization, agricultural and tourism activities in Mediterranean countries do not only increase the water demand but also led to deterioration of water quality. Water quality degradation is a common problem in all circum Mediterranean countries and there is an increasing need for the development of a common approach in tackling water resources management problems. ERANETMED CrITERIA project aims to assist the water resources management organizations with an optimization tool that includes documentation and database for decision support. Greece, Italy, Turkey, Cyprus, Jordan and Omman are the partners of the project. The project area in Turkey covers Mersin city and its surrounding. This region is located on the Mediterranean coast and consists of two main hydrogeological parts; the Coastal Aquifer and the Hillside Aquifer. The Coastal Aquifer is represented by a deltaic environment and The Hillside Aquifer is composed mainly of sedimentary and ophiolite rocks. Within the scope of the study, surface and groundwater samples were collected from the region in May 2017 and October-November 2017 and May-June 2018. About 50 sites were sampled in each period. It is determined that none of the samples has above the 50 µg/L limit of EU drinking water standard for total Cr, but some of the samples have CrVI contents above 10 µg/L. CrVI is regarded as a potential carcinogen.

**KEYWORDS:** contamination, CrVI, groundwater, Mersin

**PAPER ID:** CEST2019_00449

# Stakeholder Participation in Prioritization of Water Supply and Demand in Jordan

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## ABSTRACT

Stakeholder participation in prioritization of water supply and demand was developed to assist water resource entities and water users on decision making when coping with water scarcity, climate change and contaminated water in Zarqa River Basin, Jordan. The basin was selected for CrITERIA project to represent a case study of semi-arid area in the Mediterranean. The paper demonstrates a participatory approach of integrating stakeholders' experience and their active involvement in water management. Issues related to prioritization of water demand were identified, and the opinions of stakeholder were ranked according to their role in securing supply and improving supply reliability. The most important issues were ranked according to number of opinions out of the total. Findings showed that water management issues was the major issue in the basin and represents 86% of the stakeholders opinions, followed by water supply as 82% to less extent by water demand as 77% and quality as 68%. Most of the stakeholders agreed that management issues are the major cause of water scarcity. Like expected, water problems in Jordan are 50% associated with poor management and 50% due to water scarcity.

**KEYWORDS:** stakeholder participation, water management, water scarcity, Zarqa Basin

**PAPER ID:** CEST2019_00538

# Synthesis of kaolin supported nZVI and evaluation for the removal of Cr(VI) and Ni from waste streams

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## ABSTRACT

This study involved the synthesis of kaolin-supported nano zero valent iron (K-nZVI) and the evaluation of its performance for the removal of chromates and nickel from contaminated waters. K-nZVI was prepared by mixing a kaolin sample with a $FeCl_3$ solution, followed by the addition of sodium borohydride for the reduction of Fe(III) to the zero valent state. The effectiveness of kaolin stigated parameters included the amount of K-nZVI per solution volume, the concentration of contaminants and the effect of pH. K-nZVI was found to be more efficient for the treatment of Cr(VI) contaminated waters than for the removal of Ni. Using 1 gram of KnZVI per liter of solution, it was possible to reduce 20 mg/L of Cr(VI) to less than 5 mg/L within 3 hours. Starting with the same concentration of Ni, i.e.20 mg/L, the final concentration after 3 hours was aproximately 17 mg/L at pH 5.6, and dropped to 10 mg/L when the pH of the suspension was regulated to the value of 7.5. The results suggest the K-nZVI has a rather limited efficiency for Ni removal.

**KEYWORDS:** nano zero valent iron (nZVI), kaolin, nickel, hexavalent chromium, batch tests.

**PAPER ID:** CEST2019_00581

# A DPSIR Approach to Selected Cr(VI) Impacted Groundwater Bodies within Attica and Eastern Sterea Ellada River Basin Districts

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## ABSTRACT

The holistic approach of the Driver-Pressure-StateImpact-Response (DPSIR) analytical framework in combination with Geographical Information Systems was applied to selected Cr(VI) impacted groundwater bodies. For the characterization of water-quality "state" 157 samples including field blanks were collected during the wet and dry seasons of 2017 and 2018 and several physicochemical parameters were determined. In Loutraki area, Cr(VI) in groundwater ranged from 12 to 62 μg/L while $NO_3^-$ and Cl maximum values were 157mg/L and 218mg/L respectively. Very high concentrations of Cr(VI) (up to 430μg/L), $NO_3$ (up to 245mg/L) and Cl (up to 1039mg/L) were measured in the Schinos alluvial aquifer. Additionally, Cr(VI) up to 131μg/L and $NO_3^-$ up to 156mg/L were identified in the groundwater of Thiva agricultural area. In C. Evia, Cr(VI) was up to 96μg/L while $NO_3^-$ and Cl concentrations were also high reaching 362mg/L and 793mg/L respectively. Finally, the highest Cr(VI) concentrations (up to 11.7 mg/L) were measured in Oinofyta area. The main identified pressures are: i) $NO_3^-$ pollution due to intensive agriculture and urban waste disposal, ii) sea water intrusion due to overpumping and iii) Cr(VI) contamination due to both natural processes and industrial activities (clearly in the case of Oinofyta). In many cases, Cr(VI), $NO_3^-$ and Cl are above the upper drinking water threshold values of the European Directive 98/83/EC. Therefore, the implementation of a constant monitoring program as well as the development of a common database for water managers are among the first steps to address these issues.

**KEYWORDS:** hexavalent chromium, geogenic, anthropogenic, pressures, land use, groundwater

**PAPER ID:** CEST2019_00622

# Harmonization of sampling and chemical analysis for the study of Cr(VI) water contamination in aquifers of eastern Mediterranean and Oman- the CrITERIA project experience

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## ABSTRACT

The CrITERIA project aims to deliver a harmonized data base, to assist water resource management organizations and water users on decision making when coping with water scarcity, climate extreme events and contaminated water. Contamination by Cr(VI) is used as an example of a specific water pressure problem that has to be tackled. Comparative, collaborative research using real situation data from case study areas in each of the participating countries was the base of our methodology. Such areas had already been identified in Greece and Italy and were further monitored, evaluated and compared to potentially affected water bodies in Cyprus, Turkey, Jordan and Oman, suspect for Cr(VI) contamination due to either natural or industrial sources within the same time frame. To enable comparison a common protocol for water sampling has been developed. This served as the base for monitoring water quantity and quality aspects in the case study areas and verify if Cr(VI) contamination levels exceed regulatory levels. The analytical QA/QC has been facilitated by analyzing a proportion of the samples from each case study area in an external accredited laboratory. The paper presents the developed sampling protocol and discusses the challenges during the harmonization of data from sampling and analysis.

**KEYWORDS:** hydrogeochemistry, database, quality control, measurement uncertainty.

**PAPER ID:** CEST2019_00640

# Evaluation of calcium polysulfide as a reducing agent for the restoration of a Cr(VI)-contaminated aquifer

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## ABSTRACT

This work aims at investigating the efficiency of applying calcium polysulfide (CPS) as a reducing agent for the decontamination of a heavily Cr(VI)-contaminated aquifer. Series of batch experiments were carried out in order to evaluate the reductive behavior of CPS towards the aqueous and solid phase. CPS was added in several stoichiometric excesses (2.0X, 2.6X, 4.6X and 6.5X) with respect to the Cr(VI) concentration measured in the contaminated groundwater. The effect of time on Cr(VI) reduction by CPS was tested performing short term batch experiments. In addition, the effect of CPS on other groundwater constituents, e.g. nitrates, and potential mobilization of soil elements, sensitive to redox changes (Mn, As, Co, etc.), were also evaluated. The experimental results showed that CPS can be effectively used for the remediation of the Cr(VI) contaminated aquifer without affecting significantly the soil properties.

**KEYWORDS:** calcium polysulfide, groundwater, hexavalent chromium, reduction

**PAPER ID:** CEST2019_00726

# Occurrence and distribution of hexavalent chromium in ground and surface waters in Cyprus under the CrITERIA project

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## ABSTRACT

The origin and distribution of hexavalent chromium, Cr (VI) over four seasonal cycles was investigated through a conceptual model that included three aquifer systems in Cyprus. An extensive water sampling grid covered two sea water intruded coastal aquifers, namely the Kokkinochoria (A1) and Kiti-Pervolia (A2) aquifers and the Troodos massif (A3). Analytical results give a first insight to the presence of Cr (VI). Areas A1 and A2 exhibit high conductivity and nitrate concentrations (due to NPK fertilisers and seawater intrusion). The highest Cr (VI) value of 26 μg/l is observed in the Troodos area (A3) where Cr(VI) is detected in all water systems sampled (surface, ground and spring). Nonetheless, the highest mean value of 7 μg/l is exhibited in Kiti-Pervolia (A2). Stable isotope analyses show strong deuterium and Cr (VI) correlation with distinct differentiation between water systems. Troodos shows two distinct groups of meteoric and near meteoric waters whereas isotopically enriched water is shown to correspond to the Kiti and Kokkinochoria area.

**KEYWORDS:** Cyprus, Cr(VI), hexavalent chromium, water, sampling, climate

**PAPER ID:** CEST2019_00469

# Preliminary study on Cr-rich groundwater treatment by membrane processes

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## ABSTRACT

The aim of this work is to treat chromium (Cr)-rich groundwaters through membrane processes as alternative to conventional methods. Commonly, the highest Cr (VI) concentrations into groundwater are detected in ophiolitic areas due to water-serpentinite interaction processes. In this work, the water sample treated comes from Bonassola serpentinitic aquifer (La Spezia, Liguria, Italy), in which a Cr(VI) concentration of 84 μg/l was detected. To lower down this value under the threshold established by law, NF/RO laboratoryscale system with membranes named DK (NF polyamide membrane, GE Osmonics) and AD (RO polyamide membrane, GE Osmonics) and CD (RO cellulose membrane, GE Osmonics) were used. The experiments were conducted at different operating pressures. Membrane process treatment was able to lower the Cr concentration within the threshold values, and rejections around 95% were registered for each used membrane. These preliminary results are quite promising for future developments on Cr removal from contaminated groundwaters.

**KEYWORDS:** Chromium, groundwater, ophiolitic rocks, membrane processes

**PAPER ID:** CEST2019_00576

# Geogenic Cr(VI) in groundwater of the Pollino Massif (southern Apennines): occurrence and remediation

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## ABSTRACT

In this study total Cr, Cr(VI), Ni, major and some trace elements were determined in groundwater of northern sector of the Pollino Massif. The investigated area is characterized by ophiolitic rocks consisting of metabasites and cataclastic and highly fractured serpentinites. Two different hydro-facies were observed, reflecting low-temperature water-rock interactions. The Mg-$HCO_3$ hydrofacies was determined through the weathering of serpentinites, the Ca-$HCO_3$ groundwater are due to the interaction with calcschist and metabasites. High Cr(VI) concentrations were detected, exceeding the maximum admissible concentrations by Italian regulation, due to the release of Cr(III) from ophiolitic rocks into water and its oxidation to the hexavalent state. Remediation tests were performed at different liquid/solid concentration, and the kinetic data were interpreted with a suitable mathematical model.

**KEYWORDS:** Water-rock interaction, Hexavalent chromium, Remediation test, Serpentinites, Pollino Massif.

**PAPER ID:** CEST2019_00594

# Session 15 - Environmental impact of maritime transport

## *Thursday 5 September 2019 - afternoon*

# Problems related to Ship Recycling IMO Regulations

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## ABSTRACT

Scrapping market is unique in many respects. The value of its products is more affected by ınternational trade than by shipping economic circles. There are many regulations for the environmentally friendly dismantling of ships. Ship recycling is the eco-friendly method of ship dismantling, it is governed by a set of rules, namely: a) Hong Kong Convention on Ship Recycling - SRC - (implemented by IMO), b) UN Basel Convention and c) E.U. Waste Shipment Regulation. Despite this polyphony in legislation, no clear set of rules has been uniformly applied yet, resulting in institutional discontinuities which are often exploited by shipowners.

**KEYWORDS:** SRC, UN Basel Convention, E.U. Waste Shipment Regulation, Ship Recycling

**PAPER ID:** CEST2019_00933

# European and IMO framework on the disposal of ship waste - Greek legal interventions

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## ABSTRACT

For almost every type of ship-generated waste, there is a variety of waste flows and on-board treatment methods. Studies show that ships use different treatment methods and often only treat part of a waste stream. This results in a difference between the amounts of waste generated and the amounts landed, indicating that measures, such as for example IMO's obligatory Garbage Management Plans, fall short of sustainable and operational efficiency. The fact that IMO is encouraging voluntary cooperation between ports and shipping sectors to solve such problems indicates the urgency in developing the legislator framework of waste management, amongst other issues plaguing the shipping industry. This paper is part of a broader insight into ship generated waste and addresses the existing legislation pertinent to waste management on ships and the role of ports. In this respect the European institutional framework is presented in addition to IMO Conventions and regulations. The Greek legislative framework is also studied, in an attempt to highlight possible novel contributions to the ongoing debate.

**KEYWORDS:** Ship waste, Port waste, European Guidelines, Waste management, Greek legislative framework

**PAPER ID:** CEST2019_00915

# European Environmental Compulsory Framework on Shipping and Ports

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## ABSTRACT

The European Maritime transport policy has embraced important environmental protection schemes that are directly or indirectly connected to shipping and port performance. A comprehensive database on the European Union (EU) environmental policy for the last 30 years has been attempted concerning mainly shipping and ports in terms of mandatory secondary law. The regulatory instruments were classified according to their subject; while, the main patterns were identified and the connections with the International Maritime Organization (IMO) framework were highlighted. The major findings disclose a complementary operation by both IMO and EU.

**KEYWORDS:** shipping, ports, environmental framework, directives, regulations

**PAPER ID:** CEST2019_00921

# A proactive international regulation system based on technological innovations against emerging environmental threats


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## ABSTRACT

The adoption and enforcement of most conventions and regulations have been triggered by a series of disasters that had devastating effects on the marine environment. To improve the safety levels at sea and at the same time to protect the marine environment, it is imperative that the major shipping nations must ratify and make domestic law the international rules. Consequently, MARPOL, other conventions and codes refer to significant actions for minimising most pollution threats to the marine environment. So, member-states through their national ship-owners must comply with every new or amended regulation. This paper will focus on types of pollution that are not covered by any international legislation or are at a preliminary stage for future implementation. These types are: (i) Volatile Organic Compounds (VOC), (ii) Carbon Dioxide ($CO_2$), (iii) SOx Scrubbers Wash Water.


**KEYWORDS:** VOC, $CO_2$, SOx, MARPOL.

**PAPER ID:** CEST2019_00926

# European port trends in environmental issues

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## ABSTRACT

This paper presents the current environmental performance of the European Port Sector, based on the 2018 results of a wide representation of EcoPorts members (90 ports). All the information presented in this research comes from aggregate data of the Self-Diagnosis Method (SDM), a concise checklist against which ports can self-assess their environmental management and compare it to the performance of the EU port sector. The SDM tool is currently managed by the European Sea Ports Organisation (ESPO), which is the responsible body for this study. A set of environmental performance indicators have been analysed and their results have been discussed in this research. These key environmental indicators are categorized in: i) Environmental Management Indicators summarized in the Environmental Management Index; ii) Environmental Monitoring Indicators; iii) Top 10 Environmental Priorities for the port, and iv) Indicators on Services to Shipping offered by the port authority in order to facilitate a greener shipping.In addition to these indicators, selected benchmark performance elements are also introduced on additional topics, such as environmental communication, training or emergency planning. Moreover, the 2018 results have been compared with data on previous years, allowing the analysis of trends over time of the European port sector environmental performance.

**KEYWORDS:** Environmental Performance, Environmental Management, Sustainable Development, Port Management

**PAPER ID:** CEST2019_00736

# The Agia Zoni II oil spill: Short-term fate and imprint on the marine ecosystem of the Saronikos Gulf, Greece

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## ABSTRACT

Herein we examine the spatial and temporal imprint of the September 2017 Agia Zoni II tanker heavy fuel oil spill on the marine ecosystem of the Saronikos Gulf, Greece. Based on the chemical fingerprinting approach we characterize changes in the composition of the spilled oil across sampling sites and evaluate major mechanisms affecting its fate during the first six months from the spill. Overall, the main effects of the incident were confined to the coastal zone during the first three months after the spill where an extended petroleum imprint was recorded in many cases. In the first three months from the spill the oil was affected by combination of rapid biodegradation, volatilization processes and photodegradation, the later playing a role in its early days weathering. Regarding sediments, an imprint related to the incident was recorded in some cases but mild in respect to the chronic petroleum associated anthropogenic background of the affected area.

**KEYWORDS:** Agia Zoni II, oil spill, Saronikos Gulf

**PAPER ID:** CEST2019_00945

# The new Port Waste Reception Facility Directive

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## ABSTRACT

The Directive 2019/883/EU, which repeals and replaces the Directive 2000/59/EK on port reception facilities, aims to achieve a high level of protection of the marine environment by reducing the discharges of waste from ships at sea through the adequate availability of port reception facilities and the delivery of ship generated waste to those facilities. The new Directive reduces the administrative burden establishing the electronic reporting of waste delivered in ports and the exchange of information between Member States as well as a cost recovery system with indirect fees for all ships calling European Ports. The Directive also aligns the legal regime of port waste reception facilities with the international legal framework (MARPOL Convention) and the EU waste legislation.

**KEYWORDS:** Ports, Port Reception Facility, Marine Pollution, Separate Collection of Waste, Cost Recovery System, Green Ship

**PAPER ID:** CEST2019_00178

# The importance of the ecosystem approach in management of the marine environment

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## ABSTRACT

The present paper focuses on the importance of the Ecosystem Approach (EA) for the preservation and conservation of the marine environment. Marine ecosystems are complex entities that contribute significantly to the sustainable well being of people by providing a wide range of goods and services. The economic benefits acquired, due to their function, are enormous and to a large extent impossible to estimate. Thus, due to the extensive and irrational use, and overexploitation of marine resources, arises the need for an integrated, holistic, approach in order to achieve sustainable management. The EA is based on the deeper understanding of the ecological, economical, societal and cultural interactions and constitutes the ultimate tool for the implementation and achievement of sustainable development. EA is the key for balancing out a number of users of marine resources and stakeholders so as to promote the critical role of the green economy and (sustainable) blue growth, which includes maritime activities, fisheries, renewable energy, blue biotechnology etc. The objective always remains to optimize the benefits provided by the oceans while at the same time the EA contributes to minimize the pressures of human activities.

**KEYWORDS:** ecosystem approach, blue growth, sustainable shipping, marine spatial planning

**PAPER ID:** CEST2019_00467

# A comparative analysis between EU MRV and IMO DCS – the need to adopt a harmonised regulatory system.

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## ABSTRACT

This paper analyses and compares the two methods proposed for monitoring, reporting and verifying $CO_2$ emissions from shipping, namely the European Union MRV Regulation (EU 2015/757) and the Global Data Collection System of the IMO for fuel oil consumption of ships adopted as an amendment to MARPOL Annex VI in 2016. The two systems differ considerably in many aspects, such as, for example, the IMO DCS requires the reporting of ships' fuel consumption data, while the EU MRV involves the reporting of $CO_2$ emission; the weight of cargo carried and energy efficiency. As recently as February 2019, efforts have been made to achieve a harmonised approach to both systems, thus supporting compliance and minimising extra administrative costs incurred on shipping companies. The EU MRV system maintains the provisions on publication of individual ships' data of $CO_2$ emissions and energy efficiency, thus keeping transparency as one of its key advantages.

**KEYWORDS:** $CO_2$ emissions, EU MRV, IMO DCS, MARPOL Annex VI, fuel consumption.

**PAPER ID:** CEST2019_00925

# Chemical tanker accidents and the 2010 HNS convention

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## ABSTRACT

The 2010 HNS Convention covers any damage caused by the carriage by sea of hazardous and noxious substances in the territory or territorial sea of a State Party to the Convention. The costs of preventive actions, i.e. measures to avoid or minimize damage, are also covered wherever taken. The HNSC includes preventive measures as any reasonable measures taken by any person after an incident has occurred to prevent or minimize damage, i.e.actions such as clean-up or removal of HNS from a wreck if the HNS present a hazard or pollution risk. It seems that after the CLC (1992), much environmental legislation has lost the concept of pro-activeness/prevention of an environmental hazard and are more focused on compensation and reactiveness. This approach is not consistent with the purpose of environmental legislation and the examination of the basic principles of HNSC in parallel with distinctive environmental hazards, proves this theory of reactive strategy.

**KEYWORDS:** HNS, CLC, Chemical Tankers, IMO.

**PAPER ID:** CEST2019_00934

# Polycyclic aromatic hydrocarbons in surface sediments of the open Aegean Sea: Contribution of maritime traffic

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## ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) were investigated in surficial sediments collected from 39 stations in the open Aegean Sea, in order to assess their occurrence, distribution and major sources. Total PAH concentrations were generally low, comparable to those reported in relatively unpolluted marine areas. The highest values were recorded in the northern part Aegean Sea, which apparently receives more anthropogenic inputs both from continental runoff and atmospheric deposition. Several diagnostic criteria were used to investigate PAHs' origin. Their molecular profile reveals contributions from both pyrolytic and petrogenic sources, with their relative importance displaying significant regional variability. Phenanthrenes, which are known to mostly originate from unburned fossil fuels were found in percentages higher than 50% in the Central part of Aegean Sea and their occurrence was correlated with the marine traffic in the area. The PAH concentrations are significantly correlated with the total organic carbon content of sediments, which indicates that the latter exerts an important control on their transport and ultimate accumulation in sediments.

**KEYWORDS:** PAH, priority pollutants, sediments, open Aegean Sea

**PAPER ID:** CEST2019_00946

# Session 16 - The Non-Ionizing radiation from Wireless technology: A 21 Century Revolution or a Global pollution and Health hazard

## *Thursday 5 September 2019 - afternoon*

# The Adverse Health effects of Non İonizing Radiation on Foetus and Child: is it a mythos or a scientifically evident Global Public Health Challenge

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## ABSTRACT

Exposure to EMF/RF is continuous, multiple, exponentially growing, affecting entire population actively and passively. Children because of wireless-enabled devices are continuously exposed. Potential health Impacts include oxidative stress, carcinogenicity, developmental neurotoxicity, effects on DNA, on fertility, Hypersensitivity, Cognitive impairments in learning and memory etc, well documented in peer reviewed studies and occurring at levels well below ICNIRP/Rec1999/519/EC limits. Human brain is especially susceptible and EMF/RF can cause irreversible damage during nervous system development. Because this technology is rather recent long-term effects have not yet been fully developed nor investigated. It is obvious that present generation of children are part of a big long-term experiment. What is the present status of scientific evidence against gaps/uncertainties and conflicting studies? Are there intrinsic factors explaining part of conflicting studies? Are we excused from applying precaution for serious and irreversible effects, because of uncertainties? What are the challenges in Risk Assessment/Management. The aim of the presentation is to provide an overview of the most recent scientific evidence regarding the above potential effects of EMF/RF especially on foetus and child, along with plausible mechanisms of action and interaction with human electrophysiology. Relevant challenges and dilemmas will be also discussed

**KEYWORDS:** EMF/RF children exposure, vulnerability, effects, risk, precautionary approach.

**PAPER ID:** CEST2019_00078

# Wireless Technology, the dangers beyond the sparkle

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## ABSTRACT

The paper presents briefly studies of various effects on people following the frenzy pace of the 21st century revealing various diseases, including cancer, autoimmune, autistic symptoms and other neurodegenerative syndromes as the international scientific society repeatedly confirms. It also deals with studies and health data in communities "keeping safe distance from electricity plus high-tech facilities" with different social connectivity that show to enjoy an impressive immunity record and exceptional health statistics compared to the former group.

These tallies with Nobel nominee Robert Becker's predicting that electrical functions of the human body will struggle if needed to adjust and survive in a highly electrical environment with frequencies deviating strongly from Schumann resonance.

A close approach and further analysis of high radiation clusters in Greek towns in 2018 reveal pathogenic effects from this environmental contamination and predict an imminent population reduction / death rate changes plus an inevitable reduction in human activity and consumption burdened with soaring health costs if of course public health care will remain available.

Late legislation in various parts around the Globe plus many international efforts indicating strong global concern to arrest further deterioration of this environmental contamination is presented with a "time for action" analysis and proposal.

**KEYWORDS:** Electronic Environmental Contaminants, Public Health, Electromagnetic Pollution, EMF, EMR, Population - ecosystem changes

**PAPER ID:** CEST2019_00048

# On the Mechanism of Rf-Emf-Exposure Associated DNA Damage and Long-Term Risks

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## ABSTRACT

Exposure to radio frequent electromagnetic fields (RFEMF) as emitted by mobile phones, can damage the cellular DNA. During the ATHEM in vitro research program we confirmed 1) genotoxic effects under some but not all conditions, 2) a latency period from start of exposure to first incidence, and 3) the role DNA repair. In human volunteers we found exposure associated genotoxic and cytotoxic effects in mucosal cells. The volunteers' report on little or heavy mobile phone use and the findings in the individuals' cell samples, point towards an accumulation of RF-EMF induced effects over time. Our data corroborate international reports on RF-exposure related DNA oxidation. We observed these exposure related DNA damages associated with activated specific DNA repair mechanisms. Repair failure results in permanent DNA damage, which increases the risk for cell transformation. We observed no acute adverse health effects, however, a potential long term risk can't be excluded. The available data are not sufficient to redefine existing exposure limits to protect also from long term effects, the data call for risk management strategies to promote the safe use of the technology.

**KEYWORDS:** Mobile Phone, Radio frequent Electromagnetic Fields, RF-EMF, Genotoxicity, Biological Mechanism

**PAPER ID:** CEST2019_00345

# Telecommunication signals can cause biological effects: Our 20 years' studies in living systems

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## ABSTRACT

The big bang of telecommunication initiated a few decades ago has caused gradually an enormous increase of the electromagnetic pollution in the environment, the work place and home as well as the personal surrounding of every user. The research of our Electromagnetic Biology Laboratory is focused on the effects of various kinds and sources of telecommunication signals (mobile phones, mast antennas, wireless DECT, baby monitors) on the reproduction of Drosophila melanogaster. Our activities are focused recently on the irradiation of the rodent Mus musculus to reveal defects on memory, behaviour, brain proteome/gene expression and other lesions induced by this type of non ionizing radiation. Our studies inxolve multidisciplinary approaches engaging the most sophisticated techniques, such as the Morris water Maze behavioural task, object recognition task, proteomics/transcriptomics analysis, ROS assay, immunohisto-chemistry, confocal and electron microscopy. The data show a decrease in the reproductive capacity of Drosophila and deficits in osteogenesis of newborn mice, as well as memory impairment and brain protein/gene expression changes following irradiation. Plant growth was shown to be affected by telecommunication signals. A proposed general mechanism of action involves the raise of reactive oxygen species as a major early event governing EMF exposure of living matter.

**KEYWORDS:** cell phones, mast antennas, radiation hazards

**PAPER ID:** CEST2019_00209

# Final results regarding Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission: report regarding mean body weight and heart and brain tumor incidence

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## ABSTRACT

The Ramazzini Institute (RI) performed a life-span carcinogenic study on Sprague-Dawley rats to evaluate the carcinogenic effects of RFR in the situation of far field, reproducing the environmental exposure to RFR generated by 1.8 GHz GSM antenna of the radio base stations of mobile phone. Animals were exposed from prenatal life until natural death to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m with a whole-body exposure for 19 h/day. In 2018, we reported the final results regarding brain and heart tumors. A statistically significant increase in the incidence of heart Schwannomas was observed in treated male rats at the highest dose (50 V/m). Furthermore, an increase in the incidence of malignant glial tumors was observed in treated female rats at the highest dose (50 V/m), although not statistically significant. Furthermore, here we show for the first time the impact of the treatment on mean body weight of the F1 rats; results indicate a statistically significant decrease in group treated at 50 V/m during lactation period. Together with the recent NTP releases, findings from this study provide sufficient evidence to call for the reevaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans.

**KEYWORDS:** radiofrequency radiation, radio base antennas, Sprague-Dawley rat

**PAPER ID:** CEST2019_00057

# New Aspects on Prevention, International Policies and Actions for Public Health of Electro Magnetic Field (EMF) Related Health Problems

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## ABSTRACT

New wireless technologies have been introduced to mankind without any certainty about potentially adverse effects, raising new challenges for medicine, public health and society. Meanwhile in almost every area of life, EMF exposure occurs. Various studies, empirical observations and patient reports clearly indicate interactions between EMF exposure and health problems. There is strong evidence that particularly long-term exposure to certain EMFs is a risk factor for diseases. Similarly, mobile communication-associated diseases, like addiction and orthopaedic disorders increase in frequency and severity over time. Therefore, it is important to carry out adequate assessments and to establish correct parameters for diagnosis. Prior to treatment we should mainly focus on prevention or reduction of EMF exposure in everyday life. Restoring a world without wireless communication is an illusion. It is a matter of propagating, precautions and rules for prudent handling and encouraging and motivating the people to use these technologies as a tool, that is, only when really needed. Furthermore, potentially harmful technologies can be replaced by the implementation of other technologies without loss of comfort with sometimes even faster data transmission, like fibre optic cables. Last but not least, the simplest and easiest strategy is to implement EMF-free zones and periods.

**KEYWORDS:** wireless communication, mobile phones, Electro Hypersensitivity, EUROPAEM EMF Guidelines, 10 Medizinische Handyregeln

**PAPER ID:** CEST2019_00331

# What can we do about Smartphone-addiction – or the dream of a wireless - free digital detox Island?

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## ABSTRACT

Since the introduction of wireless technology, digital devices penetrated all strata of the society. Even children use mobile phones regularly and excessively long. Excessive use may be associated with behavioral changes and symptoms of addiction. We analyzed the available literature and define the fields to respond to the association of "screen time" and altered social behavior. There is academic discussion whether the problematic use of smartphones really fulfils all criteria for the diagnosis "Addiction". Considering addiction as a disorder with severe effects on physical and psychological health, it is clear, that the observed behavior has a similar presentation as addiction in terms of excessive use, impulsive control problems and negative consequences. In its socio-cultural context there is a need for research on the underlying neurobiology and mechanisms. We propose the installation of holiday camps equipped for research activities to study behavioral therapies and at the same time offer immediate help for families or individuals that suffer from modern technology pathologic use. An ideal setting could be a region that abstains from wireless modern technology networks and provides facilities to consume addictive technology under controlled conditions. Currently we are looking for a Greek island that can be dedicated to the project.

**KEYWORDS:** Smart phones, screen time, change of social behaviour, public health, digital detox

**PAPER ID:** CEST2019_00338

# Electromagnetic radiation including G5 frequencies, health effects summary and policy recommendations

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## ABSTRACT

5G millimeter wave technology offers advantages: "smart" homes, "smart" cities and autonomic automobiles. The price: a rise of 30-100% in exposure to electromagnetic radiation near citizens' homes and higher exposure levels inside homes. Scientists have declared current exposure levels not relevant to protect against health effects.1 Pregnant women, babies and children should be protected from chronic exposure of public source in the private home against their will. Electrohypersensitive individuals would be forced to leave their homes and become refugees. 2 In Brussels as well as other cities, 5G has been halted due to health concerns.

**KEYWORDS:** electromagnetic fields, electromagnetic radiation, G5, health effects, non-thermal

**PAPER ID:** CEST2019_00970

# Session 17 - Advanced oxidation processes

## *Thursday 5 September 2019 - afternoon*

# Fluoride-free Anodization of Titanium and the Photocatalytic Behaviour of the Produced $TiO_2$ Nanostructures

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## ABSTRACT

Current methods for anodizing titania to produce immobilized titanium dioxide ($TiO_2$) photocatalyst require the use of hazardous fluoride electrolytes. A fluoride-free electrolyte anodization method was developed. The electrolytes tested in this study were both bromide- and chloride-based and contained ethylene glycol as an additive. Under optimized anodization times and temperature conditions the alternative electrolytes led to growth of stable immobilized $TiO_2$ layers. Crystal phases and topography of the produced $TiO_2$ layers were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD) and photoelectron spectroscopy (XPS). Photocatalytic experiments showed that differences in the crystal phases had a strong effect on the degradation of the model aquatic contaminants carbamazepine and phenol. Nitrogen doping using urea made the photocatalyst more efficient by red shifting light absorption from UV into the visible region. The photocatalytic ability of fluoride-free anodized immobilized $TiO_2$ photocatalysts has previously not been investigated. Using electrolytes without fluorine can be a more sustainable and a safer way to produce immobilized $TiO_2$.

**KEYWORDS:** photocatalysis, titanium dioxide, Phenol, hydroxyl radical, electrochemical anodization

**PAPER ID:** CEST2019_00533

# Laboratory scale study of photolytic and photooxidative treatment for removal of pharmaceutical residues from water matrices


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## ABSTRACT

Photolytic and photooxidative degradations of diclofenac (DICL), naproxen (NAPR) and carbamazepine (CARB) were studied applying a batch photo-reactor containing low-pressure mercury lamp emitting at 185 and 254 nm. The drugs were added in concentration of 5×10-6 M to ultra-pure water (UPW) and biologically treated wastewater (BTWW). Almost complete photolytic and photooxidative degradations were observed by VUV irradiation for DICL, NAPR and CARB in UPW within 1.0, 1,0 and 1.5 min, respectively. But in the spiked BTWW matrix, the efficient degradation of DICL, NAPR and CARB were achieved within 1, 2 and 10 min, respectively. Several aromatic degradation products of DICL, NAPR and CARB were identified by quadrupole time-of-flight mass spectrometer hyphenated to an ultrahigh performance liquid chromatograph after preconcentration with off-line solid phase extraction upon irradiation of the UPW matrix spiked with the selected drugs at 254 nm. For several degradation products, chemical structures differing from those previously reported have been proposed. Moreover, acridine has not yet been reported as photodegradation product for DICL. Almost complete degradation of DICL, NAPR and CARB as well as their degradation products by VUV+PhO in BTWW took place in 5, 10 and 30 min, respectively applying only one 50 cm long photo-reactor and oxygen stream. The efficiency of this technology can be increased by simultaneous application of more photoreactors in a flowing system.



**KEYWORDS:** Diclofenac; Naproxen, Carbamazepine, UV irradiation; Low-pressure mercury lamp

**PAPER ID:** CEST2019_00596

# New evidence of accelerated elimination of an emergent water pollutant by $TiO_2$ assisted photo-oxidation

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## ABSTRACT

This study focuses on the photocatalytic degradation of a pharmaceutic compound essentially employed for the treatment of hypertension using $TiO_2$ as catalyst and UVA irradiation. An efficient elimination yield of 99% was obtained after 10 minutes of irradiation at initial pollutant concentration of 5 mg/L and 1.2 g/L of catalyst. A higher mineralization yield of 87% was reached in 2h of reaction. Results showed that under all studied process conditions the target molecule was degraded according to a pseudo first order kinetics. Obtained data clearly demonstrate the potential application of the investigated process for the remediation of polluted water.

**KEYWORDS:** emergent water pollutant, photocatalysis, water treatment, removal, mineralization

**PAPER ID:** CEST2019_00652

# Elimination of relevant pharmaceuticals in hospital wastewater from Colombia by combination of a biological system with a sonochemical process

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## ABSTRACT

In this work conventional biological treatment was applied to raw HWW. After 36h, such process mainly removed biodegradable substances, but had a limited action on the pharmaceuticals. The resultant biotreated water was submitted to the sonochemical process (375 kHz and 88 W $L^{-1}$, 1.5 h), which due to its chemical (i.e., radical attacks) and physical (i.e., suspended solids disaggregation) effects induced a considerable pharmaceuticals degradation (pondered removal: 58.82%), demonstrating the complementarity of the proposed combination. Afterwards, $Fe^{2+}$ (5 ppm) and UVC light (4W) were added to the sonochemical system (generating sono-photo-Fenton process), which significantly increased up to 82.86% the pondered pharmaceuticals removal. Finally, it was found that 91.13% of the initial pharmaceuticals load in HWW was removed by the biological/sono-photo-Fenton combination.

**KEYWORDS:** Pharmaceuticals elimination; Processes combination; Biological treatment; Advanced oxidation process; Sono-photo-Fenton

**PAPER ID:** CEST2019_00900

# Wastewater treatment processes utilizing hydrodynamic cavitation

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## ABSTRACT

In the present work, the potentiality of the hydrodynamic cavitation (HC) for the degradation of organic pollutants from industrial effluents has been studied. Cavitation is a phenomenon of formation, growth, collapse of microbubbles or cavities, in a few milli- to microseconds and releases large magnitude of energy in a short span of time. The main chemical effects of HC are the generation of highly reactive free radicals in the aqueous environment; it is possible to exploit these radicals for the intensification of chemical processes such as degradation of the water pollutants. HC represents an innovative advanced oxidation processes that can replace or be combined with the traditional oxidation processes. Lab experiments have been performed to remove pollutants as dyes (methyl orange) that can be present in textile effluents. In order to investigate the potentiality of HC, the effect of several operative conditions was investigated, as the presence of additivities (hydrogen peroxide and titanium oxides), contaminant concentration and cavitation device (venturi tube and orifice plate). The experiments showed the positive effect of hybrid treatment on pollutant degradation.

**KEYWORDS:** Hydrodynamic cavitation; Wastewater treatment; Advanced oxidation processes Dyes; Venturi tube, orifice plate

**PAPER ID:** CEST2019_00335

# A practical time discretization methodology for adjusting the dosage profile in photo-Fenton processes


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## ABSTRACT

This work is aimed at systematically determining conditions enhancing the performance of Photo-Fenton processes and improving the mineralization of aqueous solutions containing emergent pollutants. Current investigations cannot provide definitive solution approaches yet and optimizing $H_2O_2$ dosage is still a challenge. Thus, this work adopts recipe optimization concepts based on time discretization for experimentally addressing the optimization of the dosage profile. Results show the practicability of the solution, and discussion provides insight for the generalization of an optimization procedure.



**KEYWORDS:** Photo-Fenton, $H_2O_2$ dosage profile, recipe optimization

**PAPER ID:** CEST2019_00637

# 3D printed lab-scale raceway ponds reactors applied to photoFenton processes

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## ABSTRACT

In this work, two different printable materials, PLA (polylactic acid) and Timberfill were evaluated in terms of chemical resistance to photo-Fenton reactants and viability for conducting the assays in raceway pond reactors (RPRs). The modeling and testing of chemical reactors, in particular their prototyping can benefit from additive manufacturing. However, the preparation of RPRs by 3D printing to study photo-Fenton reactions has not been investigated. First, these raw materials were exposed to $H_2O_2$/Fe(II) solutions at pH=3±0.2 under sunlight to simulate photo-Fenton environment. TOC analysis showed that PLA did not alter the concentration of TOC of the solution in the presence of $H_2O_2$ and iron. Furthermore, printed PLA and Timberfill lab-scale raceway ponds were examined under similar conditions in addition 30±0.5 mg·L$^{-1}$ of caffeine as contaminant and involving the simultaneous exposition of the artificial UVA light. Through different assays in the PLA pond, TOC was not rised during operation, and no organic matter contaminated the solution from its container. However, in the case of Timberfill, the TOC of solution increased that represented the material destruction during contact time. This work shows the promising capability of PLA to be used as photo-Fenton reactor.

**KEYWORDS:** Photo-Fenton, Wastewater treatment, PLA, Timberfill, 3D printing

**PAPER ID:** CEST2019_00639

# Bacterial Inactivation & Study of Damages in Subcellular Level during Disinfection of Aqueous Samples

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## ABSTRACT

The aims of the study were i) to investigate ozonation and UVA/$TiO_2$ photocatalysis as water disinfection techniques & ii) to study damages in subcellular level, in terms of disinfection effects on cellular components (lipids, membrane and proteins). Disinfection experiments were conducted with the bacterial strains Escherichia coli, Pseudomonas aeruginosa and Bacillus cereus. Ozonation proved to be more effective for the disinfection of aqueous samples compared with UV-A photocatalysis, as for the Gram (-) bacteria a complete reduction was achieved within 15 min, whereas for the Gram (+) bacteria the same reduction was obtained within 30 min. Regarding the subcellular level the lipid peroxidation progressed at an exponential rate in the course of treatment. The ONPG hydrolysis assay showed negligible alterations in teh course of treatment, indicating that the cell membrane may act as an effective barrier between the cytoplasm and the outer solution in each case.

**KEYWORDS:** Photocatalysis, Ozonation, Membrane permeability, Lipid peroxidation, SDS-PAGE

**PAPER ID:** CEST2019_00665

# Session 18 - Solid waste management

## *Thursday 5 September 2019 - afternoon*

# Waste to Energy Initiatives at the Local Level

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## ABSTRACT

The problem on solid waste has been and still remains as a major problem in the Philippines especially in developing countries where proper facilities for collection and disposal are not always available. In Metro Manila alone, daily waste generation stands at 8,600 tons coming from a population 12.8M. The infrastructure has already reached its maximum capacity resulting to major upsets in environmental quality. The sheer volume of solid waste generated daily poses a big challenge for disposal options since reuse and recycling methods are the only the socially acceptable options. Incineration though not strictly banned by law has never been initiated apparently due to lack of a scientific understanding of the process and its appreciation as a safe and viable process of handling solid waste. Meanwhile, depletion of available capacities of sanitary landfills proceeds at an accelerated phase because of the sheer volume of solid waste to be disposed compounded by the reluctance to implement waste to energy options of waste disposal. In a bid to address the issue, the Philippine Congress legislated a law to require all local government units (LGU) in the country to develop a comprehensive solid waste management plan. Notwithstanding these efforts, the problem remains far from over. The volume of waste ending up in the landfill continues to be the dominant concern. Should the the problem persist, hazards, ground and surface water contamination, flooding, air pollution and spread of diseases will continue to present major problems. Hence, initiatives to reduce the volume of waste that is both environmental sound and sustainable is called for. A waste to energy (WTE) path can easily fulfill these requirements. This paper provides information on WTE developments in the Philippines seeking to encourage LGUs to consider WTE as one of the waste diversion methods in promoting environmentally sound management (ESM) of Municipal Solid Waste (MSW). Complementing this objective is for the country's Department of Energy (DOE) to change its policy on Renewable Energy (RE) to include solid waste as part of the biomass category and incorporating market driven incentives to encourage investors and waste practitioners to choose WTE as a sustainable approach in managing MSW while considering the triple bottom line (TBL) approach (Profit, People and Planet) to ensure sustainability.

**KEYWORDS:** Waste of energy, solid waste, Philippines

**PAPER ID:** CEST2019_00841

# Putting Accelerated Carbonation of Bottom Ash into practice: Operation of a Continuous-Feed Pilot Scale Reactor

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## ABSTRACT

Bottom ash (BA) is the dominant residue from municipal solid waste or refuse-derived fuel incineration. Disposal costs chiefly depend on the leachability of trace metals and salts. The mobility of these constituents is classically minimized by ageing for several months. Ageing involves the oxidation of metals, dissolution and precipitation reactions, and most importantly, car-bonation of BA induced by the uptake of carbon dioxide. Enhanced exposure to carbon dioxide sources has been referred to as accelerated carbonation. Here we report on the successful implementation of the accelerated carbonation of BA in a continuous pilot scale rotating drum reactor supplied with the exhaust gas of a cogeneration plant. The system was tested in 20 field trials that aimed at stabilizing the ash such as to comply with the regulatory standards for disposal on a lower landfill class or for its geotechnical re-use. Performance and process efficiency were addressed by maximizing the reactor loading and minimizing the BA residence time. While leachates of the fresh BA ash were indicative of a hazardous waste pertaining to a class III landfill, the carbonated material fulfilled the regulatory standards for a class I landfill and, in addition, complied with the standards for geotechnical re-use. In the field trials bottom ash residence times could be cut to 60 minutes thus allowing for an on-line integration of the process.

**KEYWORDS:** bottom ash, enhanced carbonation, scale-up, contaminant leaching

**PAPER ID:** CEST2019_00063

# Improving the quality and quantity of source-separated household food waste in areas of different socio-economic characteristics: A case study from Lübeck, Germany

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## ABSTRACT

A method aiming at improving source-separation performance of household food waste (FW) was investigated in two areas with different socio-economic characteristics in Lübeck, Germany. This included the test of a new FW collection system including the distribution of small collection buckets to each household. In addition, an information event was organized and households were provided with information material including a waste sorting guide. The study also aimed at assessing the FW avoidance potential. A method for waste composition analysis for FW from households was applied for the assessment. Both areas showed an increase of the source-separation of FW from 17.4% to 60.3% (A, socio-economic low area) and from 16.6% to 65.7% (B, socio-economic medium area) respectively. Compared to the waste composition in the bio-waste (BW) bin prior the investigation, macro impurities (including paper waste) reduced from around 6.1% to 0.6% (A) and from 13.6% to 1.2% (B). In this respect, the investigated collection system showed a significant improvement to the regular waste collection system.

**KEYWORDS:** Food waste, Waste composition analysis, Waste valorization, Circular Economy, Socio-economic assessment

**PAPER ID:** CEST2019_00484

# Conversion of coal fly ash by-products into high-grade zeolites by a quasi-natural crystallization process

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## ABSTRACT

This study is focused on a technologically viable approach to obtain zeolite Na-X by aging of lignite coal fly ash (FA) in alkaline solutions at ambient conditions resembling a quasi-natural crystallization process. Reaction products were characterized for their phase composition by X-ray diffraction, morphology by scanning electron microscopy (SEM) and surface properties by nitrogen adsorption/desorption isotherms. The effect of the crystallization time was investigated as an important parameter for the extent of zeolitization. The highest yield of zeolite Na-X was achieved by incubating FA in 1.5 mol/l NaOH for one year. However, significant crystallization extent is established after eight months of alkaline aging. Fly ash zeolites (FAZ) obtained by atmospheric crystallization have specific surface values up to 280 $m^2$ /gFAZ.

**KEYWORDS:** Coal ash utilization, Fly ash zeolite, Zeolite Na-X, Quasi natural crystallization

**PAPER ID:** CEST2019_00548

# Methane Production and Waste Stabilization in Anaerobic Co-digestion of Food Waste, Biosolids and used Cooking Oil

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## ABSTRACT

Restaurants, food processing industries and café kitchen generate significant amounts of food waste (FW) and waste cooking oil. Septage treatment also generates large amount of biosolids. This study explores the application of anaerobic process, which generates methane, a renewable energy resource, to these wastes. The performance of batch anaerobic co-digestion of food waste, biosolids and waste cooking oil at varying waste ratio, namely 0, 30, 50 and 70 mass percent volatile solids (VS) was determined. The seed sludge used was a combination of cow rumen obtained from a slaughterhouse and pig manure. The waste mixture that did not contain waste oil yielded the highest amount of methane (61.5 mL $g^{-1}$ VS), showed the highest VS destruction (48.51%) and rate of hydrolysis (first-order rate constant of 0.187 $d^{-1}$). Rates of hydrolysis and methane production, methane yield and methane content of the biogas produced were lower at higher amounts of oil added but constant amount of seed sludge. Nevertheless, the mixture containing 70% waste oil produced 9.54 mL $g^{-1}$ VS. Compared with other simple means of disposal, this method of the three kinds of wastes is a promising energy-generating option for treating food waste.

**KEYWORDS:** biogas, COD, fats, hydrolysis, septage

**PAPER ID:** CEST2019_00895

# Quantitative and qualitative assessment of food waste of the hospitality sector in Greece

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## ABSTRACT

In Greece, approximately 1.8 million tonnes of food waste are generated each year, mostly disposed of in landfill. Food waste is of concern for businesses in the hospitality and food service sectors, which in Greece dispose of an estimated 100,000 tonnes of food waste annually, almost 6% of the total food waste generated in Greece. The food waste composition analysis and generation rate were determined through Waste Analysis Campaigns (WACs). It is in the scope of the present work to illustrate the results of food waste compositional analysis on samples from the study area of the targeted hotels of Heraklion and Hersonissos in the Region of Crete. The increased need for food waste diversion from landfill and the existing policy which promotes its separate collection and treatment necessitates the comprehensive characterisation of food waste in order to fill information gaps and uncertainties towards food waste management improvements. The 'Fresh Fruits' and 'Fresh Vegetable and Salads' represented the greatest proportions (56.5%) in each WAC for the hotels. A certain degree of variability is observed though due to seasonal variation. The recorded low impurities content (~0.6%) demonstrate that the participating hotels practice effectively the source separation of the generated food waste.

**KEYWORDS:** waste management, food waste, hospitality sector, compositional analysis, Greece

**PAPER ID:** CEST2019_00965

# Valorisation of waste polyethylene by blending with ethylenevinyl acetate and incorporation of a new type of compatibilizer

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## ABSTRACT

Nowadays polyethylene is one of the polymers produced in the greatest volume, therefore, parallelly the amount of generated waste polyethylene (w-HDPE) significant as well. Valorisation and recycling of wHDPE can be realized by blending with different types of polymers and/or elastomers in order to result in thermoplastic elastomer end-product for example. One potential candidate can be ethylene-vinyl acetate (EVA) nevertheless interfacial interaction between w-HDPE and EVA is inadequate reflected in deterioration of mechanical properties of the blend in spite of the fact that they possess favourable mechanical properties themselves and they may complement each other. For the purpose of boosting of interfacial interactions between these two polymers experimental olefinmaleic-anhydride based additives have been incorporated in the blends after optimization of the processing temperature. Impact and tensile tests have been carried out in our research work besides microscopy measurements and investigation of the effects of additive structure by FT-IR and rheology.

**KEYWORDS:** polymer blend, waste management, mechanical tests, interfacial interaction, valorisation

**PAPER ID:** CEST2019_00325

# Biosynthesis of xanthan gum from fermenting potato peels extract: Influence of sucrose supplementation on yield and apparent viscosity

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## ABSTRACT

Several residues and carbohydrate-rich effluents have been studied as a possible alternative in the substitution or implementation of the traditional cultivation medium of xanthan gum, helping in the management of these residues and, consequently, reducing fermentation costs. This work studied the extract obtained from potato peels for xanthan gum production by fermentation with or not sucrose supplementation. Xanthan gum yield ranged between 2-4 g $L^{-1}$, and a linear relationship between the amount of added sucrose and gum produced was observed. In addition, the peak of gum production with higher viscosity was able to be anticipated with the sucrose supplementation, from 72 to 24 h (with the 5% of sucrose in comparison with the control condition). The maximum viscosity was 950 mPa.s, a result higher than many published papers that use residues as culture medium for xanthan production.

**KEYWORDS:** residue, viscosity, Xanthomonas, fermentation

**PAPER ID:** CEST2019_00025

# The use of recycled human food waste and leftovers in the aquaculture industry for the partial replacement of commercial manufactured feed as a more sustainable and environmentally friendly practice: Recent research and findings

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## ABSTRACT

Food waste or leftovers generated by various raw or processed food materials that are not consumed but instead are usually disposed to waste landfills are regarded as a global issue which impacts human health and environmental sustainability. An enormous pressure in disposing of food wastes in landfill sites already exists and is predicted to be increased during the forthcoming years whereas simultaneously various environmental problems associated with solid wastes have to be solved. On the other hand, a percentage higher than 60% of the operational costs of any modern aquaculture industry concerns the supplies of protein-enriched- aquafeeds which among other characteristics are commercially manufactured sources of additional healthy nutritious and digestible proteins that tend to be expensive. Recent research and published data evaluating the use of recycled food wastes as a partial replacement of fishmeal-based feeds in diets of several species suggest that this can be considered as a more sustainable and environmentally friendly practice.

**KEYWORDS:** Food waste, recycling, fish feed, aquaculture

**PAPER ID:** CEST2019_00141

# Extraction of Oil from Spent Grounds Coffee using Ultrasound as Pre-Extraction Method

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## ABSTRACT

The treatment and processing of coffee annually produces a large volume of biological waste, which contributes to environmental pollution, it is estimated that coffee production generates approx. 6 million tonnes of spent coffee grounds per year in the world (GETACHEW and CHUN, 2017). Thus, the sludge becomes a residue equivalent to approximately 50% of the roasted coffee in the soluble coffee industry (PUJOL D. et al. 2013). The major problem of the discharge of spent ground coffee in the environment is the presence of caffeine and phenolic compounds when in concentration above 2.5% due to toxicity to plants and soil microorganisms. Therefore, this project proposed to extract the oil from the coffee grounds using the ultrasound method as a pre-extraction method to the soxlet extractor, aiming at eliminating the environmental contamination of the residue and at the same time adding value through the study of the oil for use in cosmetics due to the high amounts of phenolic compounds and antioxidants. The results showed that the application of the ultrasound as a pre-extractive method during 30 min allowed to increase the oil quantity by 70% in relation to the use of the soxlet extractor only, maintaining the quality of the composition.

**KEYWORDS:** Spent ground coffee; biological waste; ultrasound method; oil from coffee.

**PAPER ID:** CEST2019_00287

# Analysis of the content of germanium, tellurium and thallium in the grounded waste of electronic equipment

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## ABSTRACT

The article draws attention to the problem of the presence of selected metals in waste electrical, electronic equipment (WEEE). These metals belong to the group of critical metals (germanium), strategic metals (tellurium) and highly toxic elements (thallium). Due to low content of these metals in e-waste, they are usually ignored during e-waste analysis, therefore they belong to the least-known metals in the literature regarding waste recycling. Their presence in WEEE can cause them to be concentrated in the environment during improper e-waste processing. The article presents the applications of Ge, Te, Tl in electronic equipment, quantities identification of these metals in a variety of electronic equipment elements, paying special attention to the ability to accumulate/concentrate Ge, Te, Tl in individual fractions after the e-waste shredding and grinding process This research aims to determine possibility getting of these metals into the environment, during the storage and processing of e-waste (especially in the unit processes of disassembly, separation, shredding), in the case of uncontrolled electronic waste handling and disposal.

**KEYWORDS:** e-waste processing, waste electrical, electronic equipment (WEEE), Technology Critical Element (TCE)

**PAPER ID:** CEST2019_00523

# Reducing the environmental impact of construction wastes by their use in the preparation of construction mixtures

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## ABSTRACT

This paper is focused on the utilization of Recycled concrete aggregate (RCA) as a substitute for natural aggregate. Concrete produced in this way is characterized by worse properties than standard concrete, mainly due to the properties of the RCA. One option is to modify the surface of the RCA and thereby to improve the properties of the concrete as a whole. By the method described in this paper, we have succeeded in reducing the total water absorption of concrete by 50%, while the compressive strengths on the tested cubes with the edge 100 mm were 55 MPa.

**KEYWORDS:** C&D waste, recycling, concrete, water absorption, compressive strength

**PAPER ID:** CEST2019_00617

# Health Care Waste Management: Challenges and Solutions

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## ABSTRACT

Limited attention has been paid to health-care waste management despite an increase in public concern about the management of such waste on a global basis. The objective of this study was to analyse the issues and challenges of health-care waste management as well as possible solutions. It is estimated that about 50% of the world's population is at particular risk from improperly treated health-care waste. In most countries wastes from hospitals and other health-related facilities are not required to be treated to remove the thousands of high volume health-care chemicals. Incomplete removal can lead to formation of transformation products which in some cases may be more toxic than the parent compounds. Uptake of contaminants by earthworms and plants may contribute to biomagnification in terrestrial food web, and thus, their food-chain effects need attention. Humans can be exposed to chemicals through the consumption of contaminated water and food. Stewardship and green pharmacy have the potential to deliver positive environmental health. The whole life cycle of a compound or health-care product has to be considered when making risk management and risk reduction decisions. Such life-cycle assessment can be made by various stakeholders in the health-care chain, including manufacturers, doctors, pharmacists, and patients.

**KEYWORDS:** Health-care waste management; Sustainable practices; Protection of the environment; Environmental pollution; Infectious waste

**PAPER ID:** CEST2019_00787

# Microbial Biodiversity of Municipal Solid Waste (MSW) dumpsites of Cochin, Kerala, India.

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## ABSTRACT

Cochin, the commercial and industrial centre of Kerala, lies on the south-west coast of Arabian sea. It covers an area of 94.88 $Km^2$. There are two major dumpsites in the city, one at Brahmapuram and other at Kalamassery. The proper management of the waste has been a challenging task for the concerned authorities. One of the cost effective combating ways is the use of microbes. A preliminary attempt was performed to quantify both the physicochemical and microbial characteristics of the dumpsite soils and evaluated by using standard techniques. The soil samples from the study sites showed higher values for bacterial and fungal counts than the control soils. Some of the isolated species belonged to the genera Bacillus, Pseudomonas and Klebsiella. As the findings reveal that the dumping site soils have wide microbial diversity which can be exploited for sustainable and eco-friendly bioremediation approach.

**KEYWORDS:** Municipal solid waste dumpsite soils, Microbial biodiversity, Cochin.

**PAPER ID:** CEST2019_00730

# Challenging the belief that landfill has higher net $CO_2$ emissions than waste-to-energy incineration or composting

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## ABSTRACT

Landfill is generally believed to have higher greenhouse gas emissions than composting or waste-to-energy. The EU Landfill Directive requires nations to progressively divert biodegradable waste away from landfill. Waste disposal in landfill is at the bottom of its Waste Hierarchy. Many nations also ban landfilling of plastic. These policies may inadvertently increase global warming by increasing incineration. In Europe, Waste-to-Energy (WTE) incineration emits 72,000,000 tonnes of fossil $CO_2$ a year, increasing yearly. Landfill methane is now generally captured. Nations that directly measure landfill gas emissions (the UK, Ireland and USA) now report about 65- 75% landfill gas recovery; the average for California is 79%. It is now almost always used to generate electricity. When burnt it does not emit fossil $CO_2$. Landfill is a carbon sink, sequestering about half of the organic carbon deposited in it, long-term, like peat. This reduces the global flux of $CO_2$.

**KEYWORDS:** landfill emissions, waste-to-energy, Waste hierarchy, composting

**PAPER ID:** CEST2019_00909

# Session 19 - Wastewater treatment

## *Friday 6 September 2019 - morning*

# Treatment of High Strength Industrial Wastewater utilizing Canna X generalis in a Simulated Vertical Flow Constructed Wetland Set-up

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## ABSTRACT

In the Philippines, DENR has mandated the regulation of oil and grease, COD, and TSS for automotive parts manufacturers. Wastewaters from industries have varying pollution strength that requires efficient treatment systems of combined physical, biological, and chemical processes. However, these methods tend to be labor intensive and costly. Constructed wetlands have become a popular treatment method for industrial wastewater because of its simplicity requiring less technical expertise compared to other technologies. In this study, four vertical subsurface flow constructed wetlands composed of cylindrical drums with diameter of 30 cm and height of 90 cm were designed to treat industrial wastewater in parallel experiments. The four constructed wetland units had various set-ups (with & without Canna X Generalis, with & without zeolite, with & without air vent) to determine the effect of the treatment efficiency. Water quality samples were collected from each unit, and were analyzed for pH, ORP, TSS, COD, aluminum, oil and grease. The findings show that the constructed wetland with zeolite and air vents demonstrated higher removal efficiency in comparison to a constructed wetlands without these features. The removal efficiencies registered 93.35% and 90.67% for COD and TSS, respectively.

**KEYWORDS:** wastewater treatment, wetland, automotive wastewater, Canna X generalis, natural systems

**PAPER ID:** CEST2019_00806

# Quality Improvement of collected rainwater by elimination of micropollutants to sea site settlements with the use of new technologies

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## ABSTRACT

The continuous increase of water needs in sea site settlements, created the need to collect rain waters in order to use them, after their treatment to achieve the necessary quality improvement. To realize that we need at first to mark the water sources in the neighboring area of the serviced district, in order to collect the necessary water quantities, for the covering of the existing necessities. One part of the sustained pollution is removed from the water treatment installations but the rest remains in the natural medium. Further treatment includes the abstraction of pollutants by natural mechanisms, like biodegradation, photolyse, votalisation, adsorption, degradation, fixation from vegetables. Further water treatment will include addition of rain water coming from roofs and other waters from country side areas, when enough water quantities are available. The water will be treated with conventional methods, in order to succeed the foreseen quality and finally get transferred to ZONES of REGECTION WITH SUITABLE VEFETATION (ZRV) for the elimination of micropollutants, as well as other pollutant traces.

**KEYWORDS:** sea site settlements, rain water, ZRV

**PAPER ID:** CEST2019_00405

# Systems improvement and energy savings program for the existing conventional extended aerobic treatment of domestic wastewater in compliance of DAO 2016-08 new general effluent regulations

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## ABSTRACT

This is a system improvement and energy savings program for a Sewage Treatment Plant treating wastewater coming from a shopping mall operation. Wastewater from shopping mall is considered domestic wastewater, which needs a big volume of water, and produced big amount of wastewater. Generators of wastewater such as in this case, from shopping mall, is mandated to be responsible for the collection, treatment of wastewater, and the ultimate disposal of the treated wastewater, as well as the separated solids, in a manner that is safe, and within the new effluent regulations as provided under DENR Administrative Order No. 2016- 08. Under this new effluent regulations which only takes effect on June 2016, shopping mall is now mandated to meet stringent parameters to comply, particularly on Nitrate, Phosphate, Ammonia and Surfactants. To comply the new general effluent regulations, there were innovative solutions and energy programs implemented, resulting of savings in water and energy.

**KEYWORDS:** Aerobic, mall effluent, reuse wastewater, energy and water savings

**PAPER ID:** CEST2019_00904

# Novel Polyethersulfone (PES) Alpha-Zirconium Phosphate (αZrP) Ion Exchange Mixed Matrix Membranes for Effective Removal of Heavy Metals from Wastewater

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## ABSTRACT

In this study, novel polyethersulfone (PES) alphazirconium (α-ZrP) ion exchange mixed matrix membranes were fabricated via phase inversion method using nano-sized alpha-zirconium phosphate (α-ZrP-n) and polyvinylpyrrolidone (PVP) as dispersant nanoadditives in the dope solution preparation. The impact of α-ZrP-n loading on the removal of Cu(II), Zn(II), and Ni(II) from wastewater effluent was studied by varying the α-ZrP-n concentrations from 0.1 up to 1 wt.% while fixing the PES concentration at 10 wt.%. The composite membranes surface morphology was characterized using scanning electron microscopy (SEM) and contact angle. The pure water flux was also determined under vacuum filtration while the removal of all heavy metals was carried out via the inductively coupled plasma - optical emission spectrometry (ICP-OES). The optimal results incorportaing 0.3 wt.% α-ZrP (i.e. Z-2 membrane) showed 98, 86, and 99% removal efficiency of Cu(II), Zn(II), and Ni(II); respectively, and a water flux of 3013.5 $L/m^2$ h (MH) that was higher than that reported using the pristine PES membrane (i.e. 985 LMH). These findings suggested that the use of α-ZrP nanoparticles in membranes offers significant potential in heavy metal removal with a considerable high water flux.

**KEYWORDS:** Wastewater; membrane; zirconium phosphate; heavy metals; removal.

**PAPER ID:** CEST2019_00937

# Performance evaluation of a flat sheet self-forming dynamic membrane (SFDM) for municipal wastewater treatment containing organic micropollutants


## Millanar-Marfa J.M.J.[1], Borea L.[2,*], Castrogiovanni F.[2], Napodano P.[2], Hasan S.W.[3], De Luna M.D. G.[1,4], Belgiorno V.[2], Naddeo V.[2]

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## ABSTRACT

Membrane bioreactors gained increasing interest due to its small footprint and high efficiency. Nonetheless, high capital and operational cost of MBR remains a challenge. With the aim to reduce MBR cost, this study used Dacron mesh to form a dynamic membrane that serves as a substitute to conventional membranes to treat municipal wastewater containing organic micropollutants (OMPs). The SFDM system obtained COD, $NH_4$-N and $PO_4$-P removal of 95%, 47% and 14%, respectively.

**KEYWORDS:** Dynamic membrane, MBR, organic micropollutant, fouling

**PAPER ID:** CEST2019_00938

# Nitrification inhibition test of salty wastewater containing Tetrakishydroxymethyl phosphonium sulphate (THPS), formaldehyde and methanol using salt-adapted nitrifying bacteria, an alternative test method to ISO method

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## ABSTRACT

Nitrification inhibition test is a standard method to test if the chemicals or samples received by wastewater treatment plants (WWTPs) are toxic to nitrifying bacteria in the wastewater treatment plant. Nitrification inhibition test based on ISO method ISO9509 or modified ISO9509 method (REFLAB method) cannot differentiate the toxicity between salt and toxicant in the sample, which is unrealistic for regulation of salty wastewaters that are treated in WWTPs with sufficient volume to dilute salts to harmless levels. To overcome the toxicity due to salinity to the nitrifying bacteria, salt-adapted nitrifying bacteria were grown on the Z400 MBBR carriers. The aim of this work was to validate and compare the nitrification inhibition of samples measured from salt-adapted nitrification inhibition test method (DTU method) with REFLAB method. The new salt-adapted nitrification inhibition test was validated by investigating the statistical uncertainty on the use of new test method with the existing REFLAB method. The inhibition concentration of formaldehyde and methanol were similar when nitrification inhibition experiment was conducted using DTU method and REFLAB method. Lower inhibition concentration of Tetrakis hydroxymethyl phosphonium sulphate (THPS) was observed with the DTU method. This means it is more sensitive to THPS and thus detects it at lower concentrations. The difference between the methods might be due to sorption of chemicals into the sludge as the biomass concentration in the DTU method is lower. The new methods standard deviation of nitrification inhibition around the 50% inhibition level was below 3%. The method is thus well suited to replace the REFLAB method for salty water samples as both repeatability and sensitivity is similar or better.

**KEYWORDS:** Nitrification inhibition, wastewater, THPS, Formaldehyde, Moving bed biofilm reactor

**PAPER ID:** CEST2019_00712

# Session 20 - Marine environment and coastal management

## *Friday 6 September 2019 - morning*

# Plastic Litter Project 2018: Exploring the Detection of Floating Plastic Litter using Drones and Satellite İmages

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## ABSTRACT

Plastic litter has been shown to pose a significant problem in the marine environment and the food chain at all trophic levels. Within the scope of Plastic Project 2018, we investigated the prospective use of imaging technology on airborne and spaceborne platforms in detecting floating plastic litter. Three artificial targets of plastic litter were prepared using PET-1water bottles, LDPE plastic bags and nylon fishing ghost nets. Each target measured 10 m x 10 m fixed by a PVC frame to prevent spillage as well as to make an aggregated target. We evaluated the derived spectral reflectances of these plastic litter targets gathered from the airborne (drone) and spaceborne (Sentinel-2) images. Improved georeferencing of the high geo-spatial resolution (resampled 10 m) Sentinel-2 images was achieved by utilizing excellent geospatial resolution (<0.03 m) drone images. Further analysis involved determining accurate pixel coverage of each target with future application in quantification efforts. Of the three plastic litter targets, it was noted that the plastic bottles had the highest spectral reflectances that were measured by the Sentinel-2 mission image. The experiment showed that Sentinel-2 satellites could be used to detect marine plastics when they cover a large area. The Sentinel-2 NIR band can significantly contribute to marine litter detection and the water content partly influence the behaviour of spectral values.

**KEYWORDS:** floating plastic litter, remote sensing, spectral reflectance of plastics, drones, UAV, UAS, pollution

**PAPER ID:** CEST2019_00490

# A study of alkali-activated concrete mixes in seawater environments

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## ABSTRACT

This paper assesses the performance in seawater environment of concrete mixes based on alkali-activated (AA) cements; these are proposed as an alternative to Ordinary Portland Cement (OPC) to address environmental footprint of cement production and to find new uses for waste materials. The proposed AA cements contained an industrial by-product, ground granulated blast furnace slag (GGBS) and a waste material, paper sludge ash (PSA). Mixes were made with fresh water and seawater respectively and were cured either in freshwater or seawater to simulate future exposure environments. The compressive strength at different curing times and a number of durability-related properties of AA mixes in marine environment were investigated and compared to those of OPC systems. The findings indicated that mixing with seawater rather than freshwater enhanced the performance of the AA mixes in terms of compressive strength and durability (resistance to chloride and sulphate attack). In a seawater environment the AA slag concrete mixes with PSA had the lowest porosity, which can be linked to their good durability performance. The study gives promise for the suitability of the tested alkaliactivated concrete mixes in seawater environments.

**KEYWORDS:** alkali activated cement concrete, seawater environment, durability, green construction materials, solid waste management

**PAPER ID:** CEST2019_00527

# Development of Continuous, Linear Models for Marine Benthic Macrophytes Description

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## ABSTRACT

The European Water Framework Directive has fostered indicator development, pertinent to biological quality elements, for ecological status assessment of coastal waters. For seaweed communities, the CFR index considers composition, abundance and physiological status, through four constituents (Richness, Opportunistic species, Cover, physiological Status) with arithmetically added scores (integers), summing up in [0, 100] and yielding ecological quality ratio (EQR) values in [0, 1]. Quantities C, O and S are expressed as percentages; R as small integer values; each one's range of values is subdivided into 5 intervals, each attributed a score (integer). Discontinuous (step-wise) score values cause CFR (integer) discontinuities in the ranges [0, 10] and [90, 100], affecting pertinent EQR values and precluding certain ones (e.g. 0.04, 0.93, 0.98). Based on the major contribution of quantities C and O to CFR, the present work transforms their combined, discontinuous variation into a continuous, linear model, employing recently used concepts (PRI approach), applied in developing a continuous, linear, composite model for another benthic macrophytic index. Application to CFR underlines the flexibility of the RPI approach.

**KEYWORDS:** Water Framework Directive, Ecological Quality Ratio, marine benthic macrophytes, CFR model, Ecological Evaluation Index RPI approach

**PAPER ID:** CEST2019_00756

# Development of Continuous, Linear Models for Marine Benthic Macrophytes Description

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## ABSTRACT

The European Water Framework Directive has fostered indicator development, pertinent to biological quality elements, for ecological status assessment of coastal waters. For seaweed communities, the CFR index considers composition, abundance and physiological status, through four constituents (Richness, Opportunistic species, Cover, physiological Status) with arithmetically added scores (integers), summing up in [0, 100] and yielding ecological quality ratio (EQR) values in [0, 1]. Quantities C, O and S are expressed as percentages; R as small integer values; each one's range of values is subdivided into 5 intervals, each attributed a score (integer). Discontinuous (step-wise) score values cause CFR (integer) discontinuities in the ranges [0, 10] and [90, 100], affecting pertinent EQR values and precluding certain ones (e.g. 0.04, 0.93, 0.98). Based on the major contribution of quantities C and O to CFR, the present work transforms their combined, discontinuous variation into a continuous, linear model, employing recently used concepts (PRI approach), applied in developing a continuous, linear, composite model for another benthic macrophytic index. Application to CFR underlines the flexibility of the RPI approach.

**KEYWORDS:** Water Framework Directive, Ecological Quality Ratio, marine benthic macrophytes, CFR model, Ecological Evaluation Index RPI approach

**PAPER ID:** CEST2019_00781

# Seasonal Variations of Water Quality and Aquatic Macrophytes Survey based on Side Scan Sonar, in a Shallow Coastal Lagoon (Gialova, SW Peloponnesus, Greece)

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## ABSTRACT

Gialova lagoon is located in the north-west of Pylos city (Prefecture of Messinia, SW Peloponnesus) and is part of the Ecological Network “Natura 2000”. The aim of the current research is the assessment of the ecological quality of the lagoon using hydroacoustic technique and the monitoring of abiotic and biotic parameters on seasonal basis. Side scan sonar imagery resulted in 6 different lagoon floor acoustic types which correspond to different percentage of vegetation cover. Samplings of aquatic vegetation were carried out from 9 different sampling stations oriented by the results of the hydroacoustic survey. Macrophytes Ruppia cirrhosa and Cymodocea nodosa but also chlorophyte Cladophora glomerata were recorded in the lagoon floor. Key water quality parameters and primary production (Chlorophylla) were monitored seasonally at nine stations. Chl-a and TP seems to be the main responsible parameters for the eutrophic ecological status of the lagoon.

**KEYWORDS:** Lagoon, side scan sonar, macrophytes

**PAPER ID:** CEST2019_00892

# Benthic litter density maps through low-cost underwater towed video camera surveys. An integrated approach

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## ABSTRACT

The marine environment is the final recipient and digester of litter. Floating and benthic litter constitute the majority of litter items in the marine environment while both remain quite unexploited due to their demand in high-cost and time-consuming surveys. In this paper we propose an integrated approach for assessing in detail the spatial distribution and composition of benthic litter in coastal environments, through the use of underwater towed cameras. The method is showcased in Syros Island, Cyclades, Greece where benthic litter density maps revealed benthic litter sources and environmental drivers controlling their spatial distribution and general pathways.

**KEYWORDS:** benthic litter assessment, underwater towed video camera, Syros Island.

**PAPER ID:** CEST2019_00893

# Genetic population structure of scallops going through a rapid population decline in the Eastern Mediterranean

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## ABSTRACT

Genetic structure of the endemic Pecten jacobaeus of Aegean inferred from mitochondrial 16s DNA sequence analysis was performed. This genetic marker is a powerful tool for measuring genetic variation and gene flow among populations. Valuable scallop stocks were abundant in the past in Euboikos gulf and Aegean but now are severely depleted due to overfishing, pollution and ocean warming. To restock and conserve this bivalve, a better understanding of its genetic variability is essential. DNA was isolated using the nucleospin tissue kit after homogenization of ligament and PCR using genus specific primers. The PCR products were analyzed by sequencing. The genomic comparison was performed by Blast analysis. We studied two hypotheses: 1. Scallops (P. maximus & P. jacobeus) which can be easily distinguished by the shell morphology belong to the same species without a significant genetic variation or not 2. The possibility to extract DNA from dead shells, a good practice for protected or endangered species. We showed that it is possible to extract DNA from ligaments of dead shells exposed for longtime on the seabed. A high similarity (>99%) between our results for P. jacobeus (16s rRNA genome) and P. Jacobeus or P. maximus nucleotide collections was revealed

**KEYWORDS:** Pecten, sequencing, genetic differentiation

**PAPER ID:** CEST2019_00263

# SeaLoc: A pilot forecasting system providing sea characteristics and other support services on high local resolution

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## ABSTRACT

SeaLoc project aims in developing an integrated forecasting system with accompanying services for the Greek seas. Further development, however, can facilitate the whole Mediterranean region. It will provide interaction both with specialists as well as with everyday users through the internet and specialized applications, whose output will be in a format ready to be utilized by relevant target groups. The specialized applications will focus on identified needs of each target group, providing easy-to-comprehend thematic indices alongside the actual forecasts. The system consists of in-house wind and wave predictions as well as other crucial Copernicus Marine products (currents, salinity, SST, nitrate, plankton and dissolved oxygen). The great impact of the project derives from the fact that it combines current forecasting research developments along with available Copernicus Marine data/ services in an effort to bridge the gap between science and end users. Additionally, the high spatial and temporal resolution in selected areas of marine-dependent financial importance, make SeaLoc a great decision support tool towards local development and financial growth. Sectors than can benefit from such a tool are: coastal and marine tourism, fishing, aquaculture, shipping, coastal constructions, energy harvesting and others.

**KEYWORDS:** marine forecasting; marine services; applied oceanography; high resolution oceanography

**PAPER ID:** CEST2019_00713

# Session 21 - Hydrology and water resources management

## *Friday 6 September 2019 - morning*

# Flood Risk Management: past and future

## Venables J., Venables Consultancy

## ABSTRACT

Based on her long involvement in water and sustainability – flood risk management, water and wastewater engineering, and water resources – Jean Venables will initially review how engineers and society have tried to deal with water in the environment. She will address recent developments in approaches such as catchment management, and integration of approaches for dealing with potable water supply, droughts and flooding. It is also important to consider how to both mitigate and adapt to climate change and its predicted effects. Jean will then address the very wide range of issues and considerations for flood risk management, including natural processes, environmental considerations, spatial planning, warning systems, preparedness, sustainability and engineered hard defences. A limiting factor can often be the availability of funding as there are competing priorities in any country and there has to be a system of prioritisation of actions. Finally, Jean will address the future and how we can improve our integration of approaches to these challenges, especially in the context of the predicted effects of climate change. At the same time, we still need to recognise, and educate the general public about, the fact that, whilst we can reduce the risk of flooding, we cannot (ever) eliminate it.

**KEYWORDS:** Flood Risk Management, catchment management, integration, natural processes, environmental considerations, spatial planning, warning systems, sustainability, engineered hard defences.

**PAPER ID:** CEST2019_00459

# Comparative Study of Flow through Vegetation Stems with and without Foliage


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## ABSTRACT

The presence of vegetation in rivers, streams and riparian zones affects significantly the flow field and consequently the resistance, pollutant dispersion, sediment transport and ecological habitat. In this paper, a comparative study is undertaken to investigate the effect of an array of simple rigid or compound semi-flexible elements, resembling submerged small plants, on key features of the flow field. Measurements were taken by means of a 3-D ADV instrument at selected locations within the vegetation array and downstream of it. Vertical profiles of the velocities and turbulent shear stresses were obtained and compared.



**KEYWORDS:** Ecohydraulics, Environmental Hydraulics, Flow through vegetation, Velocity, Shear stresses.

**PAPER ID:** CEST2019_00188

# Climate change impact on river assimilative capacity: a case study application of water related climatic indicators

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## ABSTRACT

In this investigation, we use climatic, water-related indicators to evaluate the impact of climate change on the assimilative capacity of the Asopos River, Central Greece. Indicators were developed and organised under the SWICCA climate service (http://swicca.eu), which aims to develop and showcase a Water Management Information Service for the Copernicus Climate Change Service based, among others, on real case studies and end-users. River flow indicators are the core data for evaluating the assimilative capacity of the Asopos River under different scenarios regarding average flow conditions. Assimilative capacity was evaluated for 6 heavy metals, namely Cr, Cd, Cu, Pb, Ni and Zn. Socioeconomic indicators (GDP and Land Use) were also utilized to incorporate changes of economic activities in the assessment. Climate impact indicators are free of the need for laborious processing. They cannot cover all aspects of local analysis needs but, combined with local information, they are key-data for integrated climate change impact investigations. Results from 226 scenarios of circulation, regional and impact models combinations as well as industrial activity evolution, indicate for the majority of the scenarios, a small impact on the river's assimilative capacity, associated with climate change, while industrial activity evolution could have a significant effect.

**KEYWORDS:** Climate change, Asopos, Copernicus, climatic indicators, surface waters

**PAPER ID:** CEST2019_00237

# Trends in hydrologic prediction for the design of hydraulic projects

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## ABSTRACT

Determination of runoff and related design discharges under past and future conditions are key elements for the design of flood defense, watercourse demarcation, urban stormwater, road drainage systems. Prediction is difficult and involves high uncertainty, especially for ungaged watersheds. Advanced computer capabilities provided by GIS and hydrologic modeling software facilitate computations and allow for the comparison of results by different approaches. Still many empirical relations are included, based on limited field data developed decades ago. Ministry of Infrastructure and Transportation, Greece, is in the process of updating design guidelines for hydraulic projects, including hydrologic computations. Special Secretariat for Water, Ministry of the Environment and Energy, for the implementation of 2007/60/EU Floods Directive published idf relations for all areas of Greece, based on advanced methodology. Internationally there is a trend towards risk-based design. The basic form of risk-based optimization is economic optimization aiming at minimization of the lifetime cost of the project. Climate change impacts is an additional issue that has to be addressed and research for the development of related guidelines is still under way in many countries. Economic and climate change projections also involve high uncertainty.

**KEYWORDS:** hydrologic prediction, peak discharge, design guidelines, hydraulic projects

**PAPER ID:** CEST2019_00298

# Innovative sensors for crowdsourced river measurements collection

## Krommyda M.[1,*], Tsiakos V.[1], Rigos A.[1], Tsertou A.[1], Amditis A.[1], Georgiou H.[2], Jonoski A.[3], Popescu I.[3], Assumpcao T.[3]

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## ABSTRACT

Flood risk prediction requires consistent and accurate sensor measurements, usually provided from traditional in-situ environmental monitoring systems. Crowdsourced data can complement these official data sources, allowing authorities to improve and fill gaps in the hazard assessment process. However, collecting this information from volunteers, with no technical knowledge and while using low-cost equipment such their smartphones and tablets, raises the question of quality and consistency. To alleviate this barrier two tools were developed in the context of H2020 Scent project (grant agreement No. 688930). The Water Level Measurement Tool uses image recognition techniques to extract the water level from images containing a measuring tape. The Water Velocity Calculation Tool uses video processing algorithms to extract the water surface velocity from a video containing a pre-defined floating object moving on the surface of a water body. Each extracted measurement is accompanied by a degree of trust. The tools have been designed so that a high degree of trust can be achieved from images and videos taken from regular smartphones. The crowdsourced river measurements are used to develop improved flood models with a dramatically reduced cost as both the measuring tapes and the floating object are low-cost and re-usable while effectively covering large areas of interest.

**KEYWORDS:** Flood modeling, innovative sensors, crowdsource data, campaign organization

**PAPER ID:** CEST2019_00327

# Session 22 - Emerging pollutants

## *Friday 6 September 2019 - morning*

# Identification of Biotransformation Products of Veterinary Drugs Present in Piggery Wastewater during Treatment with Photobioreactors based on Microalgae-Bacteria and Purple Phototrophic Bacteria Consortia

**López-Serna R.[1,2,*], García D.[1,2,3], Bolado S.[1,2], Jiménez J.J.[2,4], Lai F.Y.[5], Golovko O.[5], Ahrens L.[5], Wıberg K.[5], Gago-Ferrero P.[5,6], Muñoz R.[1,2]**

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## ABSTRACT

This work identified transformation products (TPs) from 16 antibiotics, 1 anti-parasitic, 1 analgesic and 1 hormone, present in spiked real piggery wastewater (PWW) before and after two different treatments in two open photobioreactors operated continuously with a consortium of microalgae-bacteria and purple photosynthetic bacteria. For this purpose, suspect and non-target strategies based on liquid chromatography quadrupole-time-of-flight mass spectrometry (LC-QTOFMS) were used. The application of quantitative structureretention relationship (QSRR) prediction models, in addition to a comprehensive evaluation of the obtained MS/MS spectra, provided valuable information to support the identifications. The confirmation of the TPs was carried out with the corresponding reference standards, when these were commercially available. Alternatively, probable structures of the TPs based on diagnostic evidence were proposed. To the best of our knowledge, some of the identified TPs have never been reported before. A transformation pathway for their biotransformation has been proposed. The presence of the identified TPs was assessed in real PWW samples through retrospective analysis. Ultimately, the potential ecotoxicological risk posed by these nineteen veterinary drugs and their TPs was evaluated by means of risk quotients.

**KEYWORDS:** Algal-bacterial processes · Contaminants of emerging concern · PPB · Suspect list · Swine manure · Transformation products

**PAPER ID:** CEST2019_00375

# Mass Balance of Selected Pharmaceuticals in an Austrian River Catchment Area: Estimation of the Different Source Contributions

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## ABSTRACT

The study refers to the assessment of the annual mass loadings of two pharmaceuticals (PhCs), sulfamethoxazole (SMX) and carbamazepine (CBZ), released in the river of an Austrian catchment area by wastewater treatment plant (WWTP) effluent, combined sewage overflows (CSOs), surface runoff, tile drainage and deep water (referring to the sludge- or manureamended soil). WWTP effluent and excess sludge loadings, based on PhC national human consumption, literature excretion rates, were modeled by Activity SimpleTreat. CSO loading was modelled by MoRE. PhC load in manure was estimated on the basis of the animal annual production and literature data of concentration. Surface runoff, tile drainage and deep water loadings were modelled integrating a literature "leachate" approach with the expected PhC phenomena of accumulation, degradation and erosion occurring in the soil. The study develops a mass balance of the different pharmaceutical loading contributions to the receiving water body by means of STAN model and highlights the uncertainties associated to the selected values in the estimation. It emerges that manure amount applied on the soil is fundamental in defining the priority contributions among the different sources (WWTP effluent, CSOs, surface runoff, tile drainage and deep water).

**KEYWORDS:** Pharmaceuticals, rural catchment area, Surface runoff, treated effluent, combined sewage overflows.

**PAPER ID:** CEST2019_00130

# Adsorption technology in wastewater treatment processes utilizing activated carbons as adsorbent materials prepared from waste vehicular tires: Recent research and trends in the removal of various toxic and persistent organic and inorganic pollutants

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## ABSTRACT

Various toxic contaminants when are present in the environment pose a threat to the inhabitants of natural ecosystems owing to their non-biodegradable nature that increases their high toxicity towards non-target organisms. The large mass of solid wastes that are generated from waste rubber tires unquestionably consists a serious threat of environmental pollution around the world. Consequently, scientific interest has focused on several recycling strategies and practices converting them into more valuable products such as adsorbents widely utilized for the removal of several different inorganic and organic compounds from environmental samples. Hence, the main objective of the present study is to review all the data in the available published bibliography concerning the recent research and future trends on using granulated adsorbent materials and activated carbons obtained and prepared from waste tires and afterwards applied for the removal of persistent and residual quantities of pollutants.

**KEYWORDS:** Waste rubber tire, adsorption isotherm, remediation, persistent contaminants, recycled discarded tires

**PAPER ID:** CEST2019_00143

# The pyrolysis of perfluorocarboxylic acids - effect of chain length

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## ABSTRACT

Per- and polyfluoroalkyl substance (PFAS) are increasingly becoming the contamination issue of our time, due to their environmental persistence, bioaccumulation and mounting evidence of their toxicity. Herein we examined the pyrolytic decomposition of a series of perfluorocarboxylic acids via the production of CO and $CO_2$, utilizing FTIR and GC/MS analysis. We observed the presence of a parallel surface-mediated reaction in conjunction with the gas-phase pyrolysis.

**KEYWORDS:** perfluorocarboxylic acids, pyrolysis

**PAPER ID:** CEST2019_00157

# Session 23 - Energy technologies and sustainability

## *Friday 6 September 2019 - morning*

# Hydrogen production from cotton wastes by mean of dark fermentation

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## ABSTRACT

Dark fermentation of textile wastes is discussed in the paper. In the experiment were used cotton wastes. Before fermentation the cotton was hydrolyzed using 0.1 M of HCl. The inoculum was pretreated using heat shocked for 0.5 h at temperature of 105°C. The fermentation was carried out under conditions: load 5 g/l, pH in the range 5 by 0.1 M of HCl, and oxygen in small quantities was added. The oxygen flow rates (OFR) was 0.008 ml/h. The fermentation was carried out at temperature of 40 °C for one day. In reactors with pretreated inoculum (pH 5) biogas was detected and its content (hydrogen carbon monoxide, carbon dioxide and nitrogen) were determined. Methane was not produced during experiment. The volume of hydrogen for process performed at temperature 40°C 0.168 $dm^3$ of at biogas content 43%.

**KEYWORDS:** dark fermentation, hydrogen, methane, cotton

**PAPER ID:** CEST2019_00022

# Long Term Solids Handling Alternatives for New York City Water Resource Recovery Facilities (WRRFs)

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## ABSTRACT

New York City Department of Environmental Protection, (DEP), owns and operates 14 water resource recovery facilities (WRRFs) which treat a combined average dry weather flow of 57 $m^3$ /sec. DEP in association with the City College of New York, (CCNY), has embarked on a long term project to assess thermal hydrolysis pretreatment of the combined sludge to enhance production of anaerobic digester gas, (ADG), and take advantages of improve reduction of volatile solids and sludge dewatering. This paper will focus on the initial phases of thermal hydrolysis.

**KEYWORDS:** Thermal Hydrolysis, resource recovery, anaerobic digestion, dewaterability

**PAPER ID:** CEST2019_00034

# Life Cycle Assessment of Electricity Production in the Czech Republic-Case-Study of Lignite Combustion and Hydropower

## Štefanica J.[1,*], Zakuciová K.[1], Kočí V.[2], Šerešová M.[2], Vlček Z.[1], Vitvarová M.[1], Opatřil J.[1]

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## ABSTRACT

Environmental impacts of various types of energy production are compared in the scope of an ongoing national research project "Life Cycle Assessment of Energy Production". The project is using the LCA method to compare the potential environmental impacts of selected energy sources throughout their whole life cycle. The energy sources are representative for the energy grid of the Czech Republic. The inventory data used for the LCA are based on case studies of selected Czech power plants. Presented article is showing the preliminary results – the comparison of environmental impacts of two electricity sources. Lignite power plant and a hydroelectric power plant are compared. Only the impacts of plant operation are compared so far, the construction and decommissioning are not included in the current analysis.

**KEYWORDS:** LCA, electricity production, case-study

**PAPER ID:** CEST2019_00200

# Production of Activated Carbon from Oil Palm Shells via physical Activation with $H_2O$ and its Characterization for Use in Aqueous Phase

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## ABSTRACT

Oil palm shells (OPS) are a solid residue of the extraction of palm oil having excellent characteristics for production of activated carbon. OPS worldwide production amounts to 17.214 ton (2018) from which Colombia participates with 364 ton. Oil palm shells were first carbonized in a horizontal oven under $N_2$ atmosphere until 850 °C for 30 min. Carbonized samples were than submitted to physical activation with steam in the same horizontal oven. A variation of process parameters was performed. Activation temperatures of 750, 800, 850 and 900 °C were studied. Residence time varied between 60 and 400 minutes. H2O flow rates between 1 a 5 ml / min were used. 50 g of carbonized oil palm shells were used for each experiment. The influence of the process conditions on pH, soluble water content, extractable acid content, methylene blue index, BET surface area from $N_2$ adsorption and density were determined. Visual inspection through scanning electron microscopy and determination of surface functional groups through infrared spectroscopy were performed. The obtained activated carbons show suitable characteristics for its use in aqueous phase. Results obtained were useful to determine its optimal production conditions.

**KEYWORDS:** Oil palm shells, activated carbons, physical activation, adsorption.

**PAPER ID:** CEST2019_00224

# Mass and energy balances of sewage sludge pyrolysis in a lab rotary kiln


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## ABSTRACT

The aim of this work is to study the influence of the main parameters of sewage pyrolysis in a rotary kiln on the product distriburion and energy balances. An indirectly heated rotary kiln at a laboratory scale was used (4 kg/h). An increase in the final temperature causes the reduction of the total condensable products and the non-condensable gas fraction increases. The residence time of the volatile phase has an important influence on the secondary reactions to increase the non-condensable gas with low tars content. These results contribute also a valuable input to perform LCA.


**KEYWORDS:** Sewage sludge, pyrolysis, rotary kiln, energy and mass balance

**PAPER ID:** CEST2019_00857

# Improving aquaculture environmental footprint utilizing offshore renewable energy

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## ABSTRACT

The main environmental impacts of aquaculture include eutrophication, chemical pollution and harm to sensitive marine ecosystems. At the same time, the required energy leads to high emissions of greenhouse gases. Offshore wind turbines are a sector of renewable energy that grows rapidly. Offshore wind turbines can be combined with aquaculture units to meet their energy needs, saving fuel and reducing their carbon footprint. However, there are many difficulties in installing aquaculture units in existing offshore wind parks (e.g. small water depth). A new paradigm is to deploy floating wind turbines and aquaculture at open sea. Open sea aquaculture is more environmentally friendly, but has not been developed due to increased supply chain cost and harsh sea state conditions. The aim of this study is to propose a renewable energy system that can cover the energy needs of an open sea aquaculture unit. The system consists of a multiuse floating structure that accommodates wind turbine, photovoltaic panels, batteries, energy management system, fish monitoring devices and automatic feeding system. In this way the frequency and cost of in-situ visits, will be reduced. The above combination makes open sea aquaculture development more attractive and at the same time improves its environmental footprint.

**KEYWORDS:** open sea aquaculture, product environmental footprint, floating windturbine, offshore renewable energy

**PAPER ID:** CEST2019_00353

# Session 24 – Climate change mitigation and adaptation

## *Friday 6 September 2019 - morning*

# Assessment of Concrete Footpath Upheavals in Heatwaves

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## ABSTRACT

Most concrete footpaths are cast without steel reinforcement and in segments between bituminous joints, with the joints intended to accommodate thermal expansions of the pavement. However, a combination of prolonged heatwave conditions and the ingress over time of material into the joints produces a situation in which the thermal movements are not in the plane of the pavement, but instead the pavement experiences an upheaval buckle. Within a framework of global warming and heatwaves, assessments of the potential for such buckles which pose a risk to safety are essential. This paper presents a solution in closed form for the combination of key parameters at buckling needed to undertake such an assessment.

**KEYWORDS:** Upheaval buckling; pavement; non-linear

**PAPER ID:** CEST2019_00053

# Reactivation of former watercourses to support urban stormwater management

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## ABSTRACT

In recent decades many urban water courses have been heavily modified by land gaining measures aiming at canalising, straightening and draining existing water systems. Additionally, urbanisation causes a higher degree of sealing which results in higher surface runoff during rainfall. To support related problem-solving, the presented work investigates the question of whether the reactivation of former water courses could make a positive contribution to urban stormwater management. Based on the case study of an Austrian municipal area the research work follows a two-target approach: First, the collection, digitalisation and verification of the former water courses in the investigated area based on historical maps and recent planning documents. Second, a GIS-based overlap of the verified (still existing but inactive) natural water courses with the current sewage and stormwater network to derive potential options for relieving the strain on the entire urban drainage system. Results show, that reactivation of former water courses can be an interesting and promising component of an integrated and thus more natural urban stormwater management approach.

**KEYWORDS:** Climate change, surface runoff, sewer system, integrated planning

**PAPER ID:** CEST2019_00120

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
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# The role of sustainability rating systems in delivering infrastructure and building engineering's contribution to climate change mitigation and adaptation

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## ABSTRACT

Although overall drivers for climate change mitigation and adaptation are clear, it is often difficult for professionals working on infrastructure and buildings to assess what relevant action they should be taking in their designs and construction. In parallel, scientists working on construction or environment-related topics often need guidance on the key construction areas that need further investigation to assist with the challenges derived from the need for climate change mitigation and adaptation. Over the last few years, rating systems have been developed for the environmental performance of buildings and infrastructure, and more recently their sustainability performance. Their development has included the formation of assessment questions and criteria that direct designers and constructors towards improved environmental and social performance. Alongside those rating systems, tools such as carbon calculators have also been refined to enable option comparisons. This paper explores a selection of climate change-related issues assessed in or by such rating systems and tools, and how the nature of assessment questions, scoring systems and measurement tools can drive improved performance. Through that improved performance, design and construction teams can maximise their contribution to climate change mitigation and adaptation, and scientists identify the key areas for further examination.

**KEYWORDS:** Infrastructure; Sustainability; Rating Systems; Climate change mitigation & adaptation.

**PAPER ID:** CEST2019_00296

# Heat of Adsorption in the Fly Ash Zeolite – $CO_2$ System at Dynamic Conditions


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## ABSTRACT

Recently, the global warming is one of the major world problems considering that coal-fired power generation accounts for 40 % of the total $CO_2$ emissions. The post combustion capture of $CO_2$ based on physical adsorption has the greatest potential to meet the industrial needs. The nature of the adsorption processes is complex and is described by many empirical constants that are determined experimentally for individual contact systems. In this study, the heat of adsorption in the fly ash zeolite (FAZ) – $CO_2$ system was investigated experimentally. The technique used includes online measurements of temperature rise during the exothermic adsorption process carried out by passing $CO_2$ through a laboratory-assembled column filled with FAZ. Based on the experimental results, the calculated specific heat of adsorption amounts to Hads=-36.83 kJ/kg.


**KEYWORDS:** post-combustion carbon capture, fly ash zeolite, adsorption, heat of adsorption

**PAPER ID:** CEST2019_00568

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# Soil erosion as a consequence of climate change

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## ABSTRACT

The climate change and relevant negative impacts are currently widely discussed topic. The agricultural soil erosion represent the risks generated also by agricultural activities reflected in soil quality. Rapid climate change can cause the instability of most agricultural and forest ecosystems. Climate change is expected to affect the conditions under which agricultural production is done in many ways. In Slovakia, agricultural soils are potentially at risk of water erosion of varying intensity. Wind erosion is not a serious problem in Slovakia in recent years. Despite the fact that soil erosion level shows in Slovakia in recent period a slight decline however the adoption of soil conservation practices are necessary for future sustainability.

**KEYWORDS:** Climate Change, Agricultural Soil, Water Erosion, Wind Erosion

**PAPER ID:** CEST2019_00888

# An Analysis of the Expected Climate Change Effects in the Vicinity of the Main Harbors from the Black Sea

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## ABSTRACT

The objective of this work is to analyze the dynamics of the environmental matrix in the context of climate change in the vicinity of the main harbors from the Black Sea. The main environmental parameters considered for analysis are wind and waves. The climatic wind fields provided by the Rossby Centre regional atmospheric model are analyzed until the end of the 21st century, considering the results corresponding to the Representative Concentration Pathway scenario 4.5. These wind fields are used to force a wave modelling system based on the SWAN (Simulating Waves Nearshore) model. In this way, the wind and wave data expected along the entire 21st century in the vicinity of the most important harbors of the Black Sea are provided. From the analysis of these wind and wave data, an enhancement of the extreme wind conditions can be noticed. On the other hand, due to the high variability in the wind direction, the amplitudes of the extreme waves are expected to slightly decrease.

**KEYWORDS:** Black Sea, harbors, wind and waves, 21st century, extreme conditions

**PAPER ID:** CEST2019_00094

# A web-based GIS tool for environmental footprint estimation of agribusinesses

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## ABSTRACT

The deterioration of environmental quality and vulnerability to climate change of the Balkan Peninsula are escalated by the lack of specific financial and strategic measures that can promote sustainable resource management. Environmental problems of the Balkan countries need to be addressed under a unified context targeting the development of common strategies to improve environmental quality and reach European and international markets. To this end, the INTERREG project "Towards farms with zero carbon-, waste- and water-footprint. Roadmap for sustainable management strategies for Balkan agricultural sector - BalkanROAD" aims to provide Balkan agribusinesses with protocols and Information Technology tools conformed to the particularities of the Balkan Peninsula, in order to promote products of high quality and value to the European and international market. Within the project's framework, a web-based GIS application tool was developed, the so-called, ROAD, that assesses all production and processing stages, namely from field to the market, capable to identify processes that can be improved and provide alternatives for reducing carbon, waste and water footprint of the final marketable products. In this work we describe the ROAD tool implementation steps, as well as some of its key functionalities.

**KEYWORDS:** ROAD tool, environmental footprint, BalkanROAD project, Balkan agribusiness, sustainable growth.

**PAPER ID:** CEST2019_00478

# The influence of Danube River hydrographic and thermic factors on fish stocks dynamics in Razim-Sinoe lagoon system

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## ABSTRACT

The Romanian fishing areas extends over 7000 km$^2$ and 50% of the numbers of authorized fishers conduct their activities in the Danube areas. Inland fisheries are highly important for income, food security and nutrition. Inland peri-rural fisheries face degradation due to climate change. According to the European Commission, the dominant factor driving the change in water resources in Danube River basin is climate change. Global mean surface temperatures have increased, fact which causes a constant increase in water temperature as well. RazimSinoie Lagoon System represents the largest lagoon (1145 km$^2$) in Romania and stands out for its ecological, historical and socioeconomic importance. The lagoon is connected to Danube River through the channels Dranov and Dunăvăț and receives significant river intake. This present study points out the vulnerability of fish stocks and Romanian fisheries in the context of climate change and global warming. Thus, the aim is to evaluate the influence of multiannual hydrographic and thermic regime on fish stocks status and structure from RazimSinoe Logoon System, between the years 2016-2018. Thus, a strong positive correlation was observed between the water temperature and the total quantity of fish catches. In case of fish stocks, a simultaneous decline of ichthyophagous fish species, while increasing the stocks of non- ichthyophagous fish species, is recorded. It is recommended that similar studies to be conducted also in other areas connected to Danube River hydrographic basin, in order to evaluate the magnitude of climate change and global warming impact on fish stocks status and structure.

**KEYWORDS:** climate change, fish stocks, danube river, razim-sinoe

**PAPER ID:** CEST2019_00529

# Thermal Swing Adsorption in a Carbon Capture System

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## ABSTRACT

In the last years, the post-combustion capture of $CO_2$ based on physical adsorption has been extensively studied in terms of economy, ecology, and process efficiency. The industrialization of the process involves the construction of adsorption columns in which adsorption and desorption mass transfer occurs. Each one solid-gas system has individual mass and heat transfer properties. In this study, the adsorption and desorption processes in the fly ash zeolite (FAZ) - $CO_2$ system were investigated in dynamic conditions. The breakthrough curves were built performing series of experimental measurements under varying conditions in order to establish the optimal desorption temperature. Multiple adsorption/desorption studies were performed in the temperature range 50-200 ºC at the maximum leakage concentration of 5 vol % $CO_2$ in the exhaust gas stream versus the time. The small variation in the adsorption capacities achieved and the minimal deviation in the break point determine suitability of the FAZ-$CO_2$ system for low thermal swing adsorption process at 50 ºC.

**KEYWORDS:** fly ash zeolite, adsorption, carbon dioxide, carbon capture

**PAPER ID:** CEST2019_00573

# Comparative studies of the equilibrium adsorption of $CO_2$ onto coal ash zeolites Na-X and Na-Ca-X

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## ABSTRACT

Coal-fired Thermal Power Plants (TPPs) are the main source of greenhouse gas emissions in the atmosphere, but they also generate huge amounts of solid by-products, including fly ash (FA). Thanks to its aluminosilicate nature, FA is investigated to be converted into zeolites for applications in gas cleaning systems. The development of technologies for $CO_2$ capture by fly ash zeolites (FAZ) will provide a join solution for the two main ecological problems concerning coal supplied TPPs, namely utilization of solid residues and implementation of carbon capture technologies. In the present study, the comparative studies were performed on the adsorption of $CO_2$ onto FAZ of Na-X and Na-Ca-X types in relation to their specific surface and porosity.

**KEYWORDS:** fly ash zeolites; carbon capture technologies; solid sorbents, $CO_2$ adsorption

**PAPER ID:** CEST2019_00590

# Coal ash zeolite as a self-catalytic-chemisorption system for conversion of carbon dioxide to hydrocarbons

## Boycheva S.[1,*], Zgureva D.[2]

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## ABSTRACT

In our study, initial attempts on the convertion of carbon dioxide to hydrocarbons based on the catalytic activity and the atmospheric moisture-retaining ability of coal fly ash derived zeolites (FAZ) are provided. The experimental investigations on the $CO_2$ chemisorptions were performed in a static reactor at pressure of 5.5 MPa over FAZ of Na-X type. The conversion of $CO_2$ to hydrocarbons was established by IR-spectroscopic and differential thermal studies. This study outlines new research challenges for the development of technological solutions for the effective reduction of greenhouse gases by converting $CO_2$ into synthetic fuels.

**KEYWORDS:** Fly ash zeolites, Carbon capture and utilization, CO2 conversion to fuels

**PAPER ID:** CEST2019_00605

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# Sustainable Development Goals (SDGs) & Indicators: Managing Drylands under Climate Change Conditions

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## ABSTRACT

The future sustainable development constitutes a critical issue at a global scale. It builds upon the concepts of combating poverty & inequality, mitigating climate change impacts as well as protecting natural & cultural resources through innovation & adoption of eco-friendly solutions. It is a human-centric approach that places people at the core of its priorities. Seventeen Sustainable Development Goals (SDGs) have now been set by the United Nations (UN) for the year 2030, each accompanied by a set of indicators measuring their performance. This paper focuses on the contribution of each sustainability indicator to the accomplishment of the respective goals, especially in case of drylands. A general overview of the SDGs & the relative indicators are analyzed. Then, indicators related to climate change impacts are explored following by an assessment of the contribution of these specific indicators to the management of drylands under climate change conditions.

**KEYWORDS:** SDGs, Sustainability indicators, Climate change, Drylands

**PAPER ID:** CEST2019_00785

# Session 25 - Wastewater treatment

## *Friday 6 September 2019 - morning*

# Coal fly ash zeolites as adsorbents for effective removal of heavy metals and dyes from contaminated waters

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## ABSTRACT

In this study, fly ash zeolites (FAZ) of Na-X type were synthesized by alkaline atmospheric aging. FAZ with a specific surface value of 280 $m^2$ /g was tested for removal of contaminants from waters in comparison to unconverted FA. The adsorption efficiency of FAZ toward methylene blue from water solutions is over 60 % for the studied concentration levels. The removal efficiency of FAZ toward $Cd^{2+}$ -ions reaches 98 % and it is not affected by the pH from 3.0 to 7.0. The obtained results reveal that FAZ are suitable adsorbents in water remediation systems.

**KEYWORDS:** Fly ash zeolites, Adsorption, Waste water remediation, Heavy metals, Dyes

**PAPER ID:** CEST2019_00552

# Feasibility of Combined Anaerobic-Aerobic System for Textile Wastewater Contained C. I. Acid Red 88 Dye Treatment: Hrt Effects and Functional Resilience

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## ABSTRACT

An integrated continuous anaerobic–aerobic system has been employed as the treatment for synthetic textile wastewater contained C. I. Acid Red 88 dye. A laboratory scale of upflow anaerobic sludge bed (UASB) flowed by activated treatment was operated at hydraulic residence time (HRT) of 24, 12, 6, and 3 h. the system showed high performance on the removal of color and COD within the HRT ranged between 24 and 6 hrs. At different organic loading rates (OLR), the chemical oxygen demand (COD) removal in the UASB was reached to 86.6% and up to 97% were obtained in the aerobic reactor. The system performance appeared to be more resilient to the inapt decrease in the HRT. The experimental analysis results indicated that the maximum methane yield was 13.2 mmol $CH_4$ g $COD^{-1}$ $d^{-1}$ at HRT 6 h, and the system is expected to have a better economic performance under HRT 12 h.

**KEYWORDS:** UASB; Aerobic Treatment; C. I. Acid Red 88 dye; HRT; continuous mode

**PAPER ID:** CEST2019_00426

# An Investigation into Impact of Heavy Metals in Soil

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## ABSTRACT

The aim of this paper is to assess the environmental risks associated with the wastewater reuse with respect to six metals; cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb) and zinc (Zn) in the city of Dubai. Treated Sewage Effluent (TSE) is used for landscape irrigation. Samples of soil and control soil as baseline measurement were collected to calculate the contamination factor (CF), pollution load index (PLI), metal pollution index (MPI), degree of contamination (CD) and modified degree of contamination (mCD) of heavy metals in soil. The results revealed that the values of the CF were very high, the PLI and MPI were high, the CD was very high, and the mCD was ultra-high.

**KEYWORDS:** Soil Pollution, Contamination Factor, Pollution Load Index, Metal Pollution Load Index, Degree of Contamination

**PAPER ID:** CEST2019_00800

# Start-up of the Nitrogen Removal Process in an Anaerobic UpFlow Reactor Inoculated with Aeration Tank Sludge

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## ABSTRACT

Anaerobic ammonium oxidation (anammox) has been considered a promising alternative to the traditional nitrification/denitrification process to remove nitrogen without using external carbon source. The start-up of the anammox process was performed in a stirred anaerobic up-flow reactor seeded with aeration tank sludge, and fed with medium containing ammonium and nitrite (1:1). The reactor was running consecutively for 369 days, with an initial instability period that lasted 117 days, resulting in nitrite removal and nitrate accumulation. In view of this, the reactor stopped being fed with nitrite, which led to a nitrate decrease in the effluent. Afterwards, a 140 days transition period was followed by a 112 days stable period. In the end, the average ammonium removal was 53.8 % in the transition stage, slighting decreasing to 45.6 % in the stable period, while there was no nitrite in the effluent. Preliminary microbial assessment showed the presence of an anammox community in the reactor related to Candidatus 'Brocadia fulgida'. The next challenge will be the assessment of eventual shifts on the microbial community structure and composition during the entire process.

**KEYWORDS:** Nitrogen removal; Upflow Bioreactors; Anaerobic processes; Anammox; Wastewater

**PAPER ID:** CEST2019_00598

# Isolation and identification of microorganisms that can biodegrade organic compounds which are present in olive mill waste.

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## ABSTRACT

Isolation of microorganisms that can biodegrade organic compounds which are present in olive mill waste and more specifically microorganisms that can survive at high phenol concentrations was studied in the Environmental Engineering Laboratory for three months in the Department of Environmental Science and Technology in the Cyprus University of Technology. Firstly, liquid crops were created, then the samples were cultivated in solid crops (with phenol as the sole carbon source) and at last isolation and purification of the samples were performed and the single colonies were replicated in liquid crops to check their performance. Eight single microbial culture will be sent to Macrogen The Netherlands Research Center for recognition and identification.

**KEYWORDS:** olive mill wastewater, pollution, cultivation of microorganism, phenol, solid cultures, isolation.

**PAPER ID:** CEST2019_00810

# An Integrated Approach for the Assessment of Constructed Wetlands Operational Efficiency, using both Chemical and Biological Data

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## ABSTRACT

The present study evaluated the operational efficiency of a constructed wetland (CW) located at Andritsaina/Krestena municipality (Western Greece, Peloponnese, Greece), using a battery of tests and bioassays. Specifically, raw WWs entering the CW basins with broadleaf cattail Typha latifolia (raw-WWs) and biologically treated WWs effluents ending up in the adjustment tank were randomly collected in October, December 2018, and January 2019. Thereafter, freshwater algae (i.e., Chlorococcum sp., Scenedesmus sp.), invertebrates (i.e., Thamnocephalus platyurus, Brachionus calyciflorus), higher plant species (i.e., Sorghum saccharatum, Lepidium sativum and Sinapis alba) and human lymphocytes were treated with WWs for determining critical toxic endpoints in any case. All data were further interpreted with physicochemical parameters, like conductivity (Cond), COD (total and dissolved), total suspended solids (TSS) and volatile suspended solids (VSS), commonly measured in both raw- and treated-WWs samples. The results showed that almost all chemical parameters measured in treated-WWs were lower than those occurred in raw-WWs, and significantly related with the obtained critical toxic endpoints in all cases. Those preliminary findings give rise to the importance of using a battery of bioassays as useful tools for assessing CWs treatment process efficiency thus contributing to the environmental sustainability and human health.

**KEYWORDS:** bioassays; chemical analysis; constructed wetlands, operational efficiency.

**PAPER ID:** CEST2019_00903

# Electrodialysis in zero liquid discharge systems for sustainable brine management

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## ABSTRACT

According to the latest environmental requirements, zero liquid discharge must be considered in all modern manufacturing processes. In principle, solid waste can be achieved only by evaporation plus crystallization, and therefore reverse osmosis is usually applied to decrease the operation expenses by pre-concentrating the evaporator feed. However, reverse osmosis can generally only achieve concentrates of about 70 to 75 g/kg, still leaving a significant gap before saturation of common salts is reached. Electrodialysis can double this concentration, thus cutting the evaporator operating expenses or even eliminating the evaporator at all, providing the concentrate can be fed directly to crystallization. In this work, an array of the most common brines was tested on a lab-scale electrodialysis unit, and salt transport, electricity consumption and electric current efficiency was evaluated. No performance drop in either scale-up factor was observed at the maximum concentrations, suggesting that under right operating conditions, integrated membrane processes should significantly decrease the evaporator costs and provide economic feasibility of zero liquid discharge process in waste brine treatment.

**KEYWORDS:** Zero liquid discharge; ZLD; electrodialysis; saturation; supersaturation, evaporation

**PAPER ID:** CEST2019_00262

# Pretreatment of antibiotics-contaminated waste biological sludge by ozonation

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## ABSTRACT

Ozonation was studied as a pretreatment method for a waste biological sludge, contaminated with large amounts of globally used antibiotics; tiamulin, levofloxacin and amoxicillin. At the concentrations of over 100 mg $L^{-1}$, these antibiotics were found to inhibit biogas production (up to 50%), which means, that the molecules would pass the anaerobic digestion system unchanged. Ozonation of sludge, contaminated with antibiotics, not only removes inhibitory effects, but also improves overall biogas production for 10% or even more, depending on the dose of the oxidant applied in the pretreatment.

**KEYWORDS:** Biological sludge, antibiotics, pretreatment, ozone, biogas production

**PAPER ID:** CEST2019_00294

# Anaerobic ammonium nitrogen oxidation and sulfate reduction in psychrophilic conditions

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## ABSTRACT

Investigations of simultaneous removal of ammonium and sulphate were carried out in anaerobic laboratory bioreactor - upflow anaerobic filter (UAF). The process was operated in psychrophilic conditions. Temperature was maintained constant at 20±2°C. Synthetic wastewater containing ammonium chlorine and sulphate magnesium was used as the feed for the bioreactor in experiment. The concentration range of ammonium and sulphate in the wastewater were kept at 22-27 mg$NH_4$-N/L and 80– 130 mg $SO_4$-S/L, respectively. About 80% of the sulphate entering the reactor was removed from the liquid phase, of which 30% appears as S–S 2- in the effluent. During sulphate conversion were formation also S-$H_2S$ in the biogas and elemental S. Raman spectroscopy (RS) were performed to confirm the presence of sulphur in the sludge. Owing to the reduction sulphate and oxidation ammonium, about 20% nitrogen initially present in the influent was removed appearing as $N_2$ in the gas phase.

**KEYWORDS:** ammonium and sulfate removal, reactor UAF, psychrophilic conditions

**PAPER ID:** CEST2019_00585

# UN(K)NOWN Project: Development of Anammox Microbial Inocula to Improve Nitrogen Removal Efficiency in Wastewater Treatment

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## ABSTRACT

The discovery of anaerobic ammonium oxidation (anammox) revealed the existence of a shortcut in the classic nitrogen cycle where ammonium is converted directly to dinitrogen gas. The anammox process can be used to develop more cost and energy-efficient sustainable nitrogen removal systems comparing to those existing today. However, large-scale applications are limited due to the slow growth rate of anammox bacteria described so far. The UNNOWN project proposes to explore the presence of these bacteria in different ecological niches, and select the appropriate seeding sludge starter as the inoculum for reactors. Anammox biomass is enriched in batch experiments as well as in laboratory scale bioreactor systems, such as Up-flow Biofilter, and Anaerobic Baffled Reactor. Afterwards, microbial community composition, optimum growth conditions, and nitrogen removal efficiency are studied. The ongoing project aims to investigate new anammox bacteria, and the relation between community structure and process activity. Ultimately, it is planned to develop microbial inocula to be used as seeding sources for anammox reactors, and to contribute to a wider application of anammox process in wastewater treatment.

**KEYWORDS:** Anammox; Bioreactors; Ecology; Nitrogen removal; Wastewater

**PAPER ID:** CEST2019_00591

# Influence of microbial fuel cell integration on organic matter and nutrient removal in a vertical constructed wetland for wastewater treatment

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## ABSTRACT

The combination of constructed wetlands (CWs) and microbial fuel cells (MFCs) has emerged in recent years with the purpose of enhancing wastewater treatment efficiency of CWs while simultaneously generating electricity. Taking the above into account, the aim of this study is to evaluate the influence of MFC integration on organic matter and nutrient removal in a constructed wetland. The results showed that $NH_4$ + -N concentration reduced from 66.5 ±9.4 at day 0 (influent) to 4.5±0.4 mg/L and 7.03±3.93mg/L for the integrated system and control system, respectively. In terms of the $NH_4$ + -N removal efficiency, an enhancement of the nitrification rate (nNi) was observed when MFC was integrated in VSSF (120.6±1.5 mg/m$^2$ d for control system and 166.8±2.3 mg/m$^2$ d for integrated system). The average COD removal efficiencies were 85.36±2.67% and 94.2±5.9% in the CW and CW-MFC, respectively, obtaining a voltage close to 250 mV. The maximum power density generated was 4.75 mW/m$^2$. In conclusion, the removal efficiencies of COD and $NH_4^+$ -N in VSSF were 85.4 and 88.4%, respectively, while in CW-MFC were 94.3 and 93.2 %. Therefore, the integrating of a MFC into CW does not have adverse effects on the capacity of the CW to efficiently domestic wastewater treatment.

**KEYWORDS:** Microbial fuel cell, Vertical constructed wetland, Chemical oxygen demand, Ammonium, Wastewater treatment

**PAPER ID:** CEST2019_00488

# Session 26 – Environmental biotechnology and bioenergy

## *Friday 6 September 2019 - morning*

# Dairy wastewater as growth substrate for biomass and biocompound production by Spirulina platensis

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## ABSTRACT

Spirulina former Arthrospira is a Cyanobacteria with economic applications in agriculture, biofuel production and wastewater treatment. In this study the influence of the carbon source in the medium and the medium's conductivity for Spirulina platensis UTEX growth over time was investigated. Three different culture media were evaluated: i) modified UTEX medium with inorganic carbon in the form of sodium bicarbonate and carbonate, ii) modified UTEX medium where inorganic carbon was replaced by lactic acid, and sea water enriched with lactic acid. Growth responses, morphological parameters (degree of spiralization), chlorophyll and phytohormone production were assessed.

**KEYWORDS:** Chlorophyll, bioproducts, phytohormones, microalgae, water treatment.

**PAPER ID:** CEST2019_00222

# Second Generation Bioethanol Production from Household Food Wastes via a Newly Isolated Yeast Strain of Wickerhamomyces Anomalus

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## ABSTRACT

In the current study the efficiency of second generation bioethanol production from the pre-dried and shredded organic fraction of household food waste was investigated using the newly isolated yeast Wickerhamomyces anomalus X19. Separate hydrolysis and fermentation (SHF) as well as simultaneous saccharification and fermentation (SSF) experiments were conducted at batch mode. Different loadings of cellulolytic enzymes as well as different mixtures of cellulolytic with amylolytic enzymatic blends were tested in order to enhance the substrate saccharification and conversion efficiency, leading to promising ethanol yields and productivities.

**KEYWORDS:** bioethanol, food wastes, W. anomalus

**PAPER ID:** CEST2019_00278

# Fuel Performance of Biodiesel from Microalgae

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## ABSTRACT

Fuel performance of biodiesel produced from transesterification of microalgae was evaluated to assess its potential as alternative fuel in diesel engine. The biodiesel was produced from transesterification of microalgae Chlorella Vulgaris using K-pumice as catalyst. The engine used in the study was Yanmar 3009D, a small diesel engine with an output power rating of 14.2 kilowatts. The experiments showed comparable power and torque when the engine was run using both the commercial diesel and the algal biodiesel. Biodiesel from microalgae was able to establish a torque of equal to 45.5 N-m while commercial diesel had 48.25 at an engine speed of 2800 rpm. Net break power of Algal biodiesel and commercial diesel are 13.57kW and 13.50kW, respectively. Algal biodiesel had been found to have higher brake-specific fuel consumption and it has a lower exhaust concentrations of nitrogen oxides, oxides of carbon and total hydrocarbons when compared to the commercial diesel. Blending commercial diesel with concentration of algal biodiesel of up to 50% did not show significant change in the performance and emission of the commercial diesel.

**KEYWORDS:** Biofuel, transesterification, K-pumice, power, torque

**PAPER ID:** CEST2019_00368

# LED light tailoring in a planar photobioreactor for optimization of microalgae growth.

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## ABSTRACT

Microalgae are well known for their potential in producing valuable substances for nutraceutical and pharmaceutical industries, as well as a source of biofuel. The use of the photosynthetic capacity of microalgae is a new alternative for carbon dioxide bio-fixation. Therefore, the purpose of this work is to identify the best microalgae growth conditions, using an experimental planar photobioreactor (PBR) and LEDs with variable intensities as light source. Two different illumination intensity levels were used during the experiment: 33 and 57 µE of PPFD (Photosynthetic Photon Flux Density). A series of growth parameters such as temperature, pH, dissolved $CO_2$ and oxygen concentrations, were real-time monitored. Optical density (OD) and dry weight were periodically evaluated in order to measure the concentration of biomass in the culture. Overall, the innovative approach of this work allowed to 1) successfully cultivate Scenedesmus obliquus in a closed photobioreactor under low photon flow; 2) establish a correlation between biomass concentration and LED intensity for this specific microalga strain which can be used in future experiments in order to finely tune light intensity to the desired biomass density.

**KEYWORDS:** Scenedesmus obliquus, LED light source, planar photobioreactor, PPFD, microalgae.

**PAPER ID:** CEST2019_00593

# Cloning and sequencing of the gene encoding the enzyme for the reductive cleavage of diaryl ether bonds of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in Geobacillus thermodenitrificans UZO 3

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## ABSTRACT

We have previously reported that a cell-free extract prepared from Geobacillus thermodenitrificans UZO 3 reductively cleaves diaryl ether bonds of 2,3,7,8- tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), a dioxin with the highest toxicity, in a sequential fashion producing 3',4',4,5-tetrachloro-2-hydroxydiphenyl ether (TCDE) as the intermediate, and 3,4- dichlorophenol (DCP) as the final reaction product. The detection of TCDE implicated the discovery of an unprecedented dioxin-degrading enzyme that reductively cleaves the diaryl ether bonds. In this study, we report the cloning and sequencing of the dioxin reductive etherase gene dreE which codes for the 2,3,7,8-TCDD-degrading enzyme. We showed that dreE was expressed in Escherichia coli and that the product of the expression could reductively cleave diaryl ether bonds of 2,3,7,8-TCDD to produce TCDE. Furthermore, we established that the amino acid sequence encoded by dreE was homologous to an enzyme with yet unknown function that is encoded by a gene located in the riboflavin (vitamin B2) biosynthesis operon in Bacillus subtilis. We also showed that the amino acid sequence possesses a coenzyme A (CoA) binding site that is conserved in the N-acyltransferase superfamily. For the first time, the degradation of 2,3,7,8-TCDD at the molecular level using a enzyme of bacterial origin has been demonstrated.

**KEYWORDS:** Bioremediation, Dioxin, 2,3,7,8-TCDD, Cloning

**PAPER ID:** CEST2019_00373

# Biotechnological conversions of crude glycerol, residue deriving from biodiesel production facilities, by strains of the yeast Yarrowia lipolytica

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## ABSTRACT

Aim of the present study was to assess the ability of four Yarrowia lipolytica strains (ACA-DC 50109, LFMB Y-20, ATCC 20460 and LMBF Y-45) to grow on biodiesel-derived crude glycerol, the principal residue-stream deriving from biodiesel manufacture. Initial trials were carried out in shake-flasks under nitrogen limitation (initial glycerol Glol0~40 g/L, initial nitrogen ~0.35 g/L), that favor the production of cellular lipids and/or extra-cellular secondary metabolites like citric acid (CA). All strains produced appreciable dry cell weight (DCW) quantities (up to 13.0 g/L). The strain ACA-DC 50109 produced CA in concentrations up to 16.0 g/L, while lipid in DCW values of ~15% w/w were recorded. In the next stage, this strain was cultured on media with higher nitrogen limitation (Glol0~50 g/L, initial nitrogen ~0.15 g/L) in batch-bioreactor and shake-flask experiments, and comparable DCW (up to 8.0 g/L) and CA (25-28 g/L) quantities were reported for these trials. Lipid production was higher in the batch-bioreactor experiment. In fed-batch bioreactor trials performed thereafter, a maximum CA quantity of 66.1 g/L (conversion yield 0.66 g per g of glycerol) was obtained. Cellular lipids of all tested strains were mainly composed of the fatty acids Δ9C18:1, Δ9,12C18:2 and C16:0.

**KEYWORDS:** biodiesel-derived glycerol, citric acid, microbial lipid, Yarrowia lipolytica

**PAPER ID:** CEST2019_00512

# Lipid production by Rhodosporidium toruloides growing on media presenting composition similarities with the spent sulfite liquor in batch and fed-batch cultures

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## ABSTRACT

Aim of this study is to explore the effect of sodium lignosulfonate (SL), a paper industry by-product, on cell growth and lipid production by the yeast Rhodosporidium toruloides, cultivated on xylose-based media, that mimic the principal waste-stream originated from paper production facilities (viz. the spent-sulfite liquor). Yeast lipids present increasing interest as alternative non-food feedstocks for biodiesel production. Strains DSM 4444 and NRRL Y-27012 were shake-flask cultured under nitrogen-limiting conditions using xylose at 50 g/L, and SL was added at varying concentrations. Finally, a fed-batch bioreactor trial of the strain NRRL Y-27012 with optimum SL addition was carried out. In the strain DSM 4444, maximum lipid production was obtained in media supplemented with 20 g/L SL, where lipid of 4.8 g/L occurred. In NRRL Y-27012 strain, maximum lipid production was seen with the addition of 10 g/L SL (lipid =5.3 g/L). In fed-batch bioreactor experiments carried out with the strain NRRL Y-27012, lipid =17.0 g/L (corresponding dry biomass =29.7 g/L) was achieved. The yield of lipid produced per unit of xylose consumed was ≈0.19 g/g. Lipids containing increased concentrations of oleic acid, constituting thus perfect materials amenable to be converted into “2nd generation” biodiesel were synthesized.

**KEYWORDS:** 2nd generation biodiesel, oleaginous microorganisms, microbial lipid, spent sulfite liquor, Rhodosporidium toruloides

**PAPER ID:** CEST2019_00607

*Proceedings of the 16th International Conference on Environmental Science and Technology*
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# Thermal and kinetic analysis of biomass fuel (powders) by differential thermal gravimetric analysis (TGA/DTG/DTA)

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## ABSTRACT

The kinetics of the thermal decomposition of the agriculture residues were evaluated using a thermogravimetric analyser under non-isothermal conditions. The thermal behaviour and pyrolysis of two types of biomass i.e. pearl millet cob and eucalyptus by using TGA from ambient to 1000°C. Three different heating rates (10, 15, and 20°C/min) were taken for the thermogravimetric analysis. This study provides a basic insight into the Pearl Millet Cob pyrolysis, which can benefit our current work in developing advanced thermal processes for high-yield producer gas production from pearl millet cob waste.

**KEYWORDS:** Thermogravimetric analysis, Derivative thermal analysis, Differential thermogravimetric analysis, Activation energy.

**PAPER ID:** CEST2019_00718

# Biotechnological production of polyols through conversions of crude glycerol by newly isolated strains of the yeast Yarrowia lipolytica

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## ABSTRACT

The purpose of this study is to investigate the ability of newly isolated Yarrowia lipolytica strains to grow on crude glycerol, the main by-product of the industrial production of biodiesel. In particular, the ability of the yeasts to metabolize glycerol and produce dry cell weight (DCW) and secondary metabolites such as lipid, endopolysaccharides and polyols (e.g. mannitol, arabitol, erythritol) was assessed. Two newly isolated strains (LMBF Y-46 and LMBF Y-47) were used, while trials were performed in different initial glycerol concentrations (Glol0=40-120 g/L) and various initial pH values (3.0-7.0) in shake-flasks. It has been seen that polyols production increased with decrease of pH value into the medium. At low Glol0 concentrations (=40 g/L), almost exclusively mannitol was synthesized (i.e. the strain LMBF Y-46 produced ~20 g/L of mannitol at pH=3.0). When Glol0 increased, other polyols (i.e. erythritol and arabitol) were also produced in appreciable quantities. At a pH=3.5 and for Glol0~120 g/L, a total quantity of polyols ~57 g/L was synthesized for the strain LMBF Y-46. Cellular lipids in restricted quantities (8-14% in DCW) were produced, while cellular polysaccharides increased with the time reaching to values of c. 35-42% w/w in DCW at the stationary phase of growth.

**KEYWORDS:** biodiesel-derived glycerol, erythritol, mannitol, polyols, Yarrowia lipolytica

**PAPER ID:** CEST2019_00610

# Session 27 – Hydrology and water resources management (2)

## *Friday 6 September 2019 - morning*

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# Water Security of Rural Water Supply Systems in Super Typhoon Haiyan Affected Areas

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## ABSTRACT

The rural water supply systems in the countryside necessitate sustainability and security assessment to ensure long-term and safe water supply to target beneficiaries. The study aimed to analyse the hidden threatening factors in water supply system along technical requirements. It also predicts the probability of incidents and security degree of the system. The rural water supply system in typhoon Haiyan affected areas was rehabilitated and constructed through national and international funds. It sampled about 5,921 rural water supply systems constructed and installed in 75 municipalities in Eastern Visayas. The water supply system sampled were: 13 Eastern Samar; 13 from Samar; 12 from Northern Samar; 13 from Leyte; 14 from Southern Leyte; and 1 from the Province of Biliran. The water security was assessed and analyzed according to the following indicators: demand and availability, natural factors affecting safety and quality, and policies and management mechanism. The water criteria was analysed using Analytic Hierarchy Process. The study found out that the natural factors such as floods, drought, eathquake have highest computed possibility values. The water security of the water supply systems in typhoon Haiyan affected areas has to implement control measures to minimize the degree of damage due to natural factors.

**KEYWORDS:** water supply system water security, water security models, rural water supply systems

**PAPER ID:** CEST2019_00362

# Water Sustainability: Evaluation of Alternative Water Supply Methods in Greek and European Islands

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## ABSTRACT

Water is a very valuable natural resource absolutely necessary for life. Lately water resources are facing high pressure from continuously increasing demand. Besides, various areas face water shortage due to decrease of precipitation, irrational use, losses and mainly very high rates of tourism, especially in areas with water shortage and/or very limited water availability. Various water supply methods are applied in different cases in order to satisfy water demand, such as dams, desalination units, reuse of wastewater treatment plants effluents and water transport. Each of these methods has different environmental and social impacts. The objective of the work is to present the progress of our on-going research work concerning the identification of the parameters defining water sustainability and the evaluation of these alternative water supply methods. To that effect, the various alternative water supply methods are analysed in terms of technical and economic as well as feasibility characteristics taking also into account their properly defined and measured sustainability according to a set of indicators that has been suggested in the literature to assess it. A multicriteria optimisation model is developed for the quantitative assessment of the various water supply methods.

**KEYWORDS:** water sustainability, multicriteria analysis, water supply methods

**PAPER ID:** CEST2019_00398

# An Agent Based Modelling tool exploring decision-making processes for flood risk management

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## ABSTRACT

Cities at risk of extreme hydro-meteorological events need to be prepared to decrease the extent of the impacts. However, the majority usually reacts to the catastrophe, having failed to proactively prepare against extremes. This can be a result of both absent structural protection measures and problematic governance. While for the first, models exist that can simulate the effect, the effect of the latter is difficult to quantify. This work aims to explore how the different decisions authorities make, regarding for example: whether or not to cooperate with someone; build something; assign funding to something else etc., affect the flood risk management of an area. For that matter, the Institutional Analysis Framework was used to conceptualise the decision-making processes of authorities responsible for flood risk management. Based on this, an Agent Based Modelling tool has been created, enabling the exploration of the system's behaviour under different decisions and risk scenarios. The tool has used as a case study the responsible authorities for flood protection in the city of Rethymno, Greece. The tool has a userfriendly interface enabling the end-user to explore the drivers of decision-making processes under different conditions.

**KEYWORDS:** decision-making, flood risk management, agent based modelling

**PAPER ID:** CEST2019_00510

# Overrated Credence to the Outdated Sand Mining Legislations: A Hydrologically Challenged Measure

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## ABSTRACT

The recent floods in the 'God's own Paradise'(Kerala) reminds the Indian Sub-Continent as well as the Global spectators of not just heavy rainfall but also the 'hungry water effect' from deranged desiltation. Laws from the first decade of independence decide the commercial desiltation permits and procedures in most parts of the country with renewed guidelines. The presentation attempts to map the in-river sand mining in all the Indian States, analyze the spatial extent and technology used, resulting degradation of the completely dug-out rivers, alterations in the geomorphology, base flow and river course, conditional water flow into the distributing channels which tend to stand at a higher surface than the further lowered river bed, impact on the continued cultivation in delta regions triggering the contingencies of extreme drought and flood. Poor and delayed adherence to the ecological economic estimates of this evolving nation and the enviro-legal regime can be traced as barriers of environmental restoration. Rampant dredging often with the under and over utilization of mining techniques, reluctant attitude to alternative construction materials raise serious economic & environmental concerns questioning the future livability of the Sub-continent.

**KEYWORDS:** River, Sand mining, Water flow, Silt, Environment.

**PAPER ID:** CEST2019_00544

# Evaluation of a New Millifluidic Device for the Consistent Determination of Oil Droplet Biodegradation Kinetics

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## ABSTRACT

Natural seeps and accidental releases of crude oil in the sea result in swarms of droplets that are carried away by underwater sea currents. The droplets may be created either at the sea surface during the breakup of an oil slick by sea waves, or at the seafloor during the extrusion of crude oil from natural cracks or broken wellheads. A high concentration of oil droplets in seawater disturbs the established ecosystem dynamics and poses a significant risk of toxic effects to fish and other marine animals. The fate of underwater droplet swarms is determined by natural attenuation processes, mainly dissolution into the seawater and biodegradation by oil-eating microbes. Using microfabrication techniques (photolithography and 3D printing), we have developed a new millifluidic device that enables the generation of oil droplet populations with desired size and, subsequently, the entrapment, long-term incubation and microscopic imaging of the droplets while they undergo microbial degradation. Here, we will present experimental results on the biodegradation of hexadecane droplets by Marinobacter sp. microbes in synthetic saltwater.

**KEYWORDS:** hexadecane, biodegradation, droplet microfluidics, emulsification

**PAPER ID:** CEST2019_00641

# The role of hydro-technical works in diminishing flooded areas. Case study: the June 1985 flood on the Miletin River

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## ABSTRACT

Hydro-technical constructions are very important in diminishing flooded areas and associated damage in the event of a flood. The case study for the Miletin River in the Moldavian Plateau (Eastern Romania) focusses on the historical floods of June 1985. The floods recorded at the Miletin River hydrometric stations are: 106 m3 /s for Nicolae Balcescu station and 204 $m^3$ /s for Şipote station. Our analysis involves a series of simulations of a flood flow constant using the hydrological data associated with the 1985 flood. The mathematical modelling base is the high-grade terrain model (LiDAR raster type). Two flood scenarios have been carried out: the first one was based on the running of a constant flow considering the present hydro-technical constructions and works; the second scenario implied running the same flow, but without hydro-technical constructions. Bands of flooding associated to the two scenarios were generated. Flooded areas and damages were determined considering the modification of the bed by these works. Comparative analysis of flooded areas scenarios reveals, in the case of the same amount of precipitation, a downward trend in flood flows due to the presence of the hydro-technical constructions.

**KEYWORDS:** hydro-technical constructions, flood, HECRAS, GIS, Miletin River

**PAPER ID:** CEST2019_00293

# Dam break analysis using HEC-RAS techniques. Case study: Cal Alb dam (NE Romania)

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## ABSTRACT

Along with the understanding of the importance of a water resource in the vicinity of a human settlement, human societies have begun to build weirs, dams or hydraulic structures to use more efficiently the natural resource. One of the most important works that can be done in the course of a river is the construction of dams for the formation of storage areas. The importance of storage areas is given by their extensive use, whether used for flood defense, pisciculture, water supply or recreation. The Cal Alb lake is located in the Başeu river basin, which is further located on the territory of Botoșani county. Botoșani county is statistically mentioned as the second county in Romania with the largest surface of water. Cal Alb lake has an area of 180 ha and a retention volume of 16.3 million $m^3$. Immediately downstream of the Cal Alb lake are built 20 polders and 4 ponds, but with a much lower retention volume. The present study aims to model flood caused by the failure of the dam of Cal Alb lake and its impact both on the elements of retention of the downstream storage areas and on the localities in the surrounding area.

**KEYWORDS:** flood, HEC-RAS, dam break, NE Romania

**PAPER ID:** CEST2019_00299

# Exceptional flood events in the summer of 2018 in the Trebes Negel Representative Basin (Romania)

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## ABSTRACT

In the summer of 2018, the general unstable weather throughout the central and eastern parts of Romania has led to significant rainfall, sometimes exceeding 60 mm/day, and therefore to a massive runoff on the slopes that rapidly increased the flow on tributaries and the main course of the river Trebes from the Moldavian Subcarpathians. The majority of the hydrometric basin stations recorded exceedances of the caution levels, and the hydrometric station Bacau registered the maximum historical level (H= 348 cm). In order to demonstrate this, there were performed analysis and data processing using programs and hydraulic calculations for different probabilities.

**KEYWORDS:** exceptional floods, historical levels, hydraulic calculation, Trebes-Negel Representative Basin

**PAPER ID:** CEST2019_00308

# The role of catchment properties on the importance of initial hydrologic conditions for seasonal hydrological forecasting in alpine areas

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## ABSTRACT

A well-known approach to seasonal hydrological forecasting involves the use of ensembles as forcing to a hydrological model, based either on historical meteorological data (Ensemble Streamflow Prediction, ESP) or on forecasts produced by one or more dynamic climate models (multi-model approach). This work aims at investigating the role of initial hydrologic conditions (ICs) and seasonal climate forecast skill on the accuracy of seasonal hydrologic predictions in alpine regions, as a function of catchment properties. The Integrated Catchment-scale HYdrological Model (ICHYMOD) is employed, forcing it with historical meteorological data and multi-model ensemble climate predictions produced by the climate forecast systems NCEP CFSv2 and ECMWF SEAS5 (the latter analysis is not included in the present work). The hydro-climatic prediction system is tested on two catchments in the Eastern Italian Alps, that are different in terms of orography and soil/groundwater storage capacity. The diverse catchment properties result in differential parameterization of the subsurface processes in the hydrological model, hence in a different impact of the initial hydrologic conditions on the seasonal runoff predictions.

**KEYWORDS:** seasonal hydrological forecasting, alpine area

**PAPER ID:** CEST2019_00105

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# The Intensity – Duration (I-D) curves towards to a spatially distributed flood early warning tool (F-EWT)

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## ABSTRACT

Attica region suffers from rainfall events of high intensity, inducing flash-floods and significant damages in the urbanized areas. This analysis concerns the determination of the maximum intensity-duration thresholds regarding flooding (F) or non-flooding (NF) regime, using the available precipitation records and the dataset of Fire Service operations in flooded properties for the period 2005-2016. Each event is classified as 'F' or 'NF' in case of flooded properties or not, respectively. As expected, 'F' events prevail for the higher rainfall intensities. Based on this characteristic, it was found that when excluding outlies in these two groups of events, then two clear limits of I-D are determined using a power-law equation. The first one ('lower limit') defines the area below which floods are absent and above which flood occur or not, while the second ('upper limit') defines the minimum limit of maximum intensities above which only events linked to flooding are observed. Based on these limits, a Flood Early Warning Tool (F-EWT) that provides the corresponding limits of cumulative precipitation as a function of the event's duration is defined and evaluated indicatively for the severe flood event of October 24, 2014.

**KEYWORDS:** floods, Attica region, early warning, flood mitigation, rainfall intensity

**PAPER ID:** CEST2019_00491

# Session 28 – Emerging pollutants (2)

## *Friday 6 September 2019 - morning*

# Evaluation of innovative water treatments at molecular level based on high resolution mass spectrometry and advanced statistical analysis tools

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## ABSTRACT

This work aims at integrating the last advances in high resolution mass spectrometry (HRMS) and statistical analysis of data to develop and optimize a smart methodology (workflow) for the assessment of the performance of innovative water treatments using different technological approaches based on advanced oxidation processes with UV-254nm: (i) UV/$K_2S_2O_8$, where oxidation takes place mainly following the initial formation of sulfate radicals, (ii) UV/$KHSO_5$, where oxidation begins with the formation of both sulfate and hydroxyl radicals and (iii) UV/$H_2O_2$, when only the formation of hydroxyl radicals takes place initially. Experiments were carried out using secondary effluent from a local wastewater treatment plant. The developed workflow allows the evaluation of the treatments in terms of overall oxidation through the careful study of Van Krevelen diagrams, where all the masses of the HRMS chromatograms are considered. The potential formation of transformation products with sulfur due to the sulfate radicals was also evaluated using statistical tools based on the isotopic pattern and accurate mass. Finally, the behavior of a large number of micropollutants with a wide range of physicochemical properties was studied using suspect screening strategies.

**KEYWORDS:** Water treatment, AOPs, HRMS, non-target screening

**PAPER ID:** CEST2019_00376

# Combined use of Anaerobic and Aerobic Moving Bed Biofilm Reactors for Micropollutants' Removal from Wastewater

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## ABSTRACT

A novel laboratory-scale continuous flow wastewater treatment system, consisting of an anaerobic moving bed biofilm reactor (AnMBBR) and an aerobic MBBR, was used for investigating the removal of hydroxybenzothiazole (OH-BTH) and selected benzotriazoles from municipal wastewater. The system was operated under three different Experimental Phases where different organic loadings were applied: 0.82 kg COD $m^{-3}d^{-1}$ (Phase A), 0.2 kg COD $m^{-3}$ $d^{-1}$ (Phase B) and 2.1 kg COD $m^{-3}d^{-1}$ (Phase C). The system achieved sufficient COD removal, nitrification and biogas production. All target micropollutants were partially removed during the experiments. Total removal efficiencies ranged from 32% for 5-methyl-1Hbenzotriazole (5TTR) to 97% for OH-BTH. The contribution of the strictly anaerobic bioreactor was important for 5TTR, 5-chlorobenzotriazole (CBTR) and xylytriazole (XTR), while the use of aerobic bioreactors resulted to important increase of target compounds removal and it was exclusively responsible for the removal of OH-BTH and benzotriazole (BTR).

**KEYWORDS:** MBBR; Anaerobic reactor; Benzothiazole; Benzotriazole

**PAPER ID:** CEST2019_00416

# Biodegradation of Pharmaceuticals by Bacteria Isolated from Estuarine Environment - Cleanup Technologies through Nature-Based Processes

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## ABSTRACT

New sustainable technologies are needed to tackle pharmaceuticals contamination in different environmental compartments. Bioremediation technology, using native microorganisms with capacity for partial or complete elimination of contaminants, can be considered. This work investigated the capability of different bacterial strains to biodegrade paroxetine and bezafibrate, either as a bacterial consortium or as a single strain. These strains were isolated from bacterial cultures previously enriched under static conditions with paroxetine or bezafibrate, using as inoculum an estuarine sediment. All strains were identified through 16S rRNA gene sequencing. Degradation potential was accessed by analyzing pharmaceutical compounds in the culture medium and fluoride ion release (only for paroxetine). The genus Pseudomonas, widely reported in biodegradation studies, was predominant among the isolated bacterial strains. Most bacterial strains showed potential to degrade paroxetine (55%-100%) as a single strain in cometabolism with sodium acetate. Furthermore, bacterial consortia also presented high removal efficiencies (>85%) for paroxetine throughout 4 weeks. For bezafibrate, tests showed a high potential of the bacterial consortia to degrade this compound (>90%). The obtained results highlight the potential of native microorganisms to degrade different pharmaceuticals which should be addressed for future development of bioremediation technologies for the recovery of contaminated environments.

**KEYWORDS:** Autochthone degrading bacteria; natural communities; bioremediation; pharmaceuticals.

**PAPER ID:** CEST2019_00631

# Magnetic solid-phase extraction of pesticides in environmental water samples using $Fe_3O_4@SiO_2@C18$ nanoparticles coupled to GC-MS determination

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## ABSTRACT

A rapid magnetic solid-phase extraction (MSPE) method coupled to Gas Chromatography-Mass Spectrometry (GC-MS) was developed for the simultaneous extraction of ten pesticides belonging to various categories (insecticides, herbicides and fungicides) in environmental water samples. The magnetic $Fe_3O_4@SiO_2@C18$ nanoparticles were synthesized by coprecipitation of $Fe^{2+}$ and $Fe^{3+}$ ions, at alkaline conditions, under hydrothermal treatment and and used as adsorbents of MSPE. The proposed method is optimized by means of experimental design and response surface methodology. Several parameters influencing MSPE efficiency were investigated. The most important were the amount of the sorbent and the extraction time. Under optimal conditions, the MSPE-GC-MS method presented fast simple separation and analysis, and excellent linearity in the range of 6.4–5000.0 ng/L, with coefficients of determination ($R^2$) higher than 0.9901 for all compounds. Moreover, the performance of the MSPE method was compared to a conventional SPE and the MSPE method was comparable. Finally, the optimized method was applied in a case control study carried out in Rivers Aliakmonas, Loudias and Axios (Macedonia Region-North Greece). The most frequently detected compounds were atrazine, methylparathion, chlorpyriphos and irgarol. The magnetic $Fe_3O_4@SiO_2@C18$ composites based MSPE method proved promising for convenient and efficient determination of pesticides in environmental water samples.

**KEYWORDS:** Experimental Design, GC-MS, magnetic solid-phase extraction, natural waters, pesticides

**PAPER ID:** CEST2019_00542

# Removal of PFAS from wastewater by bio-waste adsorbent: material characterization and adsorption kinetic study.

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## ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) are considered emerging contaminants and have been increased their attention due to their distribution in water body. These compounds are acid and characterized by a thermal stability to make them resistant to degradation processes. Activities such as tannery, paper and cardboard production, waterproof cloths, produce wastewater rich in PFAS and heavy metals. The adsorption process is one of the technologies used for the treatment of wastewater and food residues are getting increased attention as bio-adsorbent because they can be found easily as wastes or by-products and at almost no cost. In this work the removal of PFAS was performed by using food waste such as Yerba Mate (YM) as bioadsorbent. To achieve the mineralization of Heptadecafluorooctanesulfonic acid adopted as model compounds $TiO_2$ photocatalysis tests were performed. The concentration of pollutants was determined by HPLC, UV-VIS and TOC analysis. SEM-EDS, XRD, FTIR and BET were done to achieve a characterization of the adsorbent material.

**KEYWORDS:** PFAS, bio-adsorbent, adsorption, wastewater treatment, Yerba Mate

**PAPER ID:** CEST2019_00218

# Extended suspect screening to identify organic micropollutants and their transformation products as potential markers of wastewater contamination in riverine and coastal ecosystems

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## ABSTRACT

In this study, a comprehensive suspect screening of organic micropollutants (MPs), and some of their transformation products (TPs) and metabolites, was performed in waste, river and coastal waters from the Ebro Delta region (Catalonia, Spain). For this purpose, an automated suspect screening workflow was developed using two analytical steps: (i) identification of suspected compounds using on-line databases; and (ii) semi-quantification of identified compounds by using isotopic labelled standards. Using this strategy, several pollutants were identified comprising pharmaceuticals, pesticides, abused substances, personal care products, industrial chemicals and surfactants of major relevance in Catalonia. Additionally, their occurrence was evaluated along the wastewater-recipient water chain until they reach estuaries and the Mediterranean Sea. The most ecologically relevant compounds detected, that could be considered as suitable markers of wastewater contamination in freshwater and coastal ecosystems, were highlighted. Results reveal that some suspected TPs and metabolites were more ubiquitous than their parent compound and found at similar concentration levels. These results evidence that suspect screening methodologies can be a useful tool for the identification of relevant markers of wastewater contamination.

**KEYWORDS:** Suspect screening; Micropollutants; High resolution mass spectrometry;

**PAPER ID:** CEST2019_00097

# Analysis of degradation of the micro pollutant amoxicillin by photolysis and evaluation of the degradation products

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## ABSTRACT

Emerging micro pollutants are substances that have recently been identified in environmental matrices, of which information on environmental permanence and toxicity is still scarce. Due to their chemical structure, antibiotics are more stable and require more complex processes for degradation. The present study aimed to elaborate a proposal for the degradation of the β-lactam antibiotic amoxicillin by photolysis, evaluating the formation of by-products. As a methodology, 100 μg /L amoxicillin solutions were submitted to different ultraviolet light bulbs irradiations, at different power and distances, by means of a 100 mL batch quartz reactor. To evaluation degradation of amoxicillin and of the products generated, the high-performance liquid chromatography mass spectrometry was used. As a result, the best degradation condition (greater than 90% reduction of the original molecule) was with a 95W light bulb, at a distance of 5 cm from the sample at 10 min irradiation time. Two by-products originated under different pH conditions of the irradiated solution were identified. Based on the obtained results, it is concluded that this prototype and the applied method can be used in the future to reduce this pollutant.

**KEYWORDS:** emerging pollutant, degradation, amoxicilin, water

**PAPER ID:** CEST2019_00379

# Investigation of food additives readily biodegradability in respirometric tests

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## ABSTRACT

The biodegradability of fourteen (14) food additives, belonging to different groups such as artificial sweeteners, preservatives and coloring agents, was evaluated using the OECD 301F protocol (manometric respirometry test). According to the results, eight out of fourteen compounds, namely Aspartame, Cyclamate Na, Saccharin, Erythritol, Potassium Sorbate, Benzoic Acid, Sodium Ascorbate and Xylitol are characterized as readily biodegradable with biodegradation rates of 83.6 ± 11.4%, 91.5 ± 5.8%, 76.4 ± 10.3%, 70.6 ± 9.0%, 99.3 ± 7.9%, 97.5 ± 4.0%, 83.8 ± 6.1% and 68.9 ± 2.6%, respectively, during the 28-d experiment. On the other hand, Alitame, Curcumin, Ponceau 4R, Allura Red, Sunset Yellow and Azorubine did not meet the strict definition of ready biodegradability. Further biodegradations tests are required for these compounds in order to investigate their biodegradation potential under different experimental conditions.

**KEYWORDS:** food additives; wastewater; activated sludge; OECD protocol

**PAPER ID:** CEST2019_00418

# Determination of pharmaceutical residues in natural waters using high performance liquid chromatography coupled to quadrupole-Orbitrap mass spectrometry

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## ABSTRACT

The presence of residual pharmaceuticals in the aquatic environment is an important environmental issue. Since the drugs are designed to cause biological responses, they could pose a risk to organisms in their natural environment. In this study, the presence of selected pharmaceutical compounds (paracetamol, phenazone, ketoprofen, budensonide and atenolol) in surface waters was studied. Six sampling points along the aquatic system of the River Louros, close to the city of Ioannina (Epirus, NW Greece), were selected for the assessment of their pollutant load. Analytical method was based on solid-phase extraction of water samples, using Oasis HLB cartridges, followed by high performance liquid chromatography coupled to Orbitrap high resolution mass spectrometry (UHPLC-LTQ/Orbitrap-MS). The methodology exhibited good analytical characteristics (R>65%, R2 >0.9990, LOQs between 1.5 and 11.0 ng/L). Results revealed the presence of only paracetamol (although in levels below LOQ) in two sampling stations. The proposed analytical methodology proved to be fast, easy and reliable for the systematic monitoring of pharmaceuticals residues in natural waters.

**KEYWORDS:** Pharmaceuticals, SPE, LCORBITRAP/MS, river water, monitoring

**PAPER ID:** CEST2019_00522

# Characterization of Natural Organic Matter and Disinfection By-products Formed after Chemical Disinfection of Water

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## ABSTRACT

The present work aims at investigating the effects of chlorine and chloramine-based disinfection processes on organic matter and the formation of disinfection byproducts (DBPs) in drinking water treatment plants (WTPs). For this, water from four water treatment plants with different characteristics in terms of the type of disinfectant used (chlorine or chloramine) and source water type (groundwater, surface water, or artificially recharged groundwater) was analysed before and after the chemical disinfection process. Specific and generic extraction approaches, and target, suspect and non-target screening approaches using advanced mass spectrometry were used and are currently being explored to characterize the different water matrices.

**KEYWORDS:** drinking water treatment, chemical disinfection, non-target screening, mass spectrometry, DBP precursors, AOX

**PAPER ID:** CEST2019_00214

# A nine-year study on the temporal changes of licit and illicit drug use patterns as revealed from the chemical analysis of influent wastewater from the wastewater treatment plant of Athens

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## ABSTRACT

Daily flow-proportional composite influent wastewater was collected from the Wastewater Treatment Plant (WWTP) in Athens during a nine-year sampling campaign (2010-2019). Analytes in influent wastewater are markers of the consumption and the exposure of the chemicals in the population. Wastewater samples were cleaned up and enriched 200 times using a generic solid phase extraction protocol based on a mixture of four sorbent materials capable of retaining a wide-range of analytes. Extracts were analyzed by a wide-scope targeted LC-QTOFMS and by highly-sensitive LCMS/MS methods for the determination of pharmaceuticals such as antidepressants, anxiolytics, antipsychotics, antibiotics, antiepileptics, analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), diuretics, antihypertensives, antiulcer, and steroids as well as the main illicit drugs and their metabolites among others. Furthermore, the daily consumption of the substances was back-calculated with the aim of revealing trends in the use patterns of the compounds and associate the changes with socioeconomic phenomena, law enforcements and financial indicators.

**KEYWORDS:** wastewater epidemiology, use patterns, socioeconomic changes, illicit drugs, pharmaceuticals, LC-MS/MS, LC-QTOFMS, wide-scope screening

**PAPER ID:** CEST2019_00682

# Development and Application of Methods for the Determination of Pesticide Residues in Natural Waters and Sediments, Coupled to GC-MS

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## ABSTRACT

The main objectives of this study were to develop rapid and accurate screening multiresidue pesticide methods on the basis of Solid-Phase Extraction (SPE) technique for the determination of 10 pesticides in water samples and on the basis of QuEChERS technique regarding sediments samples. The target compounds were determined by Gas Chromatography-Mass Spectrometry (GC-MS). The method was validated in terms of accuracy, precision, linearity, detection and quantification limits. The recovery percentages obtained for the pesticides in water samples at three different concentration levels, ranged between 73.2 to 101.2%, with relative standard deviations below 9.3%. The corresponding results from the sediment ranged between 69.5 to 122.7% with relative standard deviations below 11.2%. The limits of detection for the pesticides in water and sediment were below 12 ng $L^{-1}$ and 9 mg $kg^{-1}$, respectively. The optimized methods were applied in Epirus region (North-Western Greece) to determine the concentration level of the target compounds in sea water and sediment samples. The analytical methodologies exhibited excellent analytical characteristics and proved to be reliable for the estimation of the pollutant load in sea water and sediment samples from marine aquaculture.

**KEYWORDS:** pesticides, QuEChERS, sediments, SPE, waters

**PAPER ID:** CEST2019_00922

# Liquid chromatography coupled to high-resolution-Orbitrap mass spectrometry for the determination of nitrofuran metabolites in fish samples

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## ABSTRACT

Nitrofurans (NFs) are synthetic antibiotic drugs employed for the treatment of bacterial diseases in livestock production or as food additives in industrial farming of food-producing animals. The most widely used NFs in veterinary medicine are nitrofurantoin (NFT), furazolidone (FZD), nitrofurazone (NFZ) and furaltadone (FTD). After intake, NFs are extensively metabolized into their corresponding metabolites (NFMs), identified as 1-amino-hydantoin (AHD), 3- amino-2-oxazolidone (AOZ), semicarbazide (SEM) and 3-amino-5-methyl-morpholino-2-oxazolidinone (AMOZ), for nitrofurantoin, furazolidone, nitrofurazone and furaltadone, respectively. NFs and their metabolites are suspected to possess carcinogenic and mutagenic potency, therefore their application in food and animal production was banned in the EU in 1995 and in the USA in 2002. Since parent NFs are extensively metabolized to tissue-bond metabolites, recent analytical methods have been focused on the determination of the NFMs instead of the parent compounds. In the present study a modified extraction technique including at first a hydrolysis-derivatization step [O'Keeffe et al., 2004] was validated and applied for the simultaneous determination of four of NFMs residues (AHD, AOZ, SEM, AMOZ) in fish samples from aquacultures located in North Western Greece.

**KEYWORDS:** Nitrofuran metabolites, fish, UHPLC-LTQOrbitrap-MS

**PAPER ID:** CEST2019_00550

# Session 29 - Energy technologies and sustainability (2)

## *Friday 6 September 2019 - morning*

# Catalytic Pyrolysis of Plum Seed

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## ABSTRACT

In this study, pyrolysis and catalytic pyrolysis of the plum seed was investigated. For this purpose, the characteristics of the raw materials were determined by proximate analysis (moisture, ash, volatile matter, fixed carbon), structural analysis (holocellulose, hemicellulose, hemicellulose, lignin, oil, protein and extractive material) and ultimate analysis. The pyrolytic behavior of the feedstocks was studied by thermogravimetric analysis. Then pyrolysis temperature, which is significant pyrolysis parameter, investigated the effect of heating rate on pyrolysis product yields. When the pyrolysis temperature is 550 °C, the nitrogen flow rate is 100 $cm^3$/min and the heating rate is 100°C/min, the highest liquid product yield is achieved. In order to improve the quality of the liquid product obtained as the next process, catalytic pyrolysis of the raw material in optimum conditions is carried out. Catalytic pyrolysis experiments were carried out by adding 10% of Purmol CTX-1 catalyst to the raw material. Liquid products are characterized with sprectroscopic and chromatographic methods such as GC-MS, FT-IR, $^1$H-NMR

**KEYWORDS:** Catalytic pyrolysis, plum seed, biofuel

**PAPER ID:** CEST2019_00421

# Clean Electro-mobility Solutions only using Green Energy Input

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## ABSTRACT

The utilization of electric vehicles (EVs) is considered as the new tool against the serious problems resulting from the oil products consumption in the transportation sector. In this context, the current work first estimates the real world electricity consumption of commercial EVs, including charging and discharging losses, using long term experimental measurements. Accordingly, on the basis of the total electricity consumption and using the electricity generation fuel mix (mainland vs. remote islands), the corresponding air pollutants are predicted. On the other hand, one may estimate the air pollutants' emissions of contemporary EVs using experimental measurements and data provided by the EV manufacturers and other external accreditation bodies. According to the results obtained one should point out that current EVs may surcharge the environment with a higher volume of pollutants than the corresponding ICEbased ones, especially when coal-based and oil-based electricity is used to charge the batteries of the EV. On the other hand, if using renewable energy sources to charge the batteries of EVs, it is evident that the environmental impact of EVs -due to air pollution- is minimal.

**KEYWORDS:** Renewable Energy; Energy Storage; Transportation Sector; Air Pollution; Greenhouse Gases

**PAPER ID:** CEST2019_00513

# Thermal-physical properties of agricultural residues for syn gas production using thermo-gravimetric analysis

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## ABSTRACT

The thermal degradation behaviour and activation energy of biomass can be utilized to know the behaviour and constituent of biomass degradation rate prior to gasification. Suitability of biomass for gasification and power generation was prejudged by its thermo-physical properties. The present study was to explore the thermochemical behaviour of agricultural waste biomass for gasification were investigated by thermo-gravimetric analysis method. Two methods was adopted for evaluating the apparent activation energies of agriculture residue i.e. The Kissinger Akahira Sunose (KAS), The Flynn-wall-ozawa (FWO) methods. The results showed that corncob was sensitive to heat and it has the lowest lignin content and activation energy, therefore, it is best suited for feedstock in pallet form for gasifier engine system for producer gas generation in a remote area like village and hill station.
**KEYWORDS:** Pearl millet cob, Corncob, TGA, Thermal degradation

**PAPER ID:** CEST2019_00716

# Saltwater a viable source of Energy for Sustainable Rural Development

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## ABSTRACT

Energy is the base for development in present time. A sustainable renewable energy source is needed to overcome the requirement of special conditions and infrastructure for the development of rural areas. Saltwater is available in abundance and energy can be harnessed directly with ease. The study analysed saltwater energy potential of three salt companies by varying salt concentration at the rate of 1%, 2%, 3%, 4%, 5% and 10 %. The company with higher energy potential was further analyzed at increased concentration of 15%, 20%, 25%, 30%, 40% and 50%. The sustainability of the energy was determined in terms of carbon emission as compared to kerosene lamp widely used in rural areas as a fuel. The energy potential of saltwater energy is low but can be successfully used in rural areas for lightning purpose. The concluded that saltwater energy is a viable, readily available, economical and green source of energy for rural development.

**KEYWORDS:** Sustainable, Renewable Energy, Rural Development, Saltwater, carbon emission

**PAPER ID:** CEST2019_00205

# Nitrogen co-doped with fluorine on reduced graphene oxide for enhanced electrocatalytic activity and stability for ORR in alkaline fuel cells

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## ABSTRACT

Nitrogen co-doped with fluorine on reduced graphene oxide (N-F-rGO) was prepared by one-pot hydrothermal treatment method. The scanning electron microscopy (SEM) images and X-ray photoelectron microscopy (XPS) spectra revealed the successful doping of nitrogen and fluorine into the rGO. The Brunauer-Emmett-Teller (BET) results demonstrated high surface area of N-F-rGO that are favorable for $O_2$ adsorption. The results show that NF-rGO catalyst has improved the catalytic performance electrode for the ORR in alkaline environment than the fluorine undoped N-rGO. The Koutechy-Levich (KL) analysis and rotating ring disk electrode (RRDE) measurements suggest that N-F-rGO dominantly favors a $4e^-$ reduction process. The nitrogen co-doped with fluorine on rGO exhibited remarkable long-term stability towards the ORR than Pt/C. These improved electrochemical properties indicate that N-F-rGO will be promising candidates for cost-effective electrode materials for application of non-polluting alternative energy sources.

**KEYWORDS:** electrocatalyst, ORR, N-F-rGO, hydrothermal treatment, fuel cells

**PAPER ID:** CEST2019_00609

# One Step Industrial Enzymatic Technology of Starch Hydrolysis to Glucose

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## ABSTRACT

Starch degrading enzymes like amylase have received great attention because of their technological significance and economic benefits. As a result of screening of Durmishidze Institute of Biochemistry and Biotechnology collection of mycelial fungi, accounting 2500 individual strains, 39 strains poducing amylases have been revealed. Three promising enzyme producer strains of genus Aspergillus have been selected and technical preparations of their amylases obtained. The hydrolysis process of starch of different concentrations with the technical preparationof Aspergillus niger p8-3 at 680 °C was studied. 94- 96 % yield of glucose was reached at incubation of 30% and 40% starch with technical preparations of fungal enzymes during 8 hours.

**KEYWORDS:** microscopic fungi, amylases, hydrolysis, glucose, technology

**PAPER ID:** CEST2019_00170

# Durability of Cement Mortars and Concretes Exposed to Biological Attack as One of the Sustainability Parameter – A Correlation Analysis

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## ABSTRACT

Among the pillars of the sustainability, the aspect of prolongation of life of constructions has to be involved. Focus on sustainability leads to study of durability of building materials. Phenomenon called bio-corrosion can result in structure deterioration. Special attention is paid to oxidation of hydrogen sulfide to sulfuric acid by bacteria community established on a concrete surface. The type of the binder and composition of aggregate is a very important factor for investigation of the bio-corrosion processes of concrete. In this paper, a comparison of deleterious processes proceeded in cement composites exposed to bacterial influence was investigated. Concentrations of dissolved ions (Ca, Si) in leachate (as an indicator of bio-corrosion) after 270-day exposure to Acidithiobacillus thiooxidans were measured every 7 days during the experiment. The samples of cement mortars and concrete composites were compared. The correlation analysis was confirmed to be a useful tool to help the interpretation of the experimental findings.

**KEYWORDS:** bio-corrosion, Acidithiobacillus thiooxidans, leaching,sulfate.

**PAPER ID:** CEST2019_00655

# Numerical simulation of $CO_2$-brine-rock interactions on $CO_2$ sequestration in Shihezi Formation of Ordos Basin in China

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## ABSTRACT

Geochemical reactions play an important role in $CO_2$ geological storage environments. $CO_2$-brine-rock interactions will be enhanced in low pH environment, because of acidity in reservoir being strengthened due to $CO_2$ dissolution. TOUGHREACT is used conduct kinetic batch modeling and reactive transport modeling in Shihezi formation in Ordos basin, where the first CCS project is carried out in China. Simulations are based on the core data, which are focused on effects of $CO_2$ for pH, gas saturation, geochemical interactions, porosity and permeability in formation. Results show thath K-feldspar and albite, main components of alkaline feldspar, are dissolved, while ankerite and siderite are precipitated. Quartz, calcite and dawsonite are dissolved first and then precipitated, whose reaction mechanisms are associated with environment pH value, temperature and electrolyte existing. These results are consistent with observations in laboratory experiments. For $CO_2$ squestration, whether minerals are dissolved and precipitated, amount of $CO_2$ will be consumed, which will promote $CO_2$ dissolution in formation resulting in $CO_2$ sequestrated underground. These processes may be very slow, but dissolved and mineralized deposits are ideal $CO_2$ storage.

**KEYWORDS:** $CO_2$ geological storage; $CO_2$-brine-rock interaction; reactive transport model

**PAPER ID:** CEST2019_00721

# Session 30 – Environmental data analysis and modelling (1)

## *Friday 6 September 2019 - morning*

# Employing data-driven models in the optimization of chemical usage in water treatment plants

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## ABSTRACT

One of the most challenging tasks in potable water production is the cost-efficient and consistent operation of water treatment plants (WTPs) that treat raw water of variable quality and quantity. To increase process stability and optimize the usage of resources, two data-driven models simulated coagulation in two WTPs. The data driven models were successfully trained on monitoring data collected from the two WTPs (mean errors of effluent turbidity were below 0.5 NTU in both case studies) and were subsequently employed in the optimization of two historical periods of the WTPs. During this model-based backtesting of the WTPs, multiple operating scenarios were investigated on a daily time step in search of chemical doses that deliver a quality threshold for treated water at the minimum usage of chemicals. Results from the application of this model-based approach for WTP optimization indicated that a reduction of chemical costs equal to 6 % and 8 % would be probable for the two case studies respectively, without hampering the efficiency of raw water treatment. This work underscores that the large quantity of passive data that are amassed daily during the operation of WTPs can be turned into actionable intelligence that supports decision-making and enhances adaptive planning for water utility operators.

**KEYWORDS:** Water treatment optimization, Data-driven modelling, Water treatment plant

**PAPER ID:** CEST2019_00238

# A Computationally Efficient Metamodeling-Based Approach for the Automatic Calibration of Coupled Hydrodynamic and Water Quality Models

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## ABSTRACT

Computational budget is a severe limitation on the automatic calibration of expensive hydrodynamic and water quality models. To tackle this limitation, the present work formulated a metamodeling-based approach for parameter estimation of such models and assessed the computational gains of this approach compared to a benchmark alternative (a derivative-free optimization method). A response surface proxy of the original model was designed to emulate the behavior of the underlying system, employing Latin hypercube sampling as a strategy for the design of computer experiments and kriging as the technique for the analysis of computer experiments. The response surface proxy of the original model was employed in the automatic fine-tuning of model parameters and, finally, the computational gain over the benchmark alternative was estimated. The metamodeling-based approach was tested in the calibration of the hydrodynamic and water quality models of two water reservoirs. The benchmark alternative analysis indicated that the metamodeling-based approach required 20% to 38% less function evaluations to reach a solution with the same quality compared to the benchmark alternative.

**KEYWORDS:** Metamodeling; calibration; hydrodynamics; water quality modeling

**PAPER ID:** CEST2019_00239

# Indoor and outdoor environment impact over the generic conditions for thermal bridge appearance

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## ABSTRACT

The presented study considers the numerical modelling of a thermal bridge distribution, based on conjugated heat transfer and Computational Fluid Dynamics (CFD) model of approximated external concrete wall. The thermal bridge distribution is cross-analyzed relative to the indoor and outdoor air parameters, under the corresponding structure's thermal properties. The main analyzed parameters in the study are the surface temperature on the exterior wall, outdoor air temperature and wall thermal conductivity. The integrated modeling results show the complex environmental impact over the generic conditions for the thermal bridge existence. The further analyses will include the relative humidity and dew point temperature impact over the thermal bridge distribution. These additional parameters may be used for moisture accumulation indicator, in the developed numerical model.

**KEYWORDS:** Thermal bridge, conjugated heat transfer, CFD, indoor and outdoor environment

**PAPER ID:** CEST2019_00485

# Design-Based and Model-Based Estimations of Distribution and Abundance of Dolphin Populations in Gulf of Corinth, Hellas

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## ABSTRACT

In recent years a major scientific effort has been focused on the protection of marine mammals. Gulf of Corinth is part of the Natura 2000 network (GR2530007) since 2016, with Special Areas of Conservation and constitutes an important habitat for striped dolphin (Stenella coeruleoalba), bottlenose dolphin (Tursiops truncatus) and short-beaked common dolphin (Delphinus delphis). Dedicated shipboard transect line surveys were designed and based in Conventional Distance Sampling and were implemented seasonally during 2018-2019, using passive acoustic and visual techniques, combined with related data derived from 2005-2006 field surveys. Estimation of distribution and abundance of dolphins' population with a design-based approach using factors such as weather conditions and cluster sizes surprisingly revealed the total absence of Delphinus delphis from the studied area. Density Surface Models (DSM) were used to model these adjusted counts based on a formula involving environmental covariates (depth, surface temperature), in order to investigate the response of populations to biotic and abiotic covariates. Model based approach for mapping the spatial distribution of animal species clusters can be a useful management tool in establishing protected areas, as well as in communicating monitoring data with non-experts.

**KEYWORDS:** Delphinids, Gulf of Corinth, Distance Sampling, Density Surface Models

**PAPER ID:** CEST2019_00604

# A Comparison between the Past and Future Expected Wind Conditions in the European Coastal Environment of the Mediterranean Sea

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## ABSTRACT

In the last years, exploitation of the wind power has been constantly increasing together with the size of the turbines. Furthermore, by 2030 wind energy is expected to supply around 30% of EU's power demand. Offshore wind represents a significant future opportunity, since resources are abundant and more stable. In the North and Baltic seas more experience is gained on bottom fixed turbines, but also many initiatives emerge to accelerate the development of floating devices, such as the projects in the Mediterranean and Atlantic. From this perspective, the objective of this work is to analyze the expected dynamics of the of the wind conditions in the European coastal environment of the Mediterranean Sea. The study is focused on estimating the average and extreme wind speeds for the 30-year time interval 2021-2050. In parallel, an analysis of the historical wind data for the 30- year period 1976-2005 is also performed. The climatic wind fields provided by the Global Change Assessment Model are considered in the analysis under the Representative Concentration Pathway scenario 4.5. This is the most probable scenario and assumes that the $CO_2$ emissions will increase until 2040 and then decline.

**KEYWORDS:** Mediterranean Sea, wind power, 2050, RCP4.5, historical data

**PAPER ID:** CEST2019_00092

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# Green jobs as an unemployment solution

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## ABSTRACT

Currently, the priority in the EU countries is the subject of unemployment, due to the economic and social situation in many countries and young people unemployment. Although unemployment in some other counties has dropped, it is still quite high. The new economic models based on heterodox economics point to some new and innovative solutions in this area, among others - creating new green jobs. Green employment is the beginning of new solutions that accept the principles of sustainable development, and the green economy, which creates new companies. New professions, as well as new jobs, are created by green organizations which, after brown organizations, are the next stage in the development of human consciousness in the context of sustainable development. The article presents the idea of green jobs as solution of unemployment problem and development of an economic sector that is vital for Europe's transition towards a circular and efficient low carbon economy.

**KEYWORDS:** green jobs, green economy

**PAPER ID:** CEST2019_00104

# Testing and validation of ENVI-met simulation based on in-situ micrometeorological measurements: the case of Syntagma Square, Athens, Greece

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## ABSTRACT

The present paper focuses on the development of a methodology that simulates micrometeorological thermal conditions in an urban context based on weather station data. The micrometeorological conditions at Syntagma square, the central square of Athens, Greece were simulated by ENVI-met software in order to evaluate the thermal conditions experienced by its users. Located in the heart of city's commercial activity, the square attracts many visitors, especially during summer months, when extreme thermal conditions could be encountered. ENVImet can simulate the necessary factors for the estimation of thermal sensation through thermal indices, i.e. air temperature, mean radiant temperature, relative humidity, and wind speed. The meteorological data needed as input were obtained from the nearest weather station. In-situ micrometeorological measurements recorded at the height of 1.1m, were used to validate the simulated results. ENVI-met simulations were performed at a high spatial and temporal resolution. The appropriate adjustments were made to the modeling procedure to achieve a successful and resource-effective simulation.

**KEYWORDS:** micrometeorological measurements; thermal sensation; field surveys; ENVI-met

**PAPER ID:** CEST2019_00213

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# Do Environment-related technologies strengthen the competitiveness of local systems?

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## ABSTRACT

Environmental innovation is considered one of the key drivers of sustainable development and economic growth. However, we still know very little about the organizational factors underling the development of this category of innovations and their relative competitive effect. In this paper, we focus on regions and we look at the specific effect of environment-related technologies and collaborative environmental inventions on the competitiveness of European regions. In fact, the complex and multidisciplinary nature of environmental innovation is expected to further strengthen the competitive advantage of regions and the strategic significance of geographical proximity. A longitudinal study of 232 European regions over the period 2000- 2013 was organized using data from the RegPat, Cambridge Econometrics and Eurostat databases. Our main results confirm the positive effect of environmentrelated technologies and local collaborative networks on regional competitiveness with significant implications in terms of policy making.

**KEYWORDS:** Environment-related technologies; Environmental innovation; Green innovation; Clean technologies; Competitiveness.

**PAPER ID:** CEST2019_00091

# Session 31 – Water treatment

## *Friday 6 September 2019 - afternoon*

# Application of TPMS architectures in water technology: Amazing potential for cost and energy savings and reduced environmental impacts

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## ABSTRACT

Additive manufacturing, also known as three-dimensional (3D) printing, is a state of the art technology that has been gaining momentum in several applications including aerospace, automotive industry and the medical field. Recently, 3D printing has also gained attention as a promising fabrication pathway for key components of membrane-based systems for desalination and water treatment as well. The unique benefit of 3D printing over conventional manufacturing processes lies in its ability to fabricate structures with complex morphologies that can be optimized for fluid flow, heat transfer, etc., based on the targeted application. One such class of complex geometries are triply periodic minimal surfaces (TPMS), which can be described mathematically such that they have no self-intersecting or enfolded surfaces. "Triply periodic" means that the structure can be patterned in the 3D space and "minimal surface" means that it locally minimizes surface area for a given boundary such that the mean curvature at each point on the surface is zero. These shapes have been shown to have been investigated for applications ranging from aerospace to biomedical tissue engineering. They have various properties with regards to enhanced, smooth fluid flow that make them ideal candidates for a number of applications in water research.

**KEYWORDS:** Additive manufacturing; membranes, water treatment

**PAPER ID:** CEST2019_00897

# Water Quality Control of Aposelemis Dam Reservoir

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## ABSTRACT

The aim of this study is to check the vertical water quality profile of Aposelemis Reservoir. The water quality was studied in nine (9) different water reservoir depth points: S9: 0 m, S8: 02 m, S7: 03 m, S6: 05 m, S5: 07 m, S4: 09 m, S3: 10 m, S2: 13 m and S1: 15 m. A sudden change in the temperature of the water was observed at the water depth of 7 m (thermocline phenomenon) and a change in pH (from pH> 8 to pH 2m, compared to 0-2 m. As the water sampling depth was increasing, the Total Organic Carbon (TOC) was decreasing, in contrary with the nutrient concentration (N, P) which was increasing. Color and odor values appear elevated in water depth greater than 5 m.

**KEYWORDS:** water, quality, thermocline, reservoir stratification

**PAPER ID:** CEST2019_00171

# Potential of using Real-time OIW Monitoring for Control of Produced Water Treatment in Offshore Oil & Gas Production

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## ABSTRACT

From the process control point of view, any reliable and online Oil-in-Water (OiW) measurement could provoke a brand new control paradigm for produced water treatment. However, the real-time OiW monitoring is still an open and ad-hoc situation in recent decades. The fundamental issue, i.e., the OiW measurement is methodology dependent, leads to numerous challenges, such as (i) how to verify the reliability and accuracy of a specific methodology/instrument; (ii) how to handle and interpret the measured data in a most objective manner; and (iii) how to keep a cost-effective on-site calibration and maintenance under the harsh offshore conditions etc. The paper reports our latest achievements and observations in usage of fluorescence- and microscopybased OiW monitoring technologies for advanced Produced Water Treatment (PWT) control and evaluation, particularly by focusing on the de-oiling hydrocyclone installations.

**KEYWORDS:** Oil-in-Water, produced water, real-time, monitoring, control

**PAPER ID:** CEST2019_00062

# Polyethersulfone/Polyamide11Cost Effective, Antifouling Nanofiltration Blend Membrane

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## ABSTRACT

Nanofiltration membranes (NF) are considered and used extensively in seawater softening, food, textile, and mining industries for the removal of di-and multivalents to increase RO lifetime by decreasing fouling rates, and chemical cleaning intervals. In this work, blend membranes of polyethersulfone and polyamide11 were prepared by phase inversion process. The membranes were characterized by scanning electron microscopy (SEM), pore size distribution, mechanical properties and membranes performance. The results indicated that, the membrane ($N^2$), which was prepared using PA11 (1 wt%) with a solution of sodium dodecyl sulphate (0.5wt%) and TiO2 (1 wt%) provides the best performance according to rejection percentage. Where, the rejection percentage of magnesium sulfate reached 99 %, 97% and 91% as a function of feed synthetic salt solution of concentration 1g/l, 2 g/l, and 5 g/l respectively. Permeate flux of ($N^2$) was the lowest one due to having a dense top layer of this membrane and low mean pore size (7.7 nm) which was 66.7 L/m2.h, 64.2 L/m2.h and 53.5 L/m2.h as a function of feed synthetic salt solution of concentration 1g/l, 2 g/l and 5 g/l respectively. The fouling test was carried out using methylene blue dye, where the membrane ($N^2$) exhibits good antifouling properties.

**KEYWORDS:** Nanofiltration; Polyethersulfone; Polyamide11; Blend membrane; Membrane performance

**PAPER ID:** CEST2019_00162

# New generation of patterned membranes for water treatment


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## ABSTRACT

Membrane technology is an energy-efficient separation process that is expected to dominate the water treatment industry. However, the high vulnerability of membranes to fouling has limited the expansion of sustainable and energy-efficient membrane processes. Surface patterning has been proven to be an effective method to improve the performance of membranes by increasing the permeate flux and lowering the attachment of fouling materials on membrane surfaces. In this study, a new generation of patterned membranes was prepared using a novel hydrogel facilitated phase separation (HFPS) method. Hydrogel contains a high water content which initiates phase separation as a nonsolvent upon contact with the polymer solution. Structuring a hydrogel mold provides the ability to control the location of the skin layer on the patterned side of the membrane. The performance of the patterned and the unpatterned membranes made with HFPS was examined in a crossflow filtration system; a significant increase in the pure water flux (~100%) was observed for the patterned membrane. Moreover, a fouling experiment with bovine serum albumin (BSA) solution showed that the patterned membranes maintained 76% higher flux after 90 minutes of operation.



**KEYWORDS:** patterned membranes, phase separation, hydrogel, antifouling, micro-molding.

**PAPER ID:** CEST2019_00504

# Application of dissolved air flotation (DAF) and liquid ferrate on mitigation of algal organic matter (AOM) during algal blooms

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## ABSTRACT

In the Middle East, Harmful algal blooms (HABs) are considered a major contributor to membrane biofouling in Seawater Reverse Osmosis desalination plants. The presence of HABs in the raw feed water leads to the increase of membrane fouling rate, the increase of chemical consumption, leading to a temporary plant shutdown. Effective pretreatment can reduce the amount of organic foulants reaching the RO membrane and alleviate the problem of flux decline during RO operation and increasing the membrane lifetime. This research compared the effect of Liquid Ferrate and Ferric Chloride in combination with dissolved air flotation (DAF) for the treatment of the algal cells and algal organic matter (AOM) during algal blooms events. The experiments were performed using a bench-scale DAF unit; HABs conditions were simulated by harvesting AOM from cultivating Chaetoceros Affinis (CA) in raw seawater to a concentration of around 10 mg C/L of total organic carbon (TOC). The liquid ferrate was generated in-situ by wet oxidation of ferric chloride in an alkaline media. The best performances were registered with the combined use of liquid ferrate and DAF with removal of algal cells up to 100%, with ATP removal up to 99.99%, and AOM removal up to 70%.

**KEYWORDS:** Advanced Oxidation, Fouling, Desalination, Algal Bloom, Pretreatment

**PAPER ID:** CEST2019_00936

# Monitoring of the Main Operational Parameters of Aposelemis Water Treatment Plant (WTP)

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## ABSTRACT

The purpose of this study is to present the annual monitoring data of the main water quality operational parameters of Aposelemis Water Treatment Plant (WTP). The main quality parameters studied are: turbidity, pH, suspended solids, conductivity, manganese (Mn), coliform bacteria, Escherichia Coli and Clostridium Perfringens of the untreated and treated surface water of the Aposelemis reservoir. There is a seasonal variation in the turbidity and in the microbiological parameters of WTP incoming water. The Suspended Solids fluctuation follows the entry water turbidity fluctuation. There is no significant difference between the water entry and exit conductivity. The produced water by Aposelemis WTP is of high quality and fulfills all the legislation requirements for water intended for human consumption.
**KEYWORDS:** turbidity, pH, suspended solids, conductivity, manganese, coliforms

**PAPER ID:** CEST2019_00175

# Session 32 – Environmental biotechnology and bioenergy

## *Friday 6 September 2019 - afternoon*

# An innovative green iron-fertilizer, produced biotechnologically, for correcting iron chlorosis of soybean plants grown in calcareous soils

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## ABSTRACT

Iron deficiency is one of the main causes of chlorosis in plants, which leads to the loss in the field crops quality and yield. Iron-deficiency is a worldwide problem, particularly sever in calcareous soils (about 30% of world´s land surface). The current use of synthetic iron chelates to prevent or correct iron-deficiency in plants raises environmental concerns due to their poor biodegradability. Thus, new, more environmentally friendly efficient solutions are needed to solve iron deficiency-induced chlorosis (IDIC) in crops grown in calcareous soils. In this work, a new green freeze-dried iron fertilizer was produced (patent submitted) from a culture of A. vinelandii containing siderophores of a natural source able to bind iron at pH 9. Soybean plants cultivated under calcareous soils and treated with the green iron-fertilizer responded more significantly and comparable to the positive control, ethylenediaminedi (ohydroxyphenylacetic) acid, than those treated with the negative control, when evaluated by their growth (dry mass) and chlorophyll concentration (SPAD index). On average, iron content was also greater on green iron fertilizer treated plants than on negative control treated ones. Results suggest that the freeze-dried product, prepared from A. vinelandii culture, can be a viable alternative for mending IDIC of soybean plants grown in calcareous soils.

**KEYWORDS:** Freeze-dried iron-bacterial siderophores products; Environmental-friendly iron-chelates; Iron chlorosis correction of soybean plants; Calcareous soils

**PAPER ID:** CEST2019_00634

# Anaerobic digestion of long-chain fatty acids (oleic, palmitic, stearic) with whey protein as the emulsifier

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## ABSTRACT

Long chain fatty acids are major lipid constituents. In this study, anaerobic digestion of oleic, palmitic or stearic acid (5 g/L each) emulsified with whey protein (20 g/L) was examined in continuous (batch-fed) stirred tank digesters with 2 L working volume. Anaerobic codigestion of oleic acid displayed high biogas yield (0.47 L/gCOD), compared to palmitic (0.42 L/gCOD) and stearic acid (0.30 L/gCOD). Oleic acid, despite its high biodegradability resulted in major inhibition of the acetoclastic methanogens, as demonstrated by VFA accumulation and by the methanogenic activity assay. Biogas production from palmitic acid was stable, with a biogas yield close (90%) to the theoretically expected values. This was not the case however for stearic which displayed negligible biodegradability. Application of the ADM1 revealed the maximum degradation rate constant of each LCFA. Based on the results of this study it can be concluded that stearic acid degradation is the rate limiting step of the anaerobic digestion process, and this attributed to its low solubility and thus bioavailability.

**KEYWORDS:** anaerobic digestion; biogas; LCFA; fat oil and grease; ADM1.

**PAPER ID:** CEST2019_00709

# High-rate anaerobic co-digestion of agro-industrial wastes combined with ammonia recovery and biogas purification

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## ABSTRACT

Screened dairy manure, pressure-sterilized animal byproducts, and cheese whey were co-digested in a Plug Flow Reactor (PFR) over a period of 150 days. The PFR process was stable even under a hydraulic retention time of 3 days, corresponding to an organic loading rate (OLR) of 22 g/Ld. Effluent COD remained low (5.6±1.4 g/L) while VFA concentrations were negligible (< 0.5 g/L as COD). The biogas production rate from the PFR ranged from 2.6 up to 7.3 L/Ld. The anaerobic digestate was characterized by high ammonia content (1.7±0.5 g/L); therefore air-stripping was chosen for the effective removal of ammonia. Hydrated lime as a slurry was utilized for the necessary pre-treatment step (pH-raising), due to its fast reaction and low cost. A temperature of ≥ 45 °C was also needed for efficient ammonia removal. The final effluent was neutralized by $CO_2$ absorption through biogas injection in a scrubber. Concurrently, the biogas was upgraded since its methane content increased substantially, while $H_2S$ was completely removed.

**KEYWORDS:** anaerobic digestion; biogas; biomethane; dairy manure; ammonia stripping

**PAPER ID:** CEST2019_00715

# Bio-scrubber coupled with ozonation for enhanced VOCs abatement


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## ABSTRACT

Volatile Organic Compounds (VOCs) are toxic for the environment and human health and their tendency to readily volatilize in the atmosphere leads to problems connected to odours annoyance. The conventional treatments for VOCs gaseous emissions conventionally entail the application of chemical-physical processes, only promoting the transfer of the contaminants from gas to liquid and/or solid phases. Advanced Oxidation Process (AOPs) and biological processes, conversely, support the oxidation of the organic pollutants, promoting their conversion into harmless and odourless compounds. This study aims at evaluating the performance of an innovative treatment solution, at pilot scale, of AOPs pretreatment coupled with a bio-scrubbing unit for the abatement of toluene, selected as model VOCs. Different operating conditions have been evaluated to understand the behavior towards inlet load fluctuations. The results exhibited that the ozonation applied as pretreatment to the biological process may promote an increase of the pollutant biodegradability along with synergic effects due to the absorption of the ozone derived compounds into the culture growth, resulting in a significant enhancement of removal performances respect to the conventional biotechnologies.



**KEYWORDS:** Biomass; Bio-Scrubbing; Ozonation; Toluene.

**PAPER ID:** CEST2019_00935

# Pyrolysis of Spirulina sp. Microalgae: Effect of Temperature on Chemical Compositions of Bio-Oil and Aqueous Phase

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## ABSTRACT

Pyrolysis of Spirulina sp. Microalgae was carried out in a semi-batch glass reactor system. Effect of temperature on the yields of pyrolytic products (gaseous, liquid and solid residue) and chemical composition of the liquid products were investigated. All experiments were performed in 25 mL/min nitrogen atmosphere with 15 g feedstock which was dry and powder form of Spirulina. Temperature was varied from 470 to 620 °C with 50 °C break by utilizing PID controller which was setted 10 °C/min heating rate. The aqueous phase and bio-oil (organic phase) of the liquid products were characterized by GC-MS. Maximum yields of bio-oil and aqueous phase were obtained approximately as 30 wt. % at 520 °C and as 20 wt. % at 470 °C. When temperature was increased, oxygenated compounds and aromatic hydrocarbons decreased. However, nitrogenous compounds and alkanes increased in the microalgal pyrolytic bio-oil.

**KEYWORDS:** Microalgae, pyrolysis, biomass, bio-oil

**PAPER ID:** CEST2019_00774

# Heterotrophic growth of Chlorella vulgaris on crude glycerol

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## ABSTRACT

The heterotrophic growth of C. vulgaris using crude glycerol as the sole carbon source was studied in five 5L flasks. Air in each flask was provided at a rate of 300 L/hr and the contents were continuously stirred with a magnetic bar. Temperature, pH and initial inorganic nutrients (nitrogen, phosphorus, potassium and micronutrients) were kept the same in all flasks. The C/N ratio varied in each of the five flasks was set at 6, 13, 25.4, 61.5 and 118 respectively while the nitrogen initial concentration was equal to 45.4 mg/L in all flasks. The residual organic carbon was measured as a function of cultivation time. It was found that biomass growth rates as well the lipid and protein content were dependent on the C/N ratio. Lipid content was proportional to the C/N ratio while the protein content was inversely proportional to the C/N ratio. Carbon concentrations above 2500 mg/L inhibited the growth rate.

**KEYWORDS:** microalgae, heterotrophic growth, glycerol, carbon

**PAPER ID:** CEST2019_00843

# Characterization of Xylanase-Treated Karagumoy Fiber Reinforced Composite (KFRC)

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## ABSTRACT

This work determined the effects of enzyme treatment on the mechanical properties of natural fiber-reinforced composite using Pandanus simplex (karagumoy) fibers. Physical modification using enzyme improved chemical and mechanical properties of fibers and the karagumoy fiber-reinforced composites (KFRCs) produced. Enzyme concentration and soaking time were used as treatment parameters. The treatment scheme improved the mechanical properties of fibers and composites, as well as the composites' water absorption property. The composites' mechanical properties- tensile and flexural strength- were measured using universal testing machine (UTM). The morphology of fibers and composites was determined through a scanning electron microscope (SEM) and results indicated a reduced fiber diameter for the treated fibers and an increase in fiber surface roughness, thereby resulting to improved adhesion or compatibility between the hydrophilic fiber and the hydrophobic matrix. FTIR analysis results of the fibers further supported this finding as evidenced by the reduction in OH groups of the enzyme-treated karagumoy fibers.

**KEYWORDS:** natural fiber, enzymatic treatment, mechanical properties, water absorption

**PAPER ID:** CEST2019_00346

# Hierarchization of pure silica LTA zeolite

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## ABSTRACT

The effect of base leaching on pure silica ITQ-29 zeolite being the counterpart of LTA zeolite, was investigated. The extent of the desilication process over pure silica zeolite was controlled by partial detemplation followed by silicon extraction. The potential of hierarchically porous ITQ-29 zeolite in environmentally friendly applications concern selective adsorption of organic molecules in aqueous environments. The introduction of additional porosity by desilication process offers full usage of zeolite grains volume without diffusional limitations during the adsorption process.

**KEYWORDS:** zeolites, hierarchical, desilication.

**PAPER ID:** CEST2019_00920

# Screening strains of genus Pleurotus for biomass production in solid state fermentation of agricultural residues

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## ABSTRACT

The ability of several strains belonging to Pleurotus ostreatus and P. eryngii mushroom genera to grow on various agricultural residues was examined and their mycelium growth rates and biomass production (estimated as glucosamine content) were compared. Four P. ostreatus (AMRL 137, 144, 147, 150) and four P. eryngii (AMRL 160, 163, 166, 173-6) strains were cultivated on wheat, barley and oat straw, poplar and beech-wood sawdust, cotton and coffee residues, corncobs, rice bark, olive cake supplemented with wheat bran on a final C/N 20-30. Colonization rate measurements of mycelium demonstrated faster colonization on wheat, beech, barley and oat, corn-cobs and rice with values of ~1.5 mm/day, yet the faster colonizers were P. ostreatus 144, 150 and P. eryngii 166, 173-6. Glucosamine content was similar for P. ostreatus and P. eryngii strains and the most pronouncing substrates for more biomass production were barley and oat straw, beech-wood sawdust, cotton and coffee residues, corn-cobs (max 450 mg/g d.w.). However, in most of the cases, glucosamine content was opposite to mycelial growth rate, as strains with high colonization rates produced the least biomass. These results are evaluated in the view of bio-converting agricultural wastes into mushrooms, an added value food with medicinal properties.

**KEYWORDS:** mushroom cultivation, agro-residues fermentation, Pleurotus, biomass

**PAPER ID:** CEST2019_00541

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# Co-Pyrolysis of Corn Stover with Plastic: Optimization Based on Synergy

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## ABSTRACT

The co-pyrolysis of lignocellulosic wastes such as Corn stover with plastic has been found to improve the both the yield and quality of pyrolysis oil and gas products. In this study, the co-pyrolysis of Corn stover (CS) with plastic (LDPE, and PP) were studied through thermogravimetric analysis. The parameter "change in weight loss rate" denoted by ΔW was used to quantify the synergistic effects on the yield during co-pyrolysis. The ΔW values were fitted using a combined mixture design to generate an RSM model relating the factors mixture component proportions, plastic type, and temperature to the response ΔW. From numerical optimization, the obtained optimum co-pyrolysis conditions are: (a) 0.60 CS proportion, 0.40 LDPE proportion, and 481.73 °C temperature for CSLDPE, (b) 0.68 CS proportion, 0.32 PP proportion, and 492.15 °C temperature for CS-PP. The activation energy, and pre-exponential factor of the reactions in the copyrolysis process were also obtained using direct solution method. The activation energy of the reaction that took place from 420 to 510 °C was found to be lower in the copyrolysis of Corn stover and plastic than in the pyrolysis of pure plastic.

**KEYWORDS:** co-pyrolysis, corn stover, plastic, optimization, combined mixture design, synergistic effect

**PAPER ID:** CEST2019_00916

# Session 33 – Hydrology and water resources

## *Friday 6 September 2019 - afternoon*

# Reliable in-Situ Sensing of Water Quality Parameters using Low-Cost Autonomous Analysers

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## ABSTRACT

A sensing platform for the in situ, real-time analysis of phosphate in natural waters has been realised using a combination of microfluidics, colorimetric reagent chemistries, low-cost LED-based optical detection and wireless communications. Prior to field deployment, the platform was tested in the laboratory where a total of 459 autonomous measurements were performed (153 each of low calibration standard, high calibration standard and sample). The platform was subsequently field-deployed in Dublin Bay at the mouth of the Tolka Estuary, County Dublin, Ireland, to track changes in phosphate continuously at a transitional water body site previously identified as at risk. Initial data from 10/04/19 to 17/04/19 is presented, comprising 168 autonomous measurements (56 each of low calibration standards, high calibration standards and sample).

**KEYWORDS:** water quality; phosphate; eutrophication; colorimetric chemistries; autonomous analysers

**PAPER ID:** CEST2019_00380

# Investigation of Shoreline Morphometry of Kizilirmak Delta's Lagoons Using Fractal Dimension and Shoreline Development Index

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## ABSTRACT

In this study, shoreline morphometry of the Karaboğaz, Balık, Uzun, Cernek, Liman, Gıcı and Tatlı lagoons which are located in the Kızılırmak Delta, was investigated by using fractal dimension and shoreline development index. The shorelines of the lagoons were obtained from Landsat 8 OLI satellite images of June 4, 2017, using remote sensing-image processing techniques including Normalized Difference Water Index (NDWI), Modified Normalized Difference Water Index (MNDWI), Gram-Schmidt pan-sharpening method and Iterative Self Organizing Data Analysis Technique (ISODATA) unsupervised classification method. In order to investigate the relationship between fractal dimension and the environmental conditions, also shoreline development index and the environmental conditions, the vegetation conditions in the surrounding of the lagoons were determined using Normalized Difference Vegetation Index (NDVI) algorithm. The result of the study reveals that the relationship between fractal dimension and NDVI is much stronger than the relationship between shoreline development index and NDVI.

**KEYWORDS:** Landsat 8 OLI, shoreline morphometry, lagoon, fractal dimension, shoreline development index, NDVI

**PAPER ID:** CEST2019_00707

# How to identify a representative subset of hydro-climatic simulations for impact modelling studies?

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## ABSTRACT

Uncertainties in hydro-climatic projections are (in part) related to different components of the modeling chain. Although a combination of numerous projections (ensemble) would be needed to characterize the overall uncertainty, in practice a small set of scenario combinations are constructed to provide users with a subset that is manageable for decision-making. The approach is based on a framework, rooted in the information theoretic Maximum Information Minimum Redundancy (MIMR) concept, for identifying a representative subset from an available large ensemble of hydro-climatic projections. We analyze an ensemble of 16 precipitation and temperature projections for Sweden and use these as inputs to the HBV hydrological model to simulate river discharge until the mid of the 21st century. Representative subsets are judged in terms of different statistical characteristics for precipitation, temperature and discharge and the sensitivity of the identified subset is assessed for different seasons and future periods. Results indicate that a 20-35% subset of the available set of projections can represent a large fraction (more than 80%) of the ensemble range of hydro-climatic changes. We find that the identified representative subsets are sensitive to the regional hydro-climatic characteristics and the choice of variables, seasons and future periods.

**KEYWORDS:** Representative projections, information theory, climate change impacts,

**PAPER ID:** CEST2019_00453

# Fuzzy Relation between the RDIst Index and the Water Table of a Coastal Aquifer of Nestos Delta, Greece

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## ABSTRACT

Drought is a complicated natural extreme event associated with the decline of water availability below the normal conditions of a hydrological system, both from a temporal and from a spatial point of view. This work aims to assess the drought impacts on groundwater fluctuation in a shallow coastal unconfined aquifer via fuzzy approach. Meteorological drought intensity is estimated by the Standardized Reconnaissance Drought Index (RDIst) based on precipitation (P) and potential evapotranspiration (PET). In addition, groundwater modeling is carried out using MODFLOW and then, the simulated values of water table (WT) of a coastal unconfined aquifer are utilized. In order to relate the RDIst with WT, a fuzzy linear regression (FLR) is applied. FLR based on Tanaka model produces a fuzzy band, where all the data must be included within, incorporating the system uncertainty. The suitability of the achieved fuzzy regression model is tested by using appropriate measures. The propounded methodology is applied in the eastern area of Nestos River Delta, Prefecture of Xanthi, Greece.

**KEYWORDS:** Reconnaissance Drought Index, coastal aquifers, groundwater modeling, fuzzy linear regression, Nestos River Delta

**PAPER ID:** CEST2019_00846

# An Assessment of Soil Erosion using Rusle Model: A Case Study from the Marmara Region

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## ABSTRACT

The aim of the study is applying the Revised Universal Soil Loss Equation (RUSLE) with the help of remote sensing and geographic information system techniques to calculate soil loss and to map soil erosion of the Marmara Region of Turkey in the changing climate conditions between 1989 and 2017, and also to make future projection of soil erosion for the years between 2020 and 2049. This model is composed of variety of factors associated with climate, vegetation, soil and topography. The results of the study showed that according to the two scenarios of the Regional Climate Model RCP 4.5 (optimistic), and RCP 8.5 (pessimistic), the future soil loss of the Marmara Region in the changing rainfall events is higher than the results of the historical data. The soil loss results for the time interval 2020-2049 of the scenario RCP8.5 is 61% higher than the results of the scenario RCP4.5. Also, the soil loss results of the historical data of the Regional Climate Model showed that the soil loss range from 0 to 24,298 Mg. $ha^{-1}$ . $year^{-1}$ during the time interval 1989 – 2017 in the Marmara Region, and also the average soil loss is 12,2 Mg. $ha^{-1}$ . $year^{-1}$ .

**KEYWORDS:** soil erosion, RUSLE Model, Regional Climate Model, Marmara region, Turkey

**PAPER ID:** CEST2019_00884

# From System Concept to serious game: The SIM4NEXUS Approach to Policy-Relevant Nexus Research

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## ABSTRACT

There is growing interest in using serious games for a wide range of applications and in the water-energyfood/land-climate nexus, where interactions in one sector lead to impacts in other sectors. Much practice revolves around sectoral silos, with little consideration of wider impacts. Serious games could help erode these silos, fostering efforts towards holistic policy making, where impacts can be explored and assessed without real consequences. SIM4NEXUS (www.sim4nexus.eu) develops policy-relevant serious games for 12 case studies, and is achieved by close case study stakeholder involvement, from qualitative system design, policy analysis, quantitative model development and serious game testing and playing. SIM4NEXUS covers five nexus sectors and develops scientifically-robust system dynamics models assessing nexus relationships. Models explore the impacts of changes in one sector on all other sectors. The SIM4NEXUS serious games 'play' the underlying models in a way accessible to those not familiar with modeling. Through intelligent game design, nexus-wide policy and climate impacts can be effectively communicated to stakeholders and policy makers while being fun to play, offering opportunity for nexus exploration in an educational setting. This work details the process in SIM4NEXUS, emphasising the constant stakeholder collaboration to ensure that the research and outputs remain relevant and accessible.

**KEYWORDS:** policy; nexus; serious game; system dynamics; water-energy-food-land-climate.

**PAPER ID:** CEST2019_00073

# Simulating Nutrient Loads in an Intensively Cultivated Mediterranean Watershed under Current and Projected Climate Conditions

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## ABSTRACT

On the global scale, agriculture constitutes the most significant non-point pollution source for surface water bodies, especially in terms of nitrogen and phosphorus. Located in northeastern Greece, Vistonis basin, in which agricultural activities are widely developed, constitutes the area that discharges into Vistonis estuarine system, which is very significant both from the environmental and economic perspective. SWAT model was used in order to quantify discharge, nitrogen and phosphorus loads for the period 2003-2014, after calibration and validation. Simulation results indicated significant variation in nutrient loads, while their contribution on a massive fish kill event that took place on summer 2014 was found to be potentially significant. Nutrient loads variation were further investigated using projected, bias-corrected climate data from 3 Regional Climate Models (RCMs) for the periods 2021-2040 and 2061-2080. The results demonstrated decreasing trend in nutrient loads due to decrease in river discharge driven by precipitation decrease.

**KEYWORDS:** SWAT model, nutrients, climate change

**PAPER ID:** CEST2019_00729

# Water Salinization in Iran: Spatial Variation of Salinity in Groundwater Resources of North West (Urmia Lake)


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## ABSTRACT

This study presents the quality of drinking water in terms of salinity in the western margin of Urmia Saline Lake (USL), Iran. During the study a total of 121 samples from 116 wells and 5 springs were collected which constitute drinking water resources of 301 villages in the study area. Approximately more than 30% of the water resources were brackish or saline. The maximum EC is recorded at 3060 µs/cm, which is more than 2500 µs/cm recommended by the European Union. The minimum EC is 410 µs/cm with an average of 980± 495µs/cm. The brackish water resources were located in the northern parts, middle parts and also in the southeast. Unfortunately, in water resources of the study area, salinity seems to be high. This issue should be addressed as a serious concern by managers of water sector.


**KEYWORDS:** water quality, groundwater, salinity, Electric Conductivity

**PAPER ID:** CEST2019_00808

# Revision of the Scarcity State Indicator in the Spanish Drought Management Plans

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## ABSTRACT

Droughts are one of the gravest natural threats currently existing in the world and their occurrence and intensity might be exacerbated due to Climate Change. Scarcity is defined as the period when demand does not accomplish the normal reliability levels due to poor water management. Water and drought management plans (DMP) prevent scarcity periods by anticipating to drought and adapting to limited water resources. DMP in Spain were updated in December 2018. Two types of indicators were included: The Prolonged Drought Indicator and the Scarcity State Indicator (SSI). This study presents a comparison of the SSI among seven river basins in Spain, with the aim of making a starting point for its optimization and computation. The scarcity indicator is based on the relationship between the availability of resources and demands, identifying situations of short-term deficit in each of the areas defined. Its computation consists of a seven-step iterative process. Results detect two different approaches when determining the threshold values for the SSI. One method bases the threshold estimation on the risk of supply of the demands while the other obtains the threshold values from direct statistics of historical variables.

**KEYWORDS:** Water scarcity, Scarcity state indicator, Drought management plan, Spanish water policy

**PAPER ID:** CEST2019_00827

# Monitoring and treatment of cyanobacterial contaminated surface waters in France and Cyprus

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## ABSTRACT

Over the past few decades eutrophication of surface water has increased worldwide because of different anthropological activities including land fertilization and sewage run-offs; in combination with climate change. Excessive amount of nutrients (phosphorus and nitrogen), is now detected in freshwater lakes, artificially made reservoirs, and streams. Cyanobacterial nuisance in surface waters is among the most current environmental issues as it causes socio-economical problems. CYANOS is a two-year bilateral project funded from the Research Promotion Foundation of Cyprus and the Campus France of France with interdisciplinary activities that combines surface water monitoring and on-site water treatment for the restoration of eutrophic surface waters. Specifically, CYANOS aims to monitor the seasonal variation of cyanobacterial harmful algal blooms (cyano-HABs) in the surface waters of Cyprus and France and explore emerging on-site treatments to control their formation.

**KEYWORDS:** eutrophication, cyanobacteria, cyanotoxins, in-lake treatment

**PAPER ID:** CEST2019_00923

# Hydrological and hydraulic modelling for a severe flood event in Sperchios River Basin

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**ABSTRACT**

A combined hydrological and hydraulic analysis is presented for an extreme flood event occurred on February 6, 2012 in Sperchios River Basin, located in Central Greece. This event caused the river's overflow and, consequently, several damages to infrastructure and agricultural land. Sperchios River Basin is a case of ungauged basin and only rainfall measurements of fine temporal scale are available. The hydrological analysis was performed with the aid of the Hydrologic Modeling System (HEC-HMS) to incorporate and combine different methods concerning the rainfall-runoff transformation, the hydrological losses, the river routing and the baseflow recession, and finally to generate the flood hydrograph. The hydrological analysis output was then used in the River Analysis System (HEC-RAS), which has the ability to model unsteady flow through a river channel network and produces the water profiles, velocity and inundation maps of the flood plain. The implementation of this integrated model for historic flood events in such ungauged basins is useful for reducing the uncertainty and developing robust flood forecasting and early warning systems in order to reduce life casualties and mitigate losses due to flooding.

**KEYWORDS:** rainfall-runoff, inundation mapping, flood, Sperchios, HEC-HMS, HEC-RAS

**PAPER ID:** CEST2019_00525

# Session 34 – Emerging pollutants

## *Friday 6 September 2019 - afternoon*

# NORMAN Non-target screening (NTS) prioritisation scheme for ranking thousands of contaminants of emerging concern in effluent wastewater collected from Europe.

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## ABSTRACT

Prioritisation of contaminants of emerging concern (CECs) remains a challenging task of primary importance for environmental managers and the scientific community as regards the definition of priority actions for pollution prevention & control and for the allocation of resources to address current knowledge gaps. The NORMAN prioritisation scheme combines the traditional risk-based ranking process with the preliminary application of a decision tree, which allows the allocation of substances into six action categories, based on the knowledge gaps and actions needed to fill them, e.g. development of more powerful analytical methods, launch of monitoring campaigns and performing additional ecotoxicity tests. The ranking within each category is then evaluated by occurrence, hazard and risk criteria. The tremendous improvements in high-resolution mass spectrometry and the development of advanced chemometric tools resulted in the update of the NORMAN prioritisation scheme, so that it incorporates the automatic retrieval of the occurrence of CECs through retrospective suspect screening. The objective of the study was to present a) the updated NORMAN prioritization scheme and the modifications introduced and b) the application of the scheme for the prioritization of more than 40,000 CECs in 46 effluent wastewater samples collected from Europe.

**KEYWORDS:** NORMAN prioritization scheme, retrospective suspect screening, effluent wastewater, Digital Sample Freezing Platform (DSFP)

**PAPER ID:** CEST2019_00683

# Dioxin-Like Polychlorinated Biphenyls at Dilijan Landfills (Republic of Armenia)

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## ABSTRACT

Polychlorinated biphenyls (PCBs) are substances of wide distribution, high toxicity, persistence, and ability to long distance migration. They are characterized by unique properties: temperature stability; high boiling point; noncombustibility; resistance to chemical and physical influences; high dielectric constants. The presence and concentration of dioxin-like and nondioxin-like PCBs in old and new landfills of Dilijan district (Republic of Armenia) were investigated. Municipal waste dumps of Dilijan are active sources of PCBs accumulation and spread. In soil samples from both the old and new landfills excess concentrations of PCBs were found in 100% of cases compared to normative level, and the summary concentrations of the latter multiply exceeded the normative level. PCBs-related environmental pollution is of great concern because the emergence and spread of PCBs in nature is not always subject to control and regulation, as the sources of PCBs formation are diverse.

**KEYWORDS:** PCBs, POPs, environmental pollution, landfills

**PAPER ID:** CEST2019_00803

# Screening of 102 Organic Pollutants in Groundwater along the Beijing-Hangzhou Grand Canal in China By GC×GC-TOFMS

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## ABSTRACT

Screening of 102 organic pollutants in groundwater along the Beijing-Hangzhou Grand Canal in China by GC×GCTOFMS. A total of 45 samples were collected. The targets of the investigation involve multiple types of organic pollutants such as Polycyclic aromatic hydrocarbons (PAHs) and their derivatives, phthalates (PAEs), phenols, anilines, polychlorinated naphthalenes (PCNs), polychlorinated biphenyls (PCBs) et al. The results showed that naphthalene, fluoranthene and phthalates are commonly detected compounds. There are 8 categories of organic pollutants detected. The highest concentration of 4-nitrobiphenyl is as high as 430 μg/L, and other targets were detected at the higher concentration in the sample. It means groundwater in the sites have been polluted by micro-organic pollutant.

**KEYWORDS:** Organic pollutants, Groundwater, GC×GCTOFMS, Screening

**PAPER ID:** CEST2019_00807

# Development of a novel GC-APCI-QTOFMS methodology for the determination of more than 300 organic compounds in Asopos river water samples

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## ABSTRACT

The site of interest of this study is Asopos river which is located in Sterea Ellada, north of Athens, and passes through areas where 20% of total Greece industrial production takes place. The extensive installation of industries in the area near the river, and the uncontrolled disposal of industrial and agricultural wastes into the river, make the water quality of Asopos questionable. The environmental problem of Asopos river basin is known since 1969, due to the detection of high Cr (VI) concentrations in ground and river water samples with potential carcinogenic effects to human health. However, the probable occurrence of industrial and agricultural organic chemicals with unknown toxic effects has not been studied so far. To the best of our knowledge, this is the first environmental monitoring study in Greece including not only the determination of legislated compounds, but also the wide-scope screening of organic chemicals for which no occurrence data exist.

**KEYWORDS:** River water, Priority pollutants, Emerging Contaminants, Gas chromatographic techniques, GCAPCI-QTOF

**PAPER ID:** CEST2019_00971

# Screening thousands of emerging contaminants in Asopos river basin by UPLC-QToF-MS

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## ABSTRACT

Monitoring activities over several decades have revealed the ubiquitous presence of organic contaminants in environmental compartments. Asopos river basin, located in Sterea Ellada, has been the focus of many environmental studies over the last decades, mainly due to its geomorphology and the extensive industrial activities that take place in this territory. The detection of high Cr(VI) concentrations, causing potential carcinogenic effects, have attracted the attention of media and raised the consciousness of the citizens. Although there are many studies in recent literature focusing on the occurrence of heavy metals in Asopos river basin, there is a lack of information concerning the presence of emerging contaminants. The aim of this study is the determination of thousands of emerging contaminants in the environmental samples (river water and sediments) form Asopos river basin, following wide-scope target screening methodologies. Solid-Phase Extraction (SPE) by mixed-mode sorbent was used during the sample preparation of river water samples to ensure the extraction of various classes of compounds with a wide range of physicochemical properties. The extracts were analyzed by complimentary chromatographic techniques, including Reversed Phase (RP) and Hydrophilic Interaction Liquid Chromatography (HILIC) coupled to Quadrupole-Time-of-Flight Mass Spectrometry (QToFMS). Moreover, the application of suspect and nontarget screening, using advanced chemometric techniques, will provide a holistic view of the pollution in the area under investigation.

**KEYWORDS:** Emerging Contaminants, River Water, Sediments, wide-scope Target and Suspect Screening, Non-target Screening, HRMS

**PAPER ID:** CEST2019_00972

# Determination of more than 2,400 emerging contaminants in apex predators and their prey from European Specimen Banks and Natural History Museums by novel and complementary High Resolution Mass Spectrometry Techniques

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## ABSTRACT

Overwhelming evidence over many decades has shown that many organic compounds have been released in the environment due to anthropogenic activities. The term "chemicals of emerging concern (CEC)" has been established for chemicals, which are not subjected to marketing restrictions and regulatory monitoring programmes but are candidates for future regulation, due to their frequent detection in environmental samples and their potential hazardous properties (Thomaidis et al, 2012; Gavrilescu et al, 2015; Dulio et al, 2018). Despite the fact that their chemical and physical properties allow them to enter marine, freshwater and/or terrestrial ecosystems, data for the potential bioaccumulation and biomagnification of CECs though the food are missing, which increases the concern about their effects on the ecosystems, biota and human health. CECs, in many studies, are determined by targeted methods, based on the analysis of reference standards (e.g., plant protection products, OCPs, PAHs, PFAS, pharmaceuticals and veterinary medicines). However, despite the high selectivity and sensitivity of targeted methods, using mainly selected reaction monitoring (SRM) mode of detection, they are limited to the determination of a restricted number of compounds. On the other hand, High Resolution Mass Spectrometry (HRMS) techniques, given the high resolution capability

(R=35,000) and mass accuracy in full scan mode, have enabled the simultaneous determination of hundreds of emerging contaminants and their transformation products, even if reference standards are not commercially available (Picó et al, 2012; Du et al, 2017).

Although thousands of chemicals are marketed in Europe, so far only 600 chemicals have been screened and identified as PBT (persistent, bioaccumulative, toxic), ED (endocrine disrupting) and/or CMR (carcinogenic, mutagenic, toxic for reproduction), because human and environmental hazard assessment is laborious and often obstructed due to the lack of data (ECHA's 2016 General Report, ECHA 2017). The determination of contaminants in apex predators and their prey (AP&P) allows to identify the emergence of chemicals including substitutes of regulated compounds which may present similar levels of hazard. Apex predators play a key role in the monitoring of environmental contaminants and in risk assessment studies for a number of reasons including: their position at the top of food webs, a relatively long lifespan over which to accumulate contaminants, integration of exposure both over time and relatively large spatial areas, relative ease with which samples can be obtained, and relative ease with which populations can be quantified and monitored (Movalli et al, 2017). The EU funded LIFE APEX project (LIFE17 ENV/SK/000355, 2018-2022), demonstrates the use of AP&P in monitoring contaminants in the environment and assessing the effectiveness of chemicals risk management measures under EU regulations. The aim of LIFE APEX (https://www.lifeapex.eu) is to improve systematic use, by regulators, of chemical monitoring data from apex predators (Harbour Seal, Common Buzzard, Eurasian Otter) and their prey (freshwater fish: Bream/Roach, marine fish: Eelpout/Herring) for better chemicals management, thereby reducing exposure to harmful substances and protecting human health and the environment. LIFE APEX links biota samples from different sample collections with novel analytical methods, for a more thorough understanding of chemicals' occurrence and bioaccumulation through the food chain. These data can be used for a better prioritization of hazardous substances, their regulation and the effectiveness evaluation of chemicals management. For revealing the presence of CECs in AP & P samples, during the first year of LIFE APEX implementation, 67 recent samples (2015-2019) of apex predators (livers) & their prey (muscles) from four Northern Europe's countries (United Kingdom, Germany, Netherlands and Sweden), from Environmental Specimen Banks (ESB's), Natural History Museums (NHM's) and other scientific collections, were analyzed following state-ofthe-art wide-scope target screening methodologies.

All samples were lyophilized before analysis, in order to enhance extraction efficiency, improve the precision and achieve lower detection limits. The analytes were extracted from the dry matrices through generic methods of extraction, using Accelerated Solvent Extraction (ASE), followed by a clean-up step using Solid Phase Extraction. The final extracts were analyzed by different chromatographic and ionization techniques (both liquid and gas chromatography) coupled to High Resolution Mass Spectrometry (using electrospray and atmospheric pressure ionization, respectively), in order to broaden the chemical domain accessible to widescope target analysis. The samples were screened for the presence of more than 2,400 organic pollutants, included in the target list of the University of Athens (UoA). UoA database includes compounds of different classes (such as pharmaceuticals, personal care products, biocides, plant protection products, illicit drugs, stimulants, sweeteners, and industrial chemicals, e.g. per- and polyfluorinated compounds (PFASs), flame retardants, corrosion inhibitors, plasticizers, surfactants), as well as their transformation products and metabolites. The target list is being updated on a regular basis, since new compounds of concern are continuously being identified.

Strict criteria of mass accuracy (<2mDa), isotopic fitting (mSigma<50), retention time (<0.40 min) and fragmentation pattern match were applied during the screening process, while the standard addition method was used for quantification purposes. Preliminary results indicate the presence of several plant protection products (including DEET, myclobutanil and terbuthylazine), stimulants (such as nicotine and its metabolites), sweeteners, industrial chemicals (including benzotriazole and tolytriazole), pharmaceuticals and psychoactive drugs (including sertraline and quetiapine) in the tested samples.

Furthermore, numerous transformation products (including propachlor-OXA, Nor-tramadol, 4-acetamido-antipyrine) were detected in livers from apex predators, underlying the power of wide-scope target screening. Moreover, more than 15 PFASs were detected in samples from all tested countries with high detection frequency and at high concentration levels. Based on the results, significantly higher concentrations of chemicals (including perfluorodecanoic acid -PFDA- and propachlor-OXA) were detected in livers from apex predators than in the muscle samples from their prey, implying a potential bioaccumulation through the food chain.

**KEYWORDS:** Apex Predators; Emerging Contaminants; High Resolution Mass Spectrometry; Biomonitoring; Bioaccumulation.

**PAPER ID:** CEST2019_00973

# Wide-scope target analysis of >2,100 emerging contaminants in landfill leachates by LC-QTOFMS and investigation of their potential ecological threat

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## ABSTRACT

Organic micropollutants are compounds which are normally detected at concentrations up to microgram per liter in the aquatic environment and they are considered to be potential threats to the ecosystem. Some of them have been studied in detail since 1980s and are already included in existing national or international legislative documents, while others are characterized as emerging contaminants (ECs) and no regulations currently require their environmental monitoring. During the last decade, several studies have been focused on the investigation of possible sources of emerging contaminants' distribution into the environment. According to the literature, sewage treatment plants are considered as major point sources of these compounds into the environment, as they receive domestic and industrial wastewater, as well as urban and - in some cases- agricultural runoff (Ratola et al., 2012; Luo et al., 2014; Arvaniti and Stasinakis, 2015). On the other side, the contribution of landfills, via the produced leachates, in transferring emerging pollutants to the environment, is not well reported so far (Oturan et al., 2015). Besides European policy for recycling and waste to-energy, landfilling still remains one of the alternative options for municipal solid waste management in EU-28, where 58 × 106 tonnes of municipal solid waste were disposed to landfills in 2017 (Eurostat, 2018). Concerning Greece, more than 80% of the produced municipal solid waste is dumped to central landfills which are located in the mainland and islands. The occurrence of ECs in leachates samples originated from different Greek landfills was investigated in this study and the possible threat for the aquatic environment was evaluated using risk quotient (RQ) methodology. For this reason, raw and treated leachate samples (after biological treatment with activated sludge process or/and advanced treatment with reverse osmosis, RO) were collected from eight (8) landfills around Greece, in June 2018. All studied landfills receive municipal solid waste but present different characteristics regarding their capacity and the technology applied for leachates' treatment. The samples were initially analyzed for conventional pollutants and afterwards for the existence of ECs using LC-ESI(+/-)-QTOFMS. For the determination of emerging contaminants, Solid-Phase Extraction using mixed-mode sorbents was used for the extraction and pre-concentration of compounds with different physicochemical properties. The HRMS chromatograms were screened with an in-house wide scope database of more than 2,100 organic pollutants including compounds of different classes (such as pharmaceuticals, personal care products, drugs of abuse, pesticides, stimulants, sweeteners, perfluorinated compounds, benzotriazoles, benzothiazoles, phthalates and surfactants), as long as their transformation products and metabolites. The concentrations of the contaminants in leachates were calculated based on standard addition method. For estimating the ecological threat for the aquatic environment, toxicity data was collected after literature review or using ECOSAR and RQs were found for the detected ECs according to the Technical Guidance Document on Risk Assessment (EC, 2003; Thomaidi et al., 2015) for raw, biologically treated and RO treated leachates. According to this methodology, in cases that RQ is less than 1, no ecotoxicological risk for the aquatic environment is indicated, while in cases that RQ is greater than 1, ecotoxicological risk is possible for the aquatic environment. According to the results, the pH of the samples was ranged between 5.28 and 8.98 and their conductivity between 0.21 mS/cm (sample treated with RO) and 27.9 mS/cm (raw leachate sample). The average COD and the NH4-N concentrations of the raw leachate samples was 7,261 ± 2,953 mg/L and 962 ± 451 mg/L, respectively, while the application of biological treatment resulted to a partial decrease of these pollutants to 2,665 ± 2,902 mg/L and 212 ± 185 mg/L, respectively. The advanced treatment of leachates with RO resulted to significant decrease of conventional pollutants to 24 ± 9 mg/L for COD and 25 ± 24 mg/L for NH4-N. Concerning the occurrence of ECs, 62 compounds were detected in total belonging to different chemical groups such as pharmaceuticals, food additives, plant protection products, industrial chemicals and perfluorinated compounds, while 14 of them were found at more than 50% of collected samples. The compounds that were detected with the higher frequency were 2-OHbenzothiazole (84% of samples), PFOA (68% of samples), bisphenol A, bentazone and propamocarb (64% of samples). The number of detected compounds, as well as their concentrations varied significantly based on the matrix and the applied treatment process. More ECs and at higher concentration levels (up to some hundreds μg/L) were detected in raw leachate samples, while the application of biological treatment removed totally some of them and partially decreased the concentrations of the rest. The elimination of ECs was much more important when RO was applied. In these samples, only few compounds were detected per sample and their concentrations did not exceed levels of ng/L. The results of risk assessment showed that the possibility of ecological threat for the aquatic environment cannot be rejected for the cases that raw or biologically treated leachates are discharged into rivers with small flow.

**KEYWORDS:** emerging pollutants; occurrence, leachates; HRMS; environmental risk assessment;

**PAPER ID:** CEST2019_00975

# Autonontarget: An R Package to Perform Automatic Non-Target Screening

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## ABSTRACT

Recent advances on Liquid Chromatography-High Resolution Mass Spectrometry (LC-HRMS) has revolutionized identification of new compounds, having various polarity, over various scientific fields especially in the environmental science. The continuous growing of LC-HRMS applications yet increased the "peak inventories". This is achieved within three main workflows of "Target", "Suspect" and "Non-target" screening. Although targeted analysis is the best way to confirm the identification of a compound, it is sometime not practical due to limited access to reference standards. The vast majority of the peaks detected in the samples generally remain unidentified and supportive information such as retention time prediction, MS/MS (experimental and estimated one) along with ionization behavior would help increase the identification confidence. As "peak inventories" expands and number of regulatory databases grows, retrieving possible candidates and screening them often become a time-consuming task and requires large amount of efforts. Thus, an automatic approach could be of great need to screen known-unknown compounds in the samples. The aim of this study is to propose a workflow (Automatic Non-target Screening (AutoNonTarget)) to screen a peaks-list, created by LCHRMS instrument, from the environmental samples such as influent/effluent wastewater (IWW and EWW) or sewage sludge samples. The proposed workflow starts with an optimized peak picking algorithm, using XCMS and enviPick, for a set of samples (16 IWW, EWW and sewage sludge samples) in which the MS and MS/MS information were recorded in data independent/dependent acquisition mode. After deriving a peaks-list, the peaks (m/z) originated from analytical procedural blank is subtracted from the sample using set an advanced chemometric method. Then, each remaining annotated peak (mainly, but not exclusively the molecular ions, adducts, double charged ions etc. detected by CAMERA and non-target R packages) or mass of interest (an ion that has significant fold changes from one sample to another, trend, or high loading weights) is searched within publicly available database (such as PubChem, REACH database, FoodB or user defined database etc.) and corresponding candidates (within a certain mass accuracy (mD/ppm) provided by user) are being retrieved afterwards. Next, the theoretical isotopic pattern is calculated for each candidate by "enviPat" and then compared with extracted experimental isotopic pattern [1]. Then, the experimental and predicted retention time indices of each candidate is derived to filter out false positives and support identification subsequently. AutoNonTarget includes additional steps to incorporate the MS/MS information during identification such as use of MetFrag [2] (for interpreting the MS/MS fragments and derive score) and CFM-ID (not only to annotate the MS/MS fragments for a list of candidates, but also to predict MS/MS spectrum at various collision energies (CE)) [3]. Finally, the public and open access mass spectral library is used by AutoNonTarget to verify the identification of the compounds. A new method is also used to calculate MS/MS similarity score taking into account effect of different collision energies between the MS2 spectra of candidates and reference standards (found in the mass spectrum libraries). AutoNonTarget provides a final table including all these information with derived level of identification confidence [4] for each m/z to facilitate the identification task in given samples by suspect/non-target screening. The workflow is evaluated by set of 100 common emerging contaminants

(prepared in a solution of 50:50 (H2O:MeOH) by their reference standards), treated as unknown, and applied externally for screening of detected m/zs in the Norman SusDat (https://www.norman-network.com/?q=node/236) and PubChem database (https://pubchem.ncbi.nlm.nih.gov/). CEST2019_00977 Analyses of wastewater samples were carried out by UHPLC-QToF-MS. More details about the analytical method used can be found in [5]. Among the compounds detected by AutoNonTarget, several pharmaceuticals, personal care products, disinfectants and surfactants, like 2-[2-(3-aminopropoxy)ethoxy]ethanol and tetraethylene glycol were identified. "AutoNonTarget" greatly facilitates a higher confidence, rapid screening of samples for suspects, providing an overview of tentative identifications and likely false positive matches for subsequent follow-up.

**KEYWORDS:** Suspect and Non-target Screening, Chemometrics, Mass Spectrometry

**PAPER ID:** CEST2019_00977

# Wastewater treatment and emerging contaminants removal in electro membrane bioreactor using self-forming dynamic membranes

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## ABSTRACT

In recent years, the technical-scientific community has been paying increasing attention to the presence of emerging contaminants that are intercepted in surface water and wastewater since these compounds could have harmful effects on human health and on environment too. Conventional wastewater treatment installations represent a source of pollution from emerging contaminants because they are not designed to remove these compounds from the wastewater in their treatment cycle. Several studies have shown the possibility of removing successfully these compounds from wastewater through the use of membrane bioreactors (MBR) combined with electrochemical processes, using conventional membranes. The present study first examined the possibility of combining electrochemical processes with MBR (eMBR), through the use of self-forming dynamic membranes (SFDM) for the removal of emerging contaminants from municipal wastewater. Thanks to this extremely innovative hybrid system, it has been possible to reduce the problems linked to the use of traditional membranes, in particular the high costs both of initial investment and of cleaning following fouling. Particularly, the four most drugs used by humans representing different therapeutic groups, diclofenac (DCF) as anti-inflammatory, carbamazepine (CBZ) as anti-epileptic, amoxicillin (AMX) as antibiotic, estrone (E1) as sexual hormone and as a pesticide used in agriculture, atrazine (ATZ) it has been analysed.

**KEYWORDS:** Electrochemical processes; Current density; Pharmaceuticals; Membrane fouling; Organic micropollutant

**PAPER ID:** CEST2019_00939

# Pharmaceutical residues in hospital and urban wastewaters: Occurrence, removal and potential risk assessment

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## ABSTRACT

The presence of ten pharmaceutical compounds (bupropion, venlafaxine, mirtazapine, sertraline, citalopram, caffeine, triclosan, carbamazepine, diazepam, clozapine) which belong to different treatment categories was studied in one hospital and three urban WWTPs in north and northwestern Greece. The pharmaceuticals have been selected due to their high usage rate but also because of their proven presence in both wastewater treatment plants and the aquatic environment. Analytical methodology was based on gas chromatography coupled to mass spectrometry (GC-MS) detection after the application of a solid phase extraction (SPE) step. In addition, elimination of these compounds in the WWTPs was assessed as well as their ecotoxicological impact on the aquatic environment was estimated by means of risk quotient (RQ). The results showed that the most often detectable compounds were caffeine, triclosan and venlafaxine. High concentration levels of caffeine, up to 22142.1 ng/L were found, while removal rates were up to 99 %. In addition, high levels of acute and chronic toxicity were observed for triclosan (RQ>1).

**KEYWORDS:** Pharmaceuticals, wastewaters, risk quotient, SPE, GC-MS

**PAPER ID:** CEST2019_00551

# Optimization of fabric phase sorptive extraction for the determination of selected pharmaceuticals in environmental waters

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## ABSTRACT

There is a growing public and scientific concern about the possibility of ecosystem and human health effects from pharmaceuticals in environment. Results have shown that several types of environmental waters (drinking water, groundwater, surface water, treated water) were contaminated by the presence of pharmaceutical compounds including psychiatric drugs. For this reason, it is imperative to develop analytical methods of extraction and pre-concentration to allow for subsequent instrumental analysis of these drugs. In this work, fabric phase sorptive extraction (FPSE) is investigated for the extraction of citalopram, clozapine and sertraline (used in the treatment of mental diseases) in water samples with the aid of chemometric tools and high performance liquid chromatography-photodiode array detection (HPLCUV/DAD). Parameters affecting the efficiency of FPSE were evaluated in depth. The method shows good linearity, with RSD of less than 15%. Relative recoveries higher than 59% were obtained for the studied compounds

**KEYWORDS:** Fabric phase sorptive extraction, experimental design, extraction

**PAPER ID:** CEST2019_00537

# Session 35 - Circular economy and industrial symbiosis

## *Friday 6 September 2019 - afternoon*

# SusNisia: Circular economy for biogenic residues for the North Aegean – case studies for Islands of Chios and Lesvos

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## ABSTRACT

The North Aegean Islands of Chios and Lesvos set recycling goals for organic residues from Municipal Solid Wastes (MSW). Both islands, in line with the National and Regional Plans for Municipal Waste Management, are discussing the approach of mechanical-biological stabilization MSW in combination with separated collection of biowastes and municipal pruning. The SusNisia-project, funded by BMU[1], adds Anaerobic Digestion (AD) to both approaches to demonstrate the added-value by production of biogas for energy purposes or as fuel for e.g. garbage trucks. The advantages of separated collection of organic input materials are the production of high quality and multi-purpose end-products to serve the goal of local nutrient recycling. As refinement, SusNisia applies digestate or compost from Biowaste-AD and char coal from municipal pruning for production of specific soil enhancement products e.g. for olive tree cultivation, vegetable farming and greenhouse applications. The char coal, as activated char, absorbs pollutions, provides a sink for carbon dioxide and delivers extended water storage capabilities. The paper focus on dry fermentation option with German technology for islands of Lesvos and Chios to demonstrate added value by sectoral coupling to integrated waste management systems.

**KEYWORDS:** Anaerobic Digestion, Biogas, Biomethane Biowaste, Combined-Heat and Power, Organic-RankineCycle, Municipal Solid Waste

**PAPER ID:** CEST2019_00103

# A Database of Existing Solid Industrial Waste Reuse Schemes as the Basis for an Industry Matching Algorithm

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## ABSTRACT

For the purposes of the SWAN Project, an integrated suite of on-line resources and tools has been developed aiming to assess novel industrial business models based on solid industrial waste reuse. One of the major components of this platform is an inventory of commercially implemented best practices. This inventory will both inform all registered users about the current opportunities for waste reuse and also serve as the basis for the SWAN matching algorithm. For all the practices or technologies included in the database, the following characteristics have been collected: (i) The type of the industrial plant supplying the waste stream; (ii) The type of the industrial plant receiving the waste stream; and (iii) The type of the waste stream exchanged between source and sink; The Statistical Classification of Economic Activities in the European Community has been used for the categorization of the industrial plant types whereas for the waste streams both the European Waste Catalogue and the European Waste Classification for Statistics have been applied. The database has been populated with more than 100 entries and has led to the identification of the most common symbiotic opportunities based on solid waste reuse.

**KEYWORDS:** Solid Waste, Industrial Symbiosis, SWAN Project, Best Practices

**PAPER ID:** CEST2019_00578

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# SWAN Platform - a Web Based Tool to support the Development of Industrial Solid Waste Reuse Business Models

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## ABSTRACT

The SWAN platform is an integrated suite of on-line resources and tools for assessing industrial symbiotic opportunities based on solid industrial waste reuse. It has been developed for the purposes of the SWAN Project, a project of the transnational Cooperation Programme Interreg V-B "Balkan-Mediterranean 2014- 2020" aiming to develop a digital solid waste reuse platform for the Balkan region and Cyprus. The SWAN platform integrates a database with the spatial and technical characteristics of industrial solid waste producers and potential consumers, which will be populated with data from all four countries involved in the project; i.e. Greece, Bulgaria, Albania and Cyprus. It also incorporates an inventory of commercially implemented best practices on solid industrial waste reuse. The SWAN platform hopes to be the facilitator in the development of novel business models based on solid industrial waste reuse in the Balkan region. Towards this end, it will allow the registered users to run the SWAN matching algorithms and identify and assess potential novel business models based on solid waste reuse, either for an individual industrial unit (source/potential receiver of solid waste) or a specific region.

**KEYWORDS:** Solid Waste, Industrial Symbiosis, SWAN Project, Web Based Tool

**PAPER ID:** CEST2019_00580

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# A Methodology for Boosting Circular Economy in Olive Oil and Wine Sectors: Opportunities for the Italian Competitiveness through Eco-Innovation Strategies

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## ABSTRACT

Applying the principles of circular economy to agriculture is a very important contemporary issue on the international political and economic agenda. In this context, current knowledge and recent insights on biosurfactant production will be surveyed to apply these novel economic approaches in the field of agricultural waste valorisation. The main objective of the CREIAMO project is to set up a replicable methodology for boosting the transition towards circular economy of the oil and wine production sectors through the creation of new destinations for residues originated, new options for their economic valorisation and new business models to increase the competitiveness of companies. A first pilot application will be run in the Lombardia Region. To achieve this objective, the project operates on different eco-innovation strategies: a. Process and product eco-innovation for the exploitation of agriculture wastes from the production of wine and olive oil for producing ecofriendly biosurfactants. Cost-effective production methods will be implemented to improve its market profitability, resulting in higher yields and purity. In CREAIMO, theses bio value-added products will be, therefore, used to treat contaminated soil, which represents a main environmental issue. b. Systemic eco-innovation through industrial symbiosis (IS), allowing companies to achieve at the same time economic, environmental, and social advantages. This project will represent the first structured attempt of industrial symbiosis implementation in the Lombardia region, aiming at creating a symbiosis network with the active participation of both SMEs and local stakeholders.

**KEYWORDS:** Circular economy; Rhamnolipids; Waste valorisation, Eco-innovation, Integrative approach.

**PAPER ID:** CEST2019_00742

# Implementing nature-based and other engineering solutions to recover water from non-conventional water sources

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## ABSTRACT

Mediterranean (MED) islands and coastal areas are under pressure due to water shortage. Water reserves are depleted, while tourism in the summer months burdens the limited water sources. A persistent issue arising from the above activity is the increased seasonal loads of sewage that wastewater treatment plants (WWTPs) receive and need to cope with. On the top of that, the circular economy concept is not implemented in the MED region and particularly in small WWTPs. Water, nutrients, energy and chemicals contained in sewage are not usually valorized. At the same time, in several MED islands, energy intensive seawater desalination is applied to produce potable water thus increasing the energy demand and producing large quantities of brine water, which is not further valorized. As a consequence, activities within the concept of circular economy are required, considering the waterenergy-food nexus. The HYDROUSA Horizon2020 Innovation Action project will provide innovative, regenerative and circular solutions for (1) nature-based water management of Mediterranean coastal areas, closing water loops; (2) nutrient management, boosting the agricultural and energy profile; and (3) local economies, based on circular value chains. The services provided lead to a win-win-win situation for the economy, environment and community within the water-energy-food-employment nexus.

**KEYWORDS:** circular economy; Horizon 2020; wastewater treatment; water reuse

**PAPER ID:** CEST2019_00953

# Turning waste into new resources in small and medium sized enterprises


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## ABSTRACT

Turning waste into new resources in small and medium sized enterprises (SME). During a three years period (2015-2018) a project involving SME's, was carried out in corporation of six Danish municipalities, the Technical University of Denmark (DTU) and Symbiosis Center Denmark. The project was financed by EU. The project focused on industrial symbioses, optimizing resources and/or potential waist minimalization. Initially 107 SME's where screened for their potential to join the project. Of these 52 SME's were offered a technical development plan and 42 SME's were offered a green development plan. The outcome of the project showed following potential savings: • Energy: 36.222 GJ/year • Materials: 10.416 tons/year • Water: 20.935 tons/year • $CO_2$ emission savings: 4.908 ton/year This corresponds to 1 million euro saved. If all the proposed solutions are implemented, it will result in at least 24 new jobs in the participating SME's. Putting resource efficiency and industrial symbiosis on the agenda of small and mediumsized enterprises showed that sustainable growth can be achieved. It requires companies that are ready to think differently and are open to new ways of doing business.


**KEYWORDS:** industrial symbioses, waist minimalization, readiness

**PAPER ID:** CEST2019_00165

# Assessment of public purchase behavior towards household green products in United Arab Emirates (UAE).

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## ABSTRACT

The aim of green production and consumption is to adopt the idea of supplying the consumers with products that fulfill their needs with lower consequences on the environment. This concept, introduced in 1970, aims to protect the environment and to have better control over natural resources. This study is aiming at investigating the consumers' purchase behaviors toward green products which can help decision-makers identify the tools that may be needed to promote green products in UAE markets. The study was conducted through the distribution of a self-administered questionnaire to assess green purchase practices and public knowledge about green products. The study concluded that the quality of green products is the most important factor that the UAE's consumers consider for their decision regarding the green purchase. Eco-labeling may not be well understood among the studied population, and more awareness is needed about Eco-labeling among the community. This study showed that social media is a very important and effective tool to spread and influence green purchase practices among the residents.

**KEYWORDS:** green product, eco-labeling, consumer purchase behavior, environment, green marketing

**PAPER ID:** CEST2019_00797

# Session 36 - Environmental data analysis and modelling (2)

## *Friday 6 September 2019 - afternoon*

# Meteorological Data Science: exploiting causality discovery in time-series for knowledge discovery and improved forecasting

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## ABSTRACT

Climate change and its impact on everyday life still remains one of the greatest challenge of our era. The complex nature of climate data addresses the use of data science techniques to provide predictive analytics to the task at hand. While most existing approaches exploit correlation between observations and features to improve forecasting, the present work deals with causality, a principle that enhances robustness and provides better insight to domain experts. More specifically, a novel framework for causality discovery is proposed, based on statistical (i.e. Granger causality tests) as well as on nonlinear state space reconstruction algorithms (i.e. Convergent Cross Mapping, a very effective algorithm in dynamic systems, such as the task at hand) in order to find the causal relations between meteorological time series. Furthermore, the framework also supports methods for graph analysis, thus providing informative visualizations on the influential levels of causality. Experiment results on a dataset of real observations from different cities of Greece, obtained through crawling of Internet sites of Davis weather stations demonstrate the ability to model and visualize the relations of the meteorological parameters amongst the cities. Moreover, by utilizing such causal inference knowledge, the forecasting performance for each city is significantly improved, since only relevant and informative features were taken into consideration.

**KEYWORDS:** Data Science, Causal Inference, Time-Series Analysis, Graph Analysis, Feature Selection.

**PAPER ID:** CEST2019_00828

CEST 2019

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# Environmental genotoxicity and risk assessment in herring (Clupea harengus), Atlantic cod (Gadus morhua) and flounder (Platichthys flesus) caught in the Gotland Basins from the Baltic Sea (2010-2017)

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## ABSTRACT

Eight nuclear abnormalities of geno-cytotoxicity were studied in peripheral blood erythrocytes of herring (Clupea harengus membras), flounder (Platichthys flesus) and Atlantic cod (Gadus morhua) sampled (2010–2017) from the Polish and the Lithuanian Exclusive Economic Zones (EEZs) in the Baltic Sea. At all study stations, total genotoxicity (∑Gentox) were found to be higher than total cytotoxicity (∑Cytox). A significant time-related decrease in genotoxicity was detected in the Lithuanian EEZ (2015–2017), while in the Polish EEZ (2014–2016), the opposite tendency was revealed. The highest ∑Gentox and ∑Cytox values recorded in the fish sampled at the study stations located relatively close to each other clearly indicate an increased environmental genocytotoxicity pressure for fish in these areas. Exceptionally high and high level genotoxicity risks to herring followed by those to flounder and cod were determined at a higher percentage of the stations studied.

**KEYWORDS:** Genotoxicity; Cytotoxicity; Oil extraction; Risk assessment; Marine fish

**PAPER ID:** CEST2019_00322

# Performance Evaluation of Mass Transfer-Based Method using Global Performance Index in Semi-Arid Region Saudi Arabia

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## ABSTRACT

The standard method for the estimation of reference evapotranspiration (ETo) is FAO-Penman-Monteith (FAO56-PM). However, it requires various climatic parameters which are often hard to achieve due to various reason. In order to bridge this gap an alternative equation has to be find out. The main aim of this research work was to assess the performance of the various mass transfer-based method with respect to standard FAO56-PM. Daily meteorological data from 1980 to 2018 has been used to compute reference evapotranspiration. Daily ETo values were computed. Among the computed values 70% of them were used to calibrate the mass transfer equations under study and remaining 30 % data were used to validate the calibrated equation against the standard method. The calibrated models were analysed and compared using statistical tools and ranked using Global Performance Indicator where a higher value represented a model's better performance. The models were then arranged using GPI and it was found that Albrecht model resulted in best estimation capability. The results of this study could be used by the water management system, crop cultivators, crop advisors, researchers and students from universities and research centres. Moreover, it is beneficial for the decision maker in the vast field of agriculture, hydrology and environment.

**KEYWORDS:** Reference Evapotranspiration; Mass Transfer method; Calibration; Validation; Global Performance Index

**PAPER ID:** CEST2019_00708

# Spatial explicit evaluation of potential future developments of forests due to climatic change and nitrogen deposition

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## ABSTRACT

Climate change and atmospheric nitrogen deposition can impact the integrity of ecosystems. Therefore, the EU Biodiversity Strategy foresees that Member States map and assess the state of ecosystems and their services in their national territory. By example of Germany, this article presents a quantitative, spatially explicit as well as nationally, regionally and site specifically applicable methodology for classifying and mapping forest ecosystems and identifying changes of their integrity comparing their reference states (1961- 1990) with measured (1991-2010) und potential future conditions (2011-2017). To this end, measured environmental data were complemented by dynamic modelling of future climate and soil conditions. A fuzzy rule-based model for estimating spatial patterns and temporal trends of soil moisture was developed and tested at the federal and regional level. Forest ecosystem conditions were evaluated and ordinated at three levels (indicators, functions and ecosystem type) with regard to functionality, chemical and biological characteristics, stress tolerance against climate change and nitrogen deposition scenarios for the years 1961- 1990, 1991-2011 and 2011-2070.

**KEYWORDS:** Ecosystem classification, integrity, dynamic and fuzzy modelling; Geographic Information System.

**PAPER ID:** CEST2019_00956

# Species prioritization for recovery potential estimation. Case of study: Seasonally dry tropical forest at an inter Andean valley of Cauca River, South America

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## ABSTRACT

Seasonally dry tropical forest (SDTF) at the Colombian inter-Andean valley of Cauca River (IVCR) has been under constant transformation. Following the current SDTF's global distribution, it has remained as small and sparse fragments embedded in an anthropogenic landscape. Information regarding the known species composition is a basic input in any modelling scheme. Environmental data is also needed to understand its influence as an explanatory variable for the species occurrences. Knowledge about the biomes and ecoregions where they have been registered may help to understand the way in which the multiple species have been distributed through environmental gradients. In such a way we could recognize the relevance that IVCR plays for the conservation of SDTF plant species in the long term. From multiple datasets, a database with 1725 plant species was built. After applying different criteria set (endangered, endemic, conservation status, at national and regional level), different species subsets were obtained. For a first subset with the species prioritized, Maxent Algorithm on R Studio has been applied to produce predictive habitat suitability models to support the detection of potential areas for restoration. Restoration scenarios will be built for each subset of prioritized species which can be used for landscape planning purposes.

**KEYWORDS:** Biomes, ecoregion, restoration, species composition.

**PAPER ID:** CEST2019_00221

# An integrated methodology to estimate the contribution of environmental factors controlling the spatial variation of total dissolved solids. Application on Jiu River Basin (Romania)

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## ABSTRACT

Through this research, we aim to develop a methodology for estimating the contribution of the natural and anthropic factors to the spatial variation of Total Dissolved Solids (TDS). The study area is Jiu River Basin, a Danube tributary from SW Romania. TDS content was measured on Jiu River and its main tributaries, in periods of low waters in the summer of 2017 and 2018. For the area upstream each point, the following factors considered as primarily responsible for the TDS concentration were mapped and integrated in GIS and statistical analysis: geology, vegetation, soil textures, relevant human activities (coal-mining industry and agriculture in the valleys and in the catchments upstream the measuring points). Using the principal component analysis (PCA) and regression models, scores were assigned to quantify the contributions to the spatial variation of TDS in the rivers. The results showed that coal mining and lithology (marls' dominance) play the main role in explaining the TDS variation. The development of such an integrated methodology improved the understanding of the relationship between the rivers' TDS and the environmental drivers.

**KEYWORDS:** total dissolved solids, GIS, PCA, Jiu River

**PAPER ID:** CEST2019_00269

# Thermal bridge modelling, based on conjugated heat transfer and CFD methods

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## ABSTRACT

In the building structure, the "thermal bridge" is defined as an isolated zone, where construction elements have higher thermal conductivity, compared with the rest of the building envelope. Thus, a significant temperature difference may exist between adjacent solid and air volumes within the developments, especially in winter conditions. The existence of thermal bridge mostly affects the energy performance of buildings, due to the increased heat losses from the occupied spaces. But also, the decreased surface temperature in these zones, could lead to moisture accumulation and substantial humidity related problems in the indoor environment. Considering these important effects, the presented study describes the development of numerical model of a thermal bridge distribution, based on conjugated heat transfer in concrete external wall section. The thermal bridge distribution is analyzed relative to the indoor and outdoor air parameters, and the envelope thermal properties. The achieved surface temperature sensitivity results may be used for further moisture accumulation model development or enhancements.

**KEYWORDS:** Thermal bridge, conjugated heat transfer, CFD, indoor and outdoor environment

**PAPER ID:** CEST2019_00486

# 50-year precipitation trends in Nestos Delta-Natura 2000 site

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## ABSTRACT

Nestos Delta (north Greece) is a complex ecosystem of high ecological importance, protected by the European Union as a Natura 2000 site. The presence of the habitats 3170* and 91E0*, which are highly connected with water resources availability, impose the continuous monitoring of precipitation in the area, since even minor changes of the precipitation regime could have a significant effect on the habitats' viability. Aim of this work is to detect significant precipitation changes by analyzing datasets from 5 nearby station for a time period of about 50 years. The results indicate statistically significant decreasing changes mainly at lower altitudes, and increasing at higher.

**KEYWORDS:** Precipitation, Trends, Mann-Kendall, Sen

**PAPER ID:** CEST2019_00820

# Session 37 – Water treatment

## *Saturday 7 September 2019 - morning*

# Susceptibility of Algal Toxins to Advanced Oxidation Processes


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## ABSTRACT

Harmful algal blooms (HABs) occur more frequently and severely in recent years due to the climate change and increasing nutrient inputs, causing higher potential for the algal toxins to enter drinking water supplies. When HABs formation is intensive, conventional water treatment is insufficient to remove those toxins, so that further advanced technologies are necessary to be added. In this presentation, Professor Dionysiou will give an overview of recent progress in the destruction of several algal toxins, such as microcystin variants (MCs) and cylindrospermopsin, using light-based advanced oxidation processes (AOPs). The discussion will focus on the kinetics and transformation pathways of the destruction by hydroxyl radical, sulfate radical, chlorine related radicals, and other reactive species generated in various AOPs. The role of the specific amino acids in the reactivity of the MCs will be emphasized. The effect of solution co-contaminants in field water samples will be presented with the focus on identifying parameters that play important roles in process performance and oxidation pathways. Finally, coupling of AOPs with conventional technologies for the removal of algal toxins will be showcased, considering also potential application of some of these technologies in a treatment plan.



**KEYWORDS:** Algal toxins; Advanced Oxidation Processes; kinetics; transformation pathways

**PAPER ID:** CEST2019_00437

# Pollutant photo-NF remediation of agro-water

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## ABSTRACT

We describe the deployment of a novel water purification technology, which was initially conceptualized in the context of a readily successful FP7 project (CLEAN WATER, Grant Agreement no 227017, 2009-2012) and is now in the progress of been upgraded and upscaled thanks to the grants awarded by a LIFE Environment and Resource Efficiency project (LIFE PureAgro$H_2O$, LIFE17 ENV/GR/000387, 2018- 2021). The technology is currently recognizable with the term "Photocatalytic Nanofiltration Reactor" (PNFR) and combines in a synergetic way the processes of nanofiltration (NF) and photocatalysis in a single stage, targeting to the complete elimination of pesticides and other organic and inorganic (heavy metals) pollutants from the wastewater of the Fruits & Vegetables Industry (F&VI) and to the reuse of 15 m3 of treated water on a daily basis.

**KEYWORDS:** Photocatalysis; Nanofiltration; Titania; Chlorpyrifos degradation; Optical Fibers.

**PAPER ID:** CEST2019_00516

# $TiO_2/CoFe_2O_4/Ag$ nanocomposites for photocatalytic reduction of water pollutants under UV and solar light

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## ABSTRACT

Novel ternary catalysts $TiO_2/CoFe_2O_4/Ag$ with variable ferrite content were synthesized, characterized and used for the photocatalytic reduction of Cr+6 pollutant, under UV and visible light illumination. Both $TiO_2$ and $CoFe_2O_4$ were synthesized using the sol-gel method followed by hydrothermal treatment to prepare $TiO_2/CoFe_2O_4$ (TCF) composite. Silver nanoparticles were successfully loaded on the surface of TCF to get three different composites, named as Ag/TCF. The crystal structure of the composites was analyzed by application of physicochemical characterization techniques. The presence of pure anatase phase $TiO_2$, cubic $CoFe_2O_4$, and silver nanoparticles was indicated in both XRD patterns and Raman spectra. It was found that the addition of silver nanoparticles has a great contribution to the photocatalytic reduction of $Cr^{+6}$ species. The photocatalytic reaction mechanism was studied by applying scavenging reaction process, revealing that electrons were strongly supported for the photocatalytic reduction of $Cr^{+6}$. After the photocatalytic experiments, the composite catalyst can be easily separated from the reaction solution by external magnetic bar and re-used.

**KEYWORDS:** $TiO_2$ nanopowder; cubic $CoFe_2O_4$; titania / ferrite/silver composites; $Cr^{+6}$ photocatalytic reduction.

**PAPER ID:** CEST2019_00517

# Evaluation of Photocatalytic Materials for Water Purification: Overview of the New CEN Standard Test

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## ABSTRACT

$TiO_2$ photocatalysis offers an attractive alternative to conventional water treatment technologies leading directly to the degradation of organic pollutants, compared to transferring them from one phase to another as in the case of membranes or activated carbon. There is an increasing interest on using photocatalysis for water treatment, rendering reliable evaluation of performance of the catalytic materials necessary. Methods for testing photocatalysts used in water treatment are generally not harmonized. Two ISO standards are available for assessing the photocatalytic activity of surfaces with regards to water purification, which are based on the photo-bleaching of methylene blue and the oxidation of DMSO, respectively. A new European standard for assessing the photocatalytic activity of materials has been developed and is under publication by the European Committee for Standardization, CEN TC386/WG3. Evaluation of the performance of photocatalytic materials in water purification is based on measurement of phenol degradation with UV irradiation under controlled conditions. The proposed standard method is applicable to materials in the form of powders (suspensions in water, slurries). İn this study, the new CEN standard test will be presented, while its differentiation from the existing ones, its applicability and the process followed for its validation, will be discussed.

**KEYWORDS:** Photocatalysis, European Standard, CEN, Phenol degradation.

**PAPER ID:** CEST2019_00520

# Treatment of drinking water by UV/Cl2: a study of βcyclocitral, a cyanobacterial taste & odor compound.

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## ABSTRACT

Homogeneous photocatalytic processes are receiving increased interest with regards to drinking water treatment for emerging pollutants. Especially the UV/$Cl_2$ technique has a potential for real large-scale applications as it can combine disinfection with chemical oxidation using processes that are more familiar and widely applied by water supplies. However, more research is needed to understand the complex mechanisms involved, including formation of hydroxyl and chlorine radicals among others, as well as overall performance against various groups of emerging pollutants, such as the less-studied water taste and odor compounds (T&O). We present results on the UV/$Cl_2$ degradation of β-cyclocitral as a model of common cyanobacterial nor-carotenoid T&O in water. The study was conducted using a novel photoreactor setup with custom-made UV-LED arrays, precise control of irradiance, continuous spectrophotometric – GC/MS monitoring and sensory evaluation of the process. Effects of key process parameters i.e. irradiance, concentration of Cl2 and β-cyclocitral, water matrix (ultrapure and typical drinking water) on the kinetics as well as key degradation products and proposed pathways are presented. Effectiveness, efficiency and prospects of real applications of UV/$Cl_2$ for removal of hazardous T&O from drinking water are discussed.

**KEYWORDS:** Advanced Oxidation Processes, UV/$Cl_2$, drinking water, Taste & Odor (T&O)

**PAPER ID:** CEST2019_00532

# Session 38 - Electric and electronic waste

## *Saturday 7 September 2019 - morning*

# Recovery of critical and precious metals from E-Waste

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## ABSTRACT

Waste of Electrical and Electronic Equipment (WEEE) is the fastest growing waste stream in Europe. This waste contains a high amhttps://www.youtube.com/watch?v=7uxLrzaZufkount of critical and valuable metals as the rare earths defined critical materials from European Commission (2010) and the precious metals. Exhaust fluorescent lamps are examples of electronic wastes that have important percentages of rare earths elements (REEs). These types of WEEE represent an important secondary source of REEs. Moreover, they are classified as hazardous materials for the presence of mercury and need to be properly handled. Among the most valuable component of WEE there are printed circuit boards (PCBs) for their precious metals content. In the present paper a hydrometallurgical process for the recovery of REEs (yttrium, europium, terbium, gadolinium, lanthanum and cerium) from fluorescent powders and copper, tin, zinc, gold and silver from WPCBs. Hydrometallurgical process for rare earths recovery includes a preliminary roasting, acid dissolution and precipitation of a mixture of REEs oxalates. Alternately, a solvent extraction operation and stripping can be added after dissolution to selective recover rare earths. For the WPCBs treatment, a hydrometallurgical process consisting of two sequential leaching procedures (performed in counter and cross current ways) followed by selective precipitation/reduction of elements of interest from solution has been designed.

**KEYWORDS:** spent lamps; waste printed circuit boards; hydrometallurgical processes; precious metals; rare earths.

**PAPER ID:** CEST2019_00681

# Plastics in WEEE Screens: Difficulties and Opportunities to Improve the Recycling Rate

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## ABSTRACT

Nowadays the screens collected by the official e-waste schemes in France are mostly comprised of Cathode Ray Tube (CRT). Nevertheless, Flat Panel Display (FPD) collection should increase in the following years. Among other differences in material compositions, FPD screens have higher plastic content. In order to keep complying with the recycling targets for screens, as well as to increase the recycling performance per material, it is necessary to improve plastics recycling. The goal of this study is to quantify the plastic flows in screens generated, collected and recycled in France and to identify the current scenario of plastic recycling. The presence of flame retardants and additives in the plastics, the variety of polymer types, as well as the high volumes of black plastics are among the main challenges in plastics sorting and recycling. From the economic outlook, it is necessary to develop the market that uses secondary raw materials to ensure the profitability of the WEEE chain.

**KEYWORDS:** E-waste; WEEE; Recycling; Plastics; Flame retardants; Recycling rate

**PAPER ID:** CEST2019_00425

# Novel Technologies & Methods for Lithium Batteries Expansion of Life Cycle

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## ABSTRACT

Technology of Lithium batteries is nowadays greatly developing, as they are an efficient mean of energy storage. Their main use is in electric and electronic devices. Moreover after 2010, these batteries are also used in the development of electric vehicles, an industrial sector which has a high growth rate. Since these technologies are advancing and the quantitative use of Lithium batteries in Europe is expected to increase, a flow of Lithium batteries waste will be generated that will need novel methods to be treated. Therefore, much research should be done focusing on the waste batteries, their collection and possibilities of reuse. Recent approaches in battery recycling are focusing on material separation and partially processed raw material re-use. But concerns about the great amounts of waste, the possible lack of the primary materials included in the batteries and also the possible soil and water contamination, is leading the scientists to find new methods of restoring, reusing and expanding the life cycle of Lithium batteries. The objective of the present work is to review the current status and future prospects of lithium batteries use and treatment as waste. The increasing importance of Lithium as well as its present applications, the storage and reuse methods as well as its constraints as an energy storage material will be highlighted in the work.

**KEYWORDS:** Lithium batteries, second life, energy storage materials

**PAPER ID:** CEST2019_00185

# Bioleaching for Metal Recovery from Telecoms Switchboard

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## ABSTRACT

Printed circuit boards (PCBs) are a necessity for electronic equipment to function especially in the telecommunication industries. From a PCB for broadcasting networks to PCBs for office communications they are what makes electronic communications equipment operate. The sophistication possible with modern electronic and microelectronic devices depends ultimately on the materials they are made from. Metals have assumed a vital role in electronics at every stage in their evolution. PCBs are rich in base and precious metals, and should be considered as secondary resources. Bioleaching is a proven green and sustainable method for metal recovery as demonstrated in the mining industry, but application to recover metals from electronic equipment is still limited. In this study, bioleaching is applied for the first time to the telecommunications products that have reached the end of their useful life. Because several biological and physicochemical parameters can influence bioleaching, the first step in this study was to analyse the metal content of PCBs. In the second part, the effect of different parameters on bioleaching is investigated, with the aim of improving metal recovery. Altogether, the study aims to demonstrate the effectiveness of bioleaching for metal recovery from WEEE.

**KEYWORDS:** PCBs, Bioleaching, PCBs, Metal recovery

**PAPER ID:** CEST2019_00623

# Session 39 - Environmental health (1)

## *Saturday 7 September 2019 - morning*

# Microbial Concrete: a Step towards Mitigating the Climate Change and Global Warming at Micro Level

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## ABSTRACT

The post-industrial revolution anthropogenic activities are mainly responsible for Pollution worldwide. This pollution is recognized globally in terms of Global warming and Climate change as their resultant impacts are felt worldwide. The world-wide effort for mitigation of climate change and global warming are in place but are ineffective and not enough to overcome the pollution in Urban landscapes. This necessitates the requirement of a system and methodology that can be applicable in a sustainable manner without disturbing the Urban Landscapes. The present study analysis the potential of microbial concrete in terms of Carbon dioxide sequestration for King Khalid University Campus. The study found that the microbial concrete panel effectively reduced carbon dioxide in range of 2- 3% from ambient air quality. Since the microbial concrete is an inbuilt part of the building it can be installed without hindering the Urban Landscape and change in user pattern. The microbial concrete is a green, sustainable and environment friendly solution to changing urban dynamics air quality.

**KEYWORDS:** Industrial revolution, Urban Landscapes, Global Warming, Climate Change, Microbial Concrete

**PAPER ID:** CEST2019_00207

# Effect of anthropogenic sources on total particles and Cloud Condensation Nuclei levels in the Eastern Mediterranean

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## ABSTRACT

The absorption and scattering of radiation by atmospheric aerosol particles, especially those originating from anthropogenic activities, is a key component of anthropogenic climate change. Aerosol particles also act as cloud condensation nuclei (CCN) "indirectly" forcing climate through the modification of cloud properties and precipitation efficiency. The activation of particles to form CCN depend highly on particle size and chemical composition and differs upon location and proximity to sources. Particle number size distributions, aerosol chemical composition and CCN measurements were performed at two sites in the Eastern Mediterranean, namely a remote background site at Finokalia, Crete and an urban background location downtown Athens, Greece. The aim of the study is to characterize the levels and distribution of total aerosol particles (CN) and CCN in the different environments and analyse the role of anthropogenic sources in the measured levels.

**KEYWORDS:** Cloud Condensation Nuclei, Urban, Remote Background, Anthropogenic Sources

**PAPER ID:** CEST2019_00266

# Air Pollution Exposures and Respiratory Health in 5-Year-Old Children

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## ABSTRACT

Background: Growing evidence indicates that respiratory health in children is related to air pollution. Most of previous studies rely on residential air pollution estimates to represent individual exposure; however, there is evidence that residential estimates tend to misclassify exposure. Aim: This study aims to assess the relations between air pollution exposures and respiratory health (asthma, wheezing and lung function) by applying a sophisticated exposure assessment technique. Methods: The study relies on a Dutch cohort and includes 733 children. The prevalence of asthma and wheezing and the spirometry measurements were determined at the age of 5. The annual average concentration maps of Particulate Matters and Nitrogen Oxides that we used in the study were derived from the European Study of Cohorts for Air Pollution Effects. To assess individualized air pollution exposures an updated exposure assessment technique was applied. Results: This study did not show significant associations between air pollution exposures and the studied health outcomes in the 5-year olds. For example, after adjusting for possible confounders, the ORs were 1.2 (95% CI: 0.86, 1.61) and 1.2 (95% CI: 0.87, 1.64) for wheezing prevalence for NOx and PM2.5 respectively.

**KEYWORDS:** air pollution, exposure assessment, asthma, wheezing, lung function, children

**PAPER ID:** CEST2019_00306

# Microbiological diversity and microbial related risks at Wawel Royal Castle in Krakow, Poland

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## ABSTRACT

Microorganisms are known to colonize and modify various environments, including cultural heritage buildings. Anthropogenic indoor environments often provide specific conditions for microbial growth e.g. microclimatic parameters. These conditions are potentially easy to control thus it is advisable to characterize and monitor bacterial and fungal communities in indoor habitats. Microbiological pollution in museums is particularly important because bacteria and fungi contribute to the deterioration of cultural heritage objects and may have a negative impact on human health. In our study we performed microbiological analysis of Wawel Royal Castle in Krakow, which is one of the greatest Polish national heritage sites and was visited by over 1.4 million tourists in 2017. There are large and valuable collections of objects related to the Polish rulers e.g. rare tapestries and paintings. Microbiome analysis was done by culture-dependent experiments for I) airborne microorganisms (50 litres of air) sampled onto various types of agar media, as well as culture-independent analysis of II) airborne microorganisms (12000 litres of air) sampled onto saline, and III) microbes from dust from historical surfaces. Microbiological diversity was determined by analysis of deeply sequenced amplicons covering hypervariable regions V3-V4 of 16S rDNA gene and ITS2 region located between 5.8S and 26S Rdna especially when in a complex interspecies consortium. Usually, environmental microbial communities are formed by many taxonomic groups of organisms, which are often unculturable in the laboratory conditions. The knowledge about the structure of microbial communities in cultural heritage may lead to preventive measures before the biodetorioration process of valuable historical objects

**KEYWORDS:** cultural heritage, microbiological diversity, high-throughput sequencing

**PAPER ID:** CEST2019_00339

# Session 40 - Water, energy and/or food nexus

## *Saturday 7 September 2019 - morning*

# The Mitigation of Environmental Impacts of High Polluted Effluents from Tuna Canning Industry through Eco-Efficiency Strategies

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## ABSTRACT

Food industry use high volume of water and energy to carry out their processes. Specifically, the fish canning industry generates effluents with high organic and saline loads, which complicates their suitable treatment before discharging to water bodies. The LIFE VERTALIM project has demonstrated the efficiency of a holistic solution (including technical, legislative, social, and environmental aspects) for the controlled integration of food industry wastewater from small and medium enterprises (SMEs) in the urban sanitation system. The implementation of low-cost innovative solutions, through the clean and eco-efficient production and wastewater pretreatment for fish canneries, has led to on average a reduction of 30% of the wastewater discharges to the environment and a reduction of food losses of up to 0.1%. Moreover, there has been a reduction of between 40% and 90% related to high organic load. These results allow the canneries to dispose their pretreated effluents to the urban sanitation system, avoiding the high costs of an industrial wastewater treatment plant (WWTP). During the project, a physical-chemical quality control has been achieved in the river waters as well as in the marine water surrounding the urban WWTP. In fact, a remarkable improvement of the river water quality has been measured.

**KEYWORDS:** Industrial wastewater management, ecoefficient food production, fish canning industry, real-time control system

**PAPER ID:** CEST2019_00477

# Evapotransiration of crops and mechanical soil composition in Rhodes island

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## ABSTRACT

The aim of this paper is to evaluate the green (from rainfall) and blue (from irrigation) evapotranspiration of the most widespread crops (olives, citrus, soft and hard wheat, watermelons/melons, barley, grapes, vegetables, winter/summer and spring potatoes, fodder crops, rest annual crops) in the geographical area of Rhodes island. While the soils of the island belong to the same category, according to the classification "USDA Texture Classification" and could be roughly considered as a homogeneous medium soil (loam) in CROPWAT software, a separation takes place in four categories, in order to investigate whether the evapotranspiration of crops varies, even in the same ground category, depending on the relation of the mechanical soil composition. Furthermore a comparison takes place with the medium soil default value of CROPWAT. The examination included the separation of irrigated and dry crops at the scale of municipal unit. Calculations were made on the basis of the irrigation schedule approach, which includes a dynamic water balance of the soil profile and monitors soil moisture content over time.

**KEYWORDS:** Evapotranspiration, CROPWAT, soil, crops, Greece, Rhodes.

**PAPER ID:** CEST2019_00555

# Enabling the Total Resource Utilization (TRU) Habitat

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## ABSTRACT

Terragon Environmental Technologies Inc. has developed a suite of user-friendly technologies to treat solid and liquid byproducts of human consumption now considered "waste" and convert them into "resources" that can be reused in the same place in which they are generated (in situ). These technologies, namely MAGSTM (combustible-waste-to-thermal-energy) and WETTTM (wastewater treatment and re-use), when integrated together in the same location, can enable a "Total Resource Utilization (TRU) Habitat". A technological overview of MAGS and WETT are presented in this paper as well as Terragon's vision of the TRU Habitat.

**KEYWORDS:** resource recovery, waste-to-energy, grey water, black water, on-site waste management

**PAPER ID:** CEST2019_00854

# Changing Cropping Patterns and Irrigation Practices: Implications for Promoting Sustainable Growth of Agriculture in West Bengal, India


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## ABSTRACT

The relationships between availability of irrigation facilities and changes in cropping patterns, especially in an agrarian economy like India, require deeper investigation for rational use of water and promoting sustainable growth of agriculture sector. The existing studies generally focus on how access to irrigation can change cropping patterns. Accordingly, policy changes and institutional arrangements are suggested to provide the farmers greater access to irrigation facilities. While this is imperative to promote inclusive agricultural growth, ensuring its sustainability requires exploring how changes in cropping patterns subsequently affect extent and patterns of irrigation. In this perspective, the present paper attempts to understand how changes cropping patterns have affected irrigation requirements and its structures in the Indian state of West Bengal. While deeper investigation at micro level is necessary to draw more robust conclusions, initiatives should be taken towards guiding the farmers towards choice of appropriate cropping patterns for more judicious use of water. The local level institutions like water users' association should play a crucial role in this regard.



**KEYWORDS:** Irrigation, cropping patterns, crop diversification, sustainable growth, West Bengal.

**PAPER ID:** CEST2019_00472

# A System Dynamics Model to explore the water-land-energyfood-climate Nexus in Latvia


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## ABSTRACT

Water, energy, food/land use and climate are connected a system defined by complexity. The characteristics of the nexus change depending on the scale, location, and the sectors of interest. System dynamics modelling (SDM) is an approach developed for studying complex systems, and has found widespread application in the environmental and natural sciences. Disparate sectors can easily be combined and interlinked in one coherent modelling environment. SIM4NEXUS (www.sim4nexus.eu) is developing serious games for 12 case studies. The SDM and baseline results are presented for the Latvia case study. The principle nexus sectors of interest are land use, energy, and water quality. Of particular interest is the drive towards a low carbon economy through the cultivation of energy crops. However this may hinder other targets such as increasing food security, and improving water quality and biodiversity. The SDM captures critical elements, dynamically linking the nexus sectors with a focus towards the biofuel and energy, and the concomitant impacts on the water, land and climate sectors. Policy options, developed with local stakeholder groups, are to be included to assess nexus-wide impacts of current, and potential future, policy directions within Latvia.



**KEYWORDS:** Latvia; nexus; system dynamics; waterenergy-food-land-climate.

**PAPER ID:** CEST2019_00074

# Prediction of Electricity Prices

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## ABSTRACT

The aim of this paper is analyzing time series that might have an impact on prices of energy commodities. Analysis and econometric modelling reveal which time series are corelated and how. This is input for further modelling of forecasting tool for electricity prices on Czech energy market trading commodity futures.

**KEYWORDS:** electricity, forecasting, prices

**PAPER ID:** CEST2019_00495

# Water Availability: a factor of sustainability and adaptation of agriculture to climate change

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## ABSTRACT

Climate change is expected to negatively affect agriculture. The effects of climate change on agricultural production are widely studied and adaptation strategies have already been proposed and even applied and assessed in many cases. A key component on agriculture vulnerability to climate change is water availability. The aim of the present study is to enlist and review representative proposed water management schemes and adaptation strategies related to agricultural water proposed in literature. Changes in technologies used, infrastructure, irrigation and crop patterns have been considered as adaptation procedures in order to prevent or reduce climate change impacts to agriculture. The choice of the most preferable measures should not be limited to their performance against water shortage but also on the assessment of their economic and social impacts. The suitability of each adaptation method is also depended on the scale of intervation; farm, river basin or national level.

**KEYWORDS:** irrigation, water management, climate change, adaptation, water availability

**PAPER ID:** CEST2019_00406

# Session 41 - Agroforestry, forest and agricultural sustainability (1)

## *Saturday 7 September 2019 - morning*

# Tolerance of Moringa Oleifera to water stress

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## ABSTRACT

Moringa oleifera (Lam) is a fast growing tree that is gradually getting more attention for it numerous uses. It is often called "natural gift" or "miracle tree" because of its many nutritional, forage, medicinal and industrial potentialities. Moringa oleifera appears to be a promising multipurpose species for use under a changing climate. To test possible adaptation potential and / or tolerance of Moringa oleifera to water stress, an experiment was conducted under semi controlled conditions. Stress was induced in the semi-controlled experiment by the application of different concentrations of polyethylene glycol (PEG-6000), to cause different levels of water potential stress for twenty days. The effect of water stress to plant growth was evaluated based on chlorophyll (a and b) and carotenoid compared to controls. Water stress resulted to a 70% gain in chlorophylls b, 44% losses in chlorophyll a and 45% in carotenoids. These results testify the tolerance ability of Moringa oleifera plants to water stress.

**KEYWORDS:** Climate change, Tunisia, water potential, multipurpose tree, agroforestry

**PAPER ID:** CEST2019_00093

# Aerial Spectral Index Analysis for Differential Management Zone Delineation in a Maize Field

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## ABSTRACT

Inhomogeneities of soil properties are responsible for within-field variations on the growth and final yield of crops. In this paper the variations of a Normalized Difference Vegetation Index (NDVI) field map, obtained through a camera mounted on an Unmanned Aerial Vehicle, were correlated with soil and plant properties measured in a typical maize cultivated field. Subsequently, the perspective of organizing the field into differential management zones through the NDVI was evaluated. The coefficient of variation for sand, silt, clay and soil organic matter content at five points was found to exceed 11% while the corresponding value for biomass and yield were greater than 14%, indicating significant spatial field soil heterogeneity and variations on plant growth. When correlated to NDVI, sand content exhibited a negative correlation (r=-0.86), while in the case of silt, clay, organic matter content, biomass and yield the correlation was positive (r>0.8). Lastly, the NDVI confirmed to be a powerful tool for the delineation of deferential management zones.

**KEYWORDS:** Soil texture, Yield variability, NDVI

**PAPER ID:** CEST2019_00136

# Microwave communication networks as a sustainable tool of rainfall monitoring for agriculture needs in Africa

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## ABSTRACT

Commercial Microwave Links (CMLs), that provide the underlying framework for data transfer between cellular network base stations have been found effective for monitoring rainfall. Wireless infrastructure of this kind is deployed widely by communication providers across Africa and can be used as a complementary monitoring device to the sparse proprietary resources that exist currently, and at minimal cost, or as a substitute tool in the many cases where alternatives do not exist. Here we focus on the potential that lies in this novel approach to acquire valuable information required for agricultural needs over the poverty-stricken countries of Africa[1].

**KEYWORDS:** Africa, agriculture, rainfall, microwave links

**PAPER ID:** CEST2019_00547

# Quantification of soil properties from hyperspectral data for sustainable agriculture using deep learning

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## ABSTRACT

The characterization of soil properties is critical for optimizing farming for sustainable agriculture. All the existing techniques for soil quantification do not take advantage of the sequential nature of Hyperspectral Data. This work focuses on proposing a Hybrid Framework that can quantitatively assess the soil properties from Hyperspectral data by extracting the essential features via Principal Component Analysis and Locality Preserving Projections. The extracted features are combined to form the Hybrid dataset which is then given as input to Long Short-Term Memory Networks, a deep learning-based framework which is typically used for sequential problems. The effectiveness of the Hybrid Framework is shown by comparing it with the existing regression models.

**KEYWORDS:** Hyperspectral data, LSTM, PCA, LPP, Nutrients.

**PAPER ID:** CEST2019_00722

# Estimation of Soil Organic Carbon for Sustainable Agriculture using Deep Learning

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## ABSTRACT

The organic carbon percentage is concomitant indicating the mineralization of nutrients and the ability of the soil to hold nutrients cations, structural stability, and water holding capacity. It is necessary to know the quantity of carbon for healthy soil and avoid the production related problems which can affect the sustainable agriculture model. In existing approaches, to quantitively calculate soil carbon, sample collection and in-situ laboratory testing are performed. In this work, a novel framework is proposed which is based on Partial Least Square Regression and Long Short-Term Memory networks to quantify soil organic carbon from the LUCAS dataset. Samples of LUCAS dataset are used as input to this framework. The samples are pre-processed by PLS to reduce their dimensions. These pre-processed samples are then passed to the LSTM, a Deep learning framework to build an efficient prediction model. The proposed framework performed more accurately, and its effectiveness is shown by comparing it with existing regression models.

**KEYWORDS:** Deep Learning, Long Short-Term Networks, Silica, Organic Carbon, Hyperspectral Data

**PAPER ID:** CEST2019_00723

# The Effect of Intercrop on Soil Properties of an Agroforestry System in Kea – Greece

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## ABSTRACT

Valonia oak is the most widespread tree species found in the Aegean island of Kea - Cyclades. It forms traditional agroforestry systems since intensive agriculture is not easily practiced in the island due to the xerothermic climate and the rough terrain with steep slopes. This system has traditionally supported the local economy by its multiple products while respecting the environment. In almost all the cases, it is found in traditional terraces which were constructed since ancient times by local farmers. Even if these systems have been threatened by abandonment and change of land use (mainly for touristic purposes), there has been an increasing interest lately motivated by the higher price gained by valonia oak acorns trade and demand for agrotouristic activities. An experimental plot was established under the framework of the AGFORWARD (FP7) research project, where two commercial pasture mixes were tested for their productive capacity under shade. Soil properties were evaluated at the end of the experiment to evaluate the effect of intercropping on the economy of certain nutrients. The importance of the environmental and economic function of this system is highlighted and suggestions are made for its preservation.

**KEYWORDS:** nitrogen, pH, nutrients, Quercus ithaburensis subsp. macrolepis

**PAPER ID:** CEST2019_00833

# Impact of nitrogen fertilization on nodulation and symbiotic efficiency of indigenous Bradyrhizobium japonicum strains

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## ABSTRACT

Nitrogen fixation is a beneficial microbial process that greatly contribute to sustainable agricultural production and environment protection. Soil bacteria, collectively named rhizobia, are characterized by their unique ability to induce the formation of root nodules in which they convert molecular nitrogen into a usable form for plants. Soybean plants require a large amount of nitrogen for their development and achievement of high seed yields. The use of high quality rhizobial inoculants strives to optimize nitrogen nutrition of soybean with minimal environmental impacts. Selection of the most suitable Bradyrhizobium japonicum strains is of great importance for successful soybean inoculation as well as optimal nitrogen fertilization. The aim of the present study was to determine the impact of fertilization with different rates of mineral nitrogen on nodulation and symbiotic efficiency of indigenous B. japonicum strains. In the vegetation pot experiment two indigenous and one reference B. japonicum strain as well as different rates of mineral nitrogen were tested. Application of increased rates of mineral nitrogen reduced number of nodules and nodule dry weight. The highest nitrogen content was determined in plants grown without any mineral nitrogen fertilization but inoculated with indigenous B. japonicum strains.

**KEYWORDS:** symbiotic nitrogen fixation, Bradyrhizobium japonicum, indigenous rhizobia, nitrogen fertilization

**PAPER ID:** CEST2019_00811

# Session 42 - Environmental planning, management and policies (1)

## *Saturday 7 September 2019 - morning*

Proceedings of the 16th International Conference on Environmental Science and Technology
Rhodes, Greece, 4-7 September 2019

# Offshore Windfarm Siting in Greece using GIS and TOPSIS

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## ABSTRACT

The deployment of offshore wind power technologies is becoming increasingly important towards the sustainable development of regions. In Greece, wind energy is provided at the time being, only by onshore plants and the interest in investigating the top choices for offshore wind applications in terms of environmental, economic, social and technical criteria is rapidly growing. The aim of this paper is to investigate the most appropriate sites for offshore windfarm siting in swallow waters (water depth ≤50m), where it is economically or/and technologically feasible to have structures resting directly on the seabed to support the turbine structure, taking advantage the existing knowledge as well as the technical experience of such applications. The proposed methodology includes two distinct stages (exclusion and evaluation) and integrates Geographical Information System (GIS) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method for solving spatial and policy planning problems. Thirteen exclusion criteria (e.g. wind velocity, distance from electricity grid, distance from residential network) and six assessment criteria (e.g. electricity energy production, distance from marine protected areas) are considered in the analysis. The results reveal five sites in swallow waters for offshore windfarm siting that could contribute to the energy interdependency of many areas.

**KEYWORDS:** offshore wind farm siting; swallow waters; GIS; TOPSIS

**PAPER ID:** CEST2019_00054

# Sustainable landscapes: restoration and land use planning in an adaptive approach to climate change and desertification. Case study of Inter-Andean Valley of Cauca River in Colombia.

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## ABSTRACT

The inter-Andean valley of Cauca River (IVCR) is one of the most industrialized regions in Colombia leading its seasonally dry tropical forest (SDTF) to a fragmented and degraded state. Changes in land cover may alter the climatic and hydrological patterns. In the period 1984 – 2014, 26% of natural areas detected remotely at IVCR have persisted in a sugarcane matrix. However, IVCR species composition and its ecological status are unknown. After reviewing several datasets, 1725 plant species were compiled. Using a modelling approach, habitat suitability was predicted with a maximum entropy algorithm implemented in Biomod2 R-Package for 14 prioritized plant species. Models were produced using as predictors, the variables selected with their Variance Inflation Factor (VIF) and for those selected with a Principal Component Analysis (PCA). Although the selected variables differed between VIF and PCA, the geographic space predicted to be suitable for the species were similar. VIF and PCA variables strongly reflect the temperature and precipitation under warm and wet periods and their seasonality. These models will help to estimate the potential restoration of SDTF at the ICVR and its vulnerability to climate change. This information will contribute to planning effectively the IVCR landscape for the future.

**KEYWORDS:** Anthropogenic landscape, Land degradation, Species distribution modelling.

**PAPER ID:** CEST2019_00223

# Risk Analysis For Gas Pipelines: a Sustainability Assessment Approach using Bow-Tie Analysis

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## ABSTRACT

Vast amounts of natural gas (NG) are consumed around the world everyday that are mainly transported and distributed through pipelines. Integrity of these pipelines is of primary interest to NG companies, consultants, governmental agencies, consumers and other stakeholder due to adverse consequences and heavy financial losses in case of system failure. Fault tree analysis (FTA) and event tree analysis (ETA) are two graphical techniques used to perform risk analysis, where FTA represents causes (likelihood) and ETA represents consequences of a failure event. 'Bow-tie' is an approach that integrates a fault tree (on the left side) and an event tree (on the right side) to represent causes, threat (hazards) and consequences in a common platform. The present study aims to help owners of transmission and distribution pipeline companies in risk management and decisionmaking to consider multi-dimensional consequences that may arise from natural gas pipeline failures.

**KEYWORDS:** Natural Gas Pipeline Failures, FTA, ETA, Bow-Tie

**PAPER ID:** CEST2019_00244

# Waste Management System and its Effects on the Water Quality of an Ecotourism Destination in Caramoan, Camarines Sur, Philippines

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## ABSTRACT

Caramoan is a municipality located in the far eastern end of Camarines Sur in the region of Bicol, Philippines. The islands of Caramoan has been the site of several editions of the international reality TV show Survivor since 2008. After being featured in the show, its popularity spread like wildfire and the volume of tourist visitors escalated. The tourism industry boosted the municipality's economy and brought income generating opportunities to its communities. Changes in the physical, environmental and social dynamics became noticeable over the years. Resorts were intensively built in shorelines, farmers shifted to tourism-related business and services and problems on waste management emerged. The worsening problem on wastes became the most challenging in one community of the municipality. This study was conducted to assess the waste management of the community and how it affects the coastal water quality. Results showed that the community and tourists gave high importance on proper waste management but the local government unit showed weak policy implementation. As an additional validation, coastal water quality tests on DO, BOD, pH, TC and TFC were done for two distinct seasons. Results showed that water is still within the standards of the Environmental Management Bureau (EMB) – DENR, Philippines.

**KEYWORDS:** Caramoan, ecotourism, waste management, water quality

**PAPER ID:** CEST2019_00229

# Fortified settlements between the Ambracian Gulf and Acherontas River in Preveza

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## ABSTRACT

The prefecture of Preveza is an area that has been an ideal place to live because there are the fields (are necessary for cultivation), the mountains (important for safe landscape), the rivers (are necessary for drinking water and watering the fields) and the sea (for trade and fishing). Such a landscape is formed between Acheron river and Louros river and their tributaries. In this article we will talk about two fortified settlements near Louros river and its tributary: the castle of Rizobouni and the Kastle of Rogon. These castles are fortified settlements of antiquity and grew again in the Byzantine era and the Ottoman period. The natural environment was an important factor for the selection of these places and their continuous habitation up to the Ottoman conquest. The aim of the article is to present the ancient remains in combination with the natural landscape, to protect the antiquities and the environment, to promote tourism development without altering the environment, looking for environmental management and policies and the environmental impacts of tourism without proper organization

**KEYWORDS:** Ambracian gulf, Castle of Rizobouni, Castle of Rogon, rivers, tourist development, environmental management.

**PAPER ID:** CEST2019_00099

# Fortified Settlements during the Ottoman Conquest in Thesprotia

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## ABSTRACT

The area of the prefecture of Thesprotia was conquered by the Ottomans before Constantinople and the final decline of Byzantium. There are fortified sites built after the Ottoman conquest in accordance with the new techniques and requirements of the era. There are also fortified places that were walled in antiquity and continued to be inhabited throughout the Ottoman period. The choice of location had, among other reasons, natural causes such as physical protection, proximity to a river and the relationship of the settlement with the surrounding area. The aim of the work is to present the Ottoman fortifications of Thesprotia (for example: the castle of Margariti, the castle of Igoumenitsa, the castle of Paramythia and the fortificated site of O(ouz)sdina in Thesprotia and their relation to the natural environment as well as the possibility of a good tourist promotion

**KEYWORDS:** Acherontas and Kalamas River, montainous landscape, fortifications - castles, Ottomans, tourist promotion.

**PAPER ID:** CEST2019_00100

# Deciphering Coastal Vulnerability Index (CVI) for the coastal areas of Rhodes Island and the possible impact on tourism

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## ABSTRACT

Rhodes Island, located in the southeastern Aegean Archipelagos. Coastal areas, extended sandy beaches, people's hospitality, and adequate infrastructure are principal factors that have increased the touristic value of the island. The estimation of the Coastal Vulnerability Index is important, since coastal environments play an important role for the tourist decision. Coastal systems are the most sensitive in environmental changes. In this study CVI is used, in order to indicate the most vulnerable areas, through the interpretation and the calculation of various parameters. The data for the calculation of the CVI were mainly geomorphological, as long as fieldwork and laboratory analysis. The data were interpreted through GIS platform. GIS environment contributes to the simultaneous processing of all these data, the representation of the spatial distribution of these parameters, and finally to depict of the most vulnerable areas. Thus, these results will contribute to the most suitable, sustainable solutions for the decision making authorities.

**KEYWORDS:** CVI, Coastal environments and tourism, Sustainable development, South Aegean Prefecture.

**PAPER ID:** CEST2019_00119

# Session 43 - Water treatment (3)

## *Saturday 7 September 2019 - morning*

# Highly efficient anti-fouling electro-conductive membranes fabricated by reduced Graphene Oxide-Polyaniline (rGOPANI) laminates

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## ABSTRACT

As an obstacle against the widespread application of membranes in larger scales, fouling via different materials could cause a severe decline in water permeation. Herein, we fabricated a novel mechanically-stable electro-conductive membrane by simple pressure-assisted laminating of reduced Graphene Oxide-Polyaniline (rGO-PANI) suspension on the commercial polyethersulfone (PES) support layers. Field emission scanning electron microscopy (FESEM) and water contact angle measurements were used to characterize rGO-PANI membranes. Using PANI improved the mechanical stability of laminated film and reduced the water contact angle, making a more hydrophilic surface. Organic fouling behaviors of newly fabricated membranes were also investigated by applying a DC voltage to membranes. The experimental results showed a significant improvement in water flux recovery when 2 V DC potential is applied on the surface of the rGO-PANI membrane.

**KEYWORDS:** Electro-conductive membrane, Reduced graphene oxide-polyaniline nanocomposite, Antifouling, Electro-oxidation, Microfiltration

**PAPER ID:** CEST2019_00660

# Improving mycoremediation of acetaminophen: Effect of pH, nitrogen limitation, and co-cultivation

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## ABSTRACT

Untreated pharmaceutical pollution and their possibly more toxic metabolites, resulting from outdated traditional wastewater treatment processes, end up in aquatic environments and are hazards to the ecosystem homeostasis. Biological wastewater remediation could supplement traditional methods and overcome the dumping of these biologically active compounds in the environment. Mycoremediation is especially promising due to the unspecific nature of fungi to decompose compounds through exoenzymes and the uptake of compounds as nutrients. In the present study, we improved on the previous advances made using the fungus Mucor hiemalis to remediate one of the most commonly occurring pharmaceuticals, acetaminophen (APAP), at higher concentration. The adjustment of pH, nitrogen limitation, and comparison with, as well as cocultivation with the white-rot fungus Phanerochaete chrysosporium were tested. Nitrogen limitation did not significantly improve the APAP remediation efficiency of M. hiemalis. Maintaining the pH of the media improved the remediation restraint of 24 h previously seen. The APAP remediation efficiency of P. chrysosporium was far superior to that of M. hiemalis and co-cultivation of the two resulted in a decreased remediation efficiency compared to P. chrysosporium in single.

**KEYWORDS:** Acetaminophen, mycoremediation, micromycetes, Mucor hiemalis, Phanerochaete chrysosporium

**PAPER ID:** CEST2019_00751

# Reduction of Halogenated Organic Compounds in Water: Comparison of Available Reduction Systems based on Cu, Pd and ZVI

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## ABSTRACT

Catalysts on the basis of copper (Cu) and the reducing agent borohydride ($BH_4^-$) have been successfully used for reduction of chlorinated aliphatics with low substitution degree which are usually resistant to zero-valent iron (ZVI) and hydrodehalogenation catalysts, such as Pd. Reactivity screening towards a broad spectrum of halogenated organic compounds (HOCs) helped to reveal the possible application areas of the Cu/$BH_4^-$ system in water treatment compared to Pd and ZVI. The HOC reactivity was found to depend on: i) the nature of the C-X bond to be cleaved, ii) the functional groups adjacent to the C-X bond and linked to it, iii) the bond dissociation energy (BDE). The use of the deactivation-stable Cu/BH4 - can be recommended as alternative reduction method to ZVI and Pd catalysts for on-site treatment of aliphatic HOCs.

**KEYWORDS:** nanoparticles, copper, borohydride, reduction technologies, halogenated organic compounds (HOCs)

**PAPER ID:** CEST2019_00809

# "LafargeHolcim's Greece (Heracles Group) journey to a Water Secure Future

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## ABSTRACT

Water is considered a precious resource globally. It is not only a source of life, but is also essential in most manufacturing processes. The demand for water is growing and the competition for its use is intensifying. Water will require more management attention in the future as it is already considered a sustainability challenge. Although the construction material industry is not a large consumer of water compared to other industries, water is an essential resource in cement operations. Managing water resources as efficiently as possible is not only a corporate social responsibility, but also is a good industry practice in today's world.

Over the last four years, LafargeHolcim has reduced its freshwater withdrawal in its cement plants by around 19 percent (73 liters) per tonne of cementitious material. With this initiative it has created water awareness in its plants and implemented improved measurement methodologies. It has reduced its freshwater withdrawal and consumption by optimizing site-level water efficiency through water recycling, rainwater harvesting and storm water management. In some communities, LafargeHolcim has achieved already a net positive water impact through greater access to water, recharging the groundwater table, protecting and promoting biodiversity, and improving agricultural practices by reducing water use.

Ambuja Cement in India is now six times water positive – an achievement that reinforces the company's commitment to water stewardship for the benefit of local communities.

Holcim Australia has significantly reduced its freshwater withdrawal and consumption by harvesting rainwater and recycling wastewater. Its aggregates operations harvests and stores rainwater in large onsite catchment areas for production use. Its Southport Concrete plant for example s now producing concrete with 100 percent recycled water, resulting in significant reduction in local water withdrawal from municipal sources.

AGET HERACLES began its journey on water issues and continues to work on improving its water efficiency, in Volos & Milaki Cement Plants, where operates a closed water recycling system which significantly drives towards better utilization of the water resources. Especially, Volos Cement plant, uses the wastewater from a neighboring beverage company for its industrial process, resulting in around 8% reduction in its freshwater withdrawal, and in LAVA pozzolan quarry, in Milos island, where operates an autonomous system for the collection and use of rainwater, in order the collected water to be used in wettings the quarry areas and in the process of quarry rehabilitation

**KEYWORDS:**

**PAPER ID:** CEST2019_00952

# Adsorption isotherm study of copper removal from aqueous solutions onto agricultural by-product.

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## ABSTRACT

Pollution by heavy metals is a serious global problem, both for the environment and for any form of life. There is a growing interest to find low cost agricultural byproducts with high adsorption capacity for the removal of heavy metals. In the present study the adsorptive capacity of chemically modified rice husk was evaluated for the removal of copper ions from aqueous solutions. Equilibrium isothermal experiments were conducted and five mathematical models were used to investigate the adsorption isotherm. The three parameters models Sips and Redlich-Peterson fitted better the experimental data. The maximum adsorption capacity of modified rice husk for copper ions was 34.38 mg/g and the maximum adsorption removal was 92.76%. Modified rice husk could be one of the low costs and effective adsorbent for copper removal from aqueous solutions.

**KEYWORDS:** Adsorption isotherm, copper, rice husk

**PAPER ID:** CEST2019_00963

CEST 2019

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*Rhodes, Greece, 4-7 September 2019*

# Thermodynamic model for a reversible desalination cycle using polyelectrolyte hydrogels

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## ABSTRACT

We propose a novel desalination scheme which employs the hydrogels as a tool to draw salt ions from a brine with low salinity to a brine with high salinity. As a driving force we use the fact that the volume of polyelectrolyte gel does depend on the surrounding salinity. While the salinity defines the gel volume in open system, i.e. in equilibrium with big aqueous solution bath, in closed system (in equilibrium with small bath) salinity is defined by the gel volume. The compression and swelling in open and closed system processes are combined into four stages thermodynamic cycle working between two bathes of different salinities. The cycle implies reversibility at any stage, so, in principle, the method can achieve the maximum thermodynamic efficiency. We have shown that for weak polyelectrolyte gels the dependence between the salinity and gel volume appears to be non-monotonic. Depending on the model parameters the surrounding salinity may increase or decrease during compression. In both cases we consider the possible use of this relation in desalination cycle.

**KEYWORDS:** desalination, polyelectrolytes, hydrogels, forward osmosis

**PAPER ID:** CEST2019_00663

# Mixed Nanostructures / PES / RO Membrane for Water Desalination

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## ABSTRACT

Different nanomaterials graphene, zinc nanorode and zinc nanosephere were used in membrane preparation. Polyethersulphone as a main polymer was blended with nano-soultions of these nanomaterials. This Support layer was coated by a composite coating layer formed of polyvinylacohol and titanium dioxide nanotubes to provide strength and enhance hydrophilicity of such membranes. M2 (using graphene) provides highest permeate flux 30.6 L/m$^2$.h due to its highest hydrophilicity, but it was lowest salt rejection 48.9% at feed concentration of 5000 ppm. M3 and M4 provide high salt rejection 99% for M4 and 89% for M3. The highest mechanical strength was found clear with M3 formulation, which gives about 8.8 N/cm$^2$ tensile strength and elongation of 20 mm.

**KEYWORDS:** RO membrane, membrane desalination, Zinc nanospheres, Zn nanorods, Polyvinyl alcohol coatings

**PAPER ID:** CEST2019_00771

# Radiation-induced degradation products of 2-methyl isoborneol and geosmin: the role of different reactive species

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## ABSTRACT

Gamma radiolysis can serve as an effective method for the degradation of organic water pollutants, due to the production of reactive species, oxidative (OH•, OOH•, O2• ⁻ ) or reductive (eaq - , H•). The application of scavengers enables the selective production of these species. Our aim was to explore the effects of the radiolytically produced reactive species, on commonly occuring water taste and odour compounds (T&O), 2-methyl isoborneol (MIB) and geosmin (GSM). Transformation products (TPs) were identified using liquid extraction followed by GC-MS/MS and confirmed with Linear Retention Indexes (LRI). The diversity and proposed structure of the TPs depend on the reactive species present in the solution. Structure elucidation of TPs revealed that reaction pathways are strongly dependent on the presence of individual reactive species. The oxidative degradation of MIB via OH• proceeds with the production of carbonyl- (camphor) and hydroxyl-containing TPs, a subsequent ring opening, arriving to linear structured products. Fewer TPs are produced upon the effect of OOH•, starting with a ring opening and addition of one hydroxyl group. The oxidative pathway of GSM via OH• occurs with an initial ring opening, formation of carboxyl-group and subsequent second ring opening. The reductive pathway is currently under study.

**KEYWORDS:** gamma-radiolysis, water treatment, taste & odour compounds, transformation products

**PAPER ID:** CEST2019_00601

# Microbiological treatment of water by cold plasma at atmospheric pressure


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## ABSTRACT

Ensuring the world's population access to drinking water is one of the millennium's challenges, for although our planet is made up of 70% of water, poor distribution and water quality are problems that concern world leaders, being among the objectives of development 2030 agenda set by the ONU. The proposed work aimed at the microbiological treatment of water through cold plasma technology at atmospheric pressure, the control to confirm the efficiency of the treatment was through the analysis of thermotolerant coliforms. The reduction was 93.33% for thermotolerant coliforms and cold plasma technology reduces the time of microbiological treatment of water by 90% over traditional methods due to high energy density, ozone generation and ultraviolet radiation, thus reducing costs because the energy expenditure was low and there is no need to add chemicals.



**KEYWORDS:** microbiological treatment; cold plasma; nonthermal plasma; E. coli inactivation; air plasma gas

**PAPER ID:** CEST2019_00840

# Feasibility of reuse filter backwash water as primary/aid coagulant in coagulation-sedimentation process for synthetic effluent

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## ABSTRACT

The purpose of this study is to evaluate the feasibility of reusing filter backwash water (FBWW) from the water treatment plant (WTP)as a substitute for the conventional coagulants (primary coagulant) in the coagulation sedimentation process applied for synthetic effluent. The coagulation effect on the elimination of the turbidity and UV254 was investigated by treating synthetic effluent using FBWW as a substitute for conventional coagulants.

**KEYWORDS:** Filter backwash water; Coagulation; Recycling; Organic matter; Synthetic effluent.

**PAPER ID:** CEST2019_00773

# Bio-Based Phosphate Functionalized Activated Carbon from Indian Gooseberry Seed Shells for the Efficient Copper (II) Adsorption

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## ABSTRACT

Preparation of an efficient activated carbon for the removal of metal pollutants is a challenging research today. The characteristic features of an efficient phosphate functionalized activated carbon, synthesized by following chemical activation process followed by subsequent functionalization from Indian gooseberry seed shells for the copper (II) adsorption are reported. Indian gooseberry seed shells based activated carbon showed the BET surface area of 1359 $m^2$ /g, the adsorption capacity of 44.84 mg/g at 30 °C and at a pH value of 9.52. The adsorption process was satisfied by the pseudo-second order kinetic model along with the Langmuir adsorption isotherm. This AC could be used as a favorable and cost effective copper (II) adsorbent in wastewater treatment to remove the metal contaminants.

**KEYWORDS:** Activated carbon, Adsorption isotherm, Kinetic model, Characterization.

**PAPER ID:** CEST2019_00908

# Session 44 - Electric and electronic waste (2)

## *Saturday 7 September 2019 - morning*

# Development and promotion of the WEEE prevention culture in Greece

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## ABSTRACT

WEEE streams challenge the goals towards a circular economy, since WEEE contain valuable and scarce resources that could be prepared for a second life or recovered. In the framework of the project LIFE REWEEE (LIFE14 ENV/GR/000858), Hellenic Recycling Agency (HRA) aims to raise awareness among stakeholders and consumers on the preference for reuse rather than consumption and recycling. A set of specifications have been prepared, applicable to the collection, storage, sorting of WEEE and to all stages of the preparing for reuse process. The specifications aim to provide an integrated legal framework in Greece and simultaneously a standard procedure for managing WEEE in order to encourage the reuse of WEEE as promoted by the Directive 2012/19/EU and the MD 23615/651/E.103/2014. Moreover, a Guide describing prevention and management practices of WEEE addressed to citizens was prepared, which provides information to the citizens concerning ways of extending appliances' life and alternative treatment ways of WEEE. Finally, Repair Events were organized for citizens who had the opportunity to repair their appliances without cost and to be introduced in an attractive way to the WEEE prevention culture. This paper presents the HRA's actions to promote reuse as well as restrictions faced and further actions.

**KEYWORDS:** WEEE, preparation for reuse, prevention, REWEEE

**PAPER ID:** CEST2019_00204

# Current state and challenges in WEEE recycling industry in Serbia


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## ABSTRACT

Waste from electrical and electronic equipment (WEEE) is defined as a special waste flow due to the fact that contains hazardous materials and should not be mixed and treat with other waste streams. In order to ensure adequate environmental protection and proper management of this waste flow, Serbia has harmonized its legislation in this field with the EU regulations. However, main objectives are still not implemented, mainly because undeveloped separate collection scheme and lack of advanced treatment technologies. Also, EPR principles are still not fully established, including issues in ensuring stabile financial support for treatment operators. In this paper, an overview of the current situation, as well as problems and challenges in the management of WEEE in Serbia, with the focus on the recycling industry, will be addressed.


**KEYWORDS:** WEEE, recycling, pre-treatment, Serbia

**PAPER ID:** CEST2019_00444

# From Refuse to Resource: E-Plastic as Building Material

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## ABSTRACT

The pursuit of the sustainable development goal of responsible consumption and production requires innovative multi-disciplinary approaches. These goals are achieved in the present work with the use of granulated plastic made from waste electronic and electrical equipment (WEEE) panels as a substitute for sand in the production of concrete mixtures. The optimal amount of plastic added, curing time, and water-cement ratio were determined experimentally. Data show that a theoretical compressive strength of 17.68 MPa was achieved using a water-cement ratio of 0.45, 6% sand replacement and 19 days curing time. While this strength is already suitable for general construction purposes, this represents a 13.54-percent deterioration compared with conventional concrete. Thus, enhancement was done with the addition of arrowroot powder as organic admixture which improved the compressive strength to a level comparable to conventional concrete. These results reveal that Eplastics are technically viable process inputs in the production of building materials and provide a sustainable strategy for responsible consumption and production.

**KEYWORDS:** E-Plastic, WEEE, RSM, arrowroot

**PAPER ID:** CEST2019_00869

# WEEE preparing for reuse in Greece: potential and initiatives

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## ABSTRACT

This paper presents one of the core deliverable reports of the LIFE-REWEEE project, the "Mapping Electrical and Electronic Equipment (EEE) reuse and WEEE preparing for reuse practices and initiatives in Greece". The main goal of this report was – for the first time in Greece – the development of a reliable and updated baseline regarding the current conditions on (W)EEE reuse and preparing for reuse in Greece (i.e. practices and initiatives). The study evolved into two parallel axes: i) Collection, assessment and analysis of data from reliable sources, and ii) Investigation of the impact of economic crisis in Greece on WEEE generation.

**KEYWORDS:** preparing for reuse, WEEE, Greece

**PAPER ID:** CEST2019_00958

# Recovery of Rare Earth Elements from Luminophores using the Red Alga Galdieria

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## ABSTRACT

The red alga Galdieria phlegrea was used as an experimental organism to test the bioaccumulation of rare earth elements (REEs) from luminophores. Algal cells were cultured mixotrophically in a liquid medium with addition of glycerol as a source of carbon. Luminophores from two different sources (fluorescence lamps and energy saving light bulbs) were added into the medium in the form of a powder. The cell number was monitored to follow the growth of the algal culture. The content of single REEs in the luminophores, and the biomass, were determined using ICP-MS. The most abundant element in both luminophores was yttrium, representing about 90% w/w. The growth of cultures grown in the presence of both luminophores was comparable with the control. The total amount of accumulated REEs in biomass differed with the type and concentration of luminophore used. The most abundant element accumulated in the biomass was lanthanum. To conclude, Galdieria phlegrea can grow in the presence of luminophores and accumulate REEs. The enriched biomass is a promising template for biotechnological applications.

**KEYWORDS:** rare earth elements; red algae; Galdieria; waste; luminophores

**PAPER ID:** CEST2019_00464

# Session 45 - Environmental health (2)

## *Saturday 7 September 2019 - morning*

# Effect of iodine containing irrigation water on plant physiological processes of bean and potato cultivated in different soils

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## ABSTRACT

Iodine deficiency in humans is a well-known environmental health problem in several regions of the world. Fruits and vegetables have been proven to be an effective way to increase iodine intake for humans by iodine enriched edible plants. In our study plant physiological processes of potato and bean plants cultivated on three different soils (sandy, silty sand, silt) applying potassium iodide containing irrigation water in concentration of 0.10 and 0.50 mg/L were investigated. After the harvest the plant parts (root, aerial parts and fruits) were dried and their mass were determined. The homogenized plant parts were mineralized by microwave-assisted acidic digestion. Iodine and essential element concentrations were measured by inductively coupled plasma mass spectrometer. In case of bean fruits the iodine addition (0.50 mg/L) resulted in considerable reduction (20-50%) of biomass, while the relative change of potato mass amounted to only -10% - +10% depending on the soil type. Results showed, that applying 0.50 mg/L iodine concentration in the irrigation water, the highest iodine concentration in edible parts of bean and potato plants were 1.6 mg/kg (silt soil) and 1.8 mg/kg (sandy soil), respectively.

**KEYWORDS:** bean, potato, iodine deficiency, nutrition

**PAPER ID:** CEST2019_00443

# An initial study of the opinions of car purchasers in Poland: do they choose electric vehicles?

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## ABSTRACT

Road transport causes one fifth of the EU's total emissions of carbon dioxide (CO2), which are especially high in cities. A suggested solution to this situation is the introduction of electric vehicles (EV). However, evidence from European countries shows that, the sales of EVs are low in comparison to other vehicles, especially without any governmental support. Our pilot study, conducted in Wrocław (Poland), shows that car purchasers in Poland are aware of the difference between pure electric and hybrid vehicles (HEVs). However, the potential for sales of EVs and HEVs still seems limited as most car purchasers buy on the second-hand market. Our study shows that consumers have a generally positive opinion about EVs. However, they see strong barriers in adopting EV as none of 52 respondents decided to buy an EV.

**KEYWORDS:** electric vehicle, hybrid electric vehicle, consumers, willingness to pay, survey

**PAPER ID:** CEST2019_00496

# Influence of the Environmental Factors on Contamination of Mediterranean Mussels (Mytilus galloprovincialis)

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## ABSTRACT

Mussel harvesting areas in Slovenia are monitored for contamination with E. coli as pollution indicator bacteria. According to contamination levels, areas are classified into A, B or C category. An A category means that there is less than 700 E. coli MPN/100 g of the shellfish flesh and intervalvular fluid. Mussels from the areas with the established A category are placed on the market directly, whereas shellfish from areas classified as B or C category undergo a depurating process. The aim of our research was to gain detailed insight into the contamination with E. coli as well as with some other microorganisms and heavy metals. We also took into account possible factors affecting the contamination of seawater and shellfish (e.g. marine currents, rainfall, tides). During a one-year period 34 samplings at three shellfish harvesting areas and one wild area were carried out (306 samples). Higher levels of contamination were observed in colder parts of the year (spring, winter) and at the time of heavy rainfalls. Correlation between E. coli number in mussels and enterococci in seawater was statistically significant. To ensure safety of the mussels it is therefore important to carry out increased number of samplings at critical periods of the year.

**KEYWORDS:** mussels, E. coli, safe food

**PAPER ID:** CEST2019_00579

# On-chip Mach-Zehnder Interferometers for rapid detection of bacteria in drinking water


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## ABSTRACT

A miniaturized optical immunosensor for the simultaneous label-free determination of bacteria in drinking water is presented. The sensor consists of an array of ten Mach-Zehnder interferometers (MZIs) integrated on silicon chip along with their corresponding broad-band light sources. The transmitted spectra of the MZIs were continuously recorded through a spectrometer. The spectral shifts caused by changes of the effective refractive index on the sensor surface due to bioreaction were converted to phase shifts through discrete Fourier transform. For the analysis, the different MZIs of the chip were biofunctionalized with the respective S. typhimiurim and E. coli membrane antigens. Then, mixtures of bacteria solutions with anti-bacteria antibodies were pumped over the chip followed by reaction with biotinylated anti-species specific antibody and streptavidin. The assays were fast (10 min), sensitive (LODs<$2X10^2$ CFU/mL), accurate (recovery 86-115%), repeatable with intra- and inter-assay CVs <5% and 8%, respectively, and the chip could be regenerated/reused for at least 20 times. Considering the low detection limits achieved in combination with the short analysis time and the small chip size, the proposed immunosensor could find wide application for bacteria detection in drinking water at the point-of-need.



**KEYWORDS:** immunosensor, bacteria, drinking water, Mach-Zehnder Interferometers

**PAPER ID:** CEST2019_00586

# Human exposure to PFCs by drinking water

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## ABSTRACT

The aim of this study was to investigate the presence and potential health risks of perfluorinated compounds (PFCs) in drinking water. An extended literature review was initially conducted to collect monitoring data of PFCs in drinking water, worldwide. In order to assess the potential risk for human health associated with the presence of PFCs in drinking water, risk assessment was based on Risk Quotient (RQ) methodology, while RQs were calculated for different life stages, applying different scenarios based on the Acceptable Daily Intake (ADI) values published in the literature. According to the results, there is a considerable number of published articles in scientific journals (31) concerning the presence of PFCs in drinking water. Their mean concentration levels ranged from less than 1 ng $L^{-1}$ up to less than 200 ng $L^{-1}$. Amongst all target compounds, perfluorooctanesulfonic acid (PFOS) seemed to pose a probable risk to human health, especially to infants and young children, indicating the need for further research.

**KEYWORDS:** perfluorinated compounds, drinking water, human health risk assessment.

**PAPER ID:** CEST2019_00295

CEST 2019

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# Biomonitoring of 21 phthalate metabolites in Slovak pre-school and school age children related to their consumer practices

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## ABSTRACT

Consumer practices are considered to be the main source of human exposure to phthalates. The aim of our study was biomonitoring of low molecular weight phthalate (LMWP) and high molecular weight phthalate (HMWP) metabolites in Slovak pre-school (n=100; age range 1-6 years) and school age children (n= 96; age range 7-15 years) and relate exposures to consumer practices. We used high performance liquid chromatography and tandem mass spectrometry for spot urine sample analysis to determine concentrations of 21 phthalate monoesters, metabolites of 11 LMWP and HMWP diesters. Median concentrations of ∑LMWP (177.32 $\mu g.L^{-1}$) were close to the ∑HMWP (169.83 $\mu g.L^{-1}$) metabolites. We observed significantly ($p \leq 0.05$) higher concentrations of 5 LMWP and 4 HMWP metabolites in school-age compared to preschool-age children. Data showed several statistically significant associations ($p \leq 0.05$) between concentrations of phthalate metabolites and the consumption of food and beverages. Interestingly, we observed for all HMWP metabolites (except mono(2-ethylhexyl) phthalate MEHP) and 1 LMWP metabolite (mono-methyl phthalate MMP) significantly lower concentrations in children who used at least 2 personal care products in comparison to non-users. Unexpected results suggest that potential routes of exposure differ from consumer practices included in our study.

**KEYWORDS:** biomonitoring, phthalates, children, consumer practices

**PAPER ID:** CEST2019_00543

# QuEChERS methodology combined with high performance liquid chromatography-UV/DAD for the determination of common pesticides in honey

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## ABSTRACT

Over the past few decades, honey products have been found to contain residues of a variety of contaminants. Among them pesticides residues resulting from treatments applied either inside beehives or in the agricultural environment have become an issue of great awareness. In this work, a modified QuEChERS (quick, easy, cheap, effective, rugged and safe) extraction method is proposed for the simultaneous quantification of amitraz, bromopropylate, coumaphos and taufluvalinate, which are the most frequently used insecticides to control varroatosis and ascospherosis in hives. Analyses were performed by high performance liquid chromatography on a C18 reversed-phase column with UV/diode array detection (HPLC-UV/DAD). An isocratic elution system was used with acetonitrilewater (80:20 v/v) containing 0,01 M acetic acid as the mobile phase while the selected compounds, amitraz, bromopropylate, coumaphos and τ-fluvalinate were detected at 249, 233, 313 and 254 nm, respectively. Overall recovery rates from honey samples ranged from 78% (bromopropylate) to 103% (amitraz), with correlation coefficients >0,99 in all cases. The proposed methodology was successfully applied to the analysis of 19 commercial honey samples.

**KEYWORDS:** Honey, QuEChERS, HPLC-UV/DAD, insecticides, residues.

**PAPER ID:** CEST2019_00528

# Environmentally friendly disinfection of air and surfaces in medicine

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## ABSTRACT

Hospitals are faced with increasingly resistant strains of microorganisms. When it comes to disinfection, individual parts of electronic equipment of angiology diagnostics such as patient couches of computer tomography (CT) and magnetic resonance imaging (MRI) scanners prove to be very hard to disinfect. Disinfectants of choice are therefore expected to possess properties such as rapid, residue-free action without any damaging effect on the sensitive electronic equipment. This paper discusses the use of the neutral electrolyzed oxidizing water (EOW) as a biocide for the disinfection of diagnostic rooms and equipment, without residues and environmental effects.

**KEYWORDS:** disinfection, electrolyzed oxidizing water, air, surface, microbial resistance

**PAPER ID:** CEST2019_00445

# Session 46 - Nanomaterials in the environmental applications and effects

## *Saturday 7 September 2019 - morning*

# Adsorption of Heavy Metals (Hexavalent Chromium, Lead, Manganese and Cadmium) on Multiwall Carbon Nanotubes

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## ABSTRACT

Nanotechnology holds great potential in the sector of water/wastewater treatment since it is considered as an advanced technology for improving water quality. Carbon nanotubes is a carbonaceous material that shows exceptional adsorption capacity for the removal of heavy metals due to their novel properties. Thus, their application for the treatment of industrial wastewater or contaminated groundwater exhibits high interest. In this study the efficiency of multiwall carbon nanotubes as adsorbent for hexavalent chromium, manganese, lead and cadmium removal as a function of pH and the initial concentration of heavy metal is investigated. In addition, the occurrence of any competitive effects amongst the aforementioned metals during adsorption is investigated. For this reason batch experiments are performed keeping constant the concentration of multiwall carbon nanotubes (2 g/L) and the contact time (5 h).

**KEYWORDS:** multi wall carbon nanotubes, adsorption, hexavalent chromium, manganese, lead, cadmium

**PAPER ID:** CEST2019_00458

# Removal of Cr(VI) under flow conditions using a green nanoiron loaded resin

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## ABSTRACT

A new nanocomposite material, consisting of nanoiron incorporated in cationic resin beads, was evaluated for the removal of Cr(VI) under flow conditions, by conducting column experiments. An aqueous solution containing Cr(VI) 5 mg/L and NaCl 0.01 M as inert electrolyte was introduced in the column applying a continuous up-flow mode. The tests were carried out using a column with diameter 2.6 cm and the flowrate was stepwise increased, reducing the Empty Bed Contact Time (EBCT) from 38 to 2.3 minutes. The reduction of Cr(VI) was found to depend on the residence time of the solution inside the bed of R-nFe, and the pH of flowing solution. The column has treated an amount of solution equivalent to 640 bed volumes without appearance of the Cr(VI) breakthrough. Also, when the feeding solution was spiked with both Cr(VI) and Ni, the effluents were free from the two elements, indicating that the nanocomposite material can be equally efficient in the case of mixed contamination.

**KEYWORDS:** nanoiron loaded resin, cation exchange resin, hexavalent chromium, column tests

**PAPER ID:** CEST2019_00565

# Aqueous synthesized mixed-phase nano-$TiO_2$ photocatalysts for water treatment of both organic and inorganic pollutants

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## ABSTRACT

Nano-sized mixed-phase titanium dioxide ($TiO_2$) particles are synthesized through aqueous hydrolytic precipitation of $TiCl_4$, in an easily-scalable continuously stirred tank reactor, CSTR. Different conditions give tunable mixed phase nanotitania particles consisting of anatase (A), rutile (R) or brookite (B) that are further characterized as photocatalysts in both oxidative and reductive roles and compared with the well-known commercial nanotitania, Evonik P25. Degradation of an organic model compound, methyl orange under UV light irradiation using the newly synthesized $TiO_2$ blends is first investigated. Further, the remediation of selenium inorganic species from simulated wastewater is tackled. Selenium (Se) is an element of environmental concern, as it may report to natural waters via industrial effluents as those released from mining and metallurgical operations among other.

**KEYWORDS:** nano$TiO_2$ precipitation, photocatalytic application, effluent treatment

**PAPER ID:** CEST2019_00772

# Interactions between Plants and Rare Earth Oxide Nanoparticles

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## ABSTRACT

Rare earth oxide nanoparticles (REO NPs) can be released into the environment from various application routes, but their effects on the ecosystem are still little known. In this study, we exposed cucumber seedlings to suspensions of $La_2O_3$ and $CeO_2$ NPs for 14 d. Phytotoxicity of the two REO NPs was assessed and their distribution and transformation in plant tissues were investigated. $CeO_2$ NPs had no toxicity to cucumber at all tested concentrations, while $La_2O_3$ NPs showed significant inhibition on root elongation, biomass, as well as induced more ROS and cell death in roots. The different distribution and speciation of Ce and in plants were determined by synchrotron-based micro X-ray fluorescence microscopy (SR-mXRF) and X-ray absorption spectroscopy (XAS). In the aerial parts, all of La was combined with phosphate or carboxylic group while only a fraction of Ce was changed to Ce(III)-carboxyl complexes, implying that $La_2O_3$ acted as its ionic form while $CeO_2$ displayed the behavior of particles or particle-ion mixtures. The higher dissolution of $La_2O_3$ than $CeO_2$ NPs might be the reason for their significant difference in phytotoxicity and transporting behaviors in cucumber plants.

**KEYWORDS:** Biotransformation, Phytotoxicity, Rare earth oxide nanoparticles

**PAPER ID:** CEST2019_00501

# Adsorption of Gatifloxacin from Aqueous Solution with Highly Stable Zr(IV)-Based Porphyrinic Metal-Organic Frameworks

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## ABSTRACT

Water stable Zr-metal–organic framework nanoparticles (PCN-224 NPs) have been solvothermally synthesized. PCN-224 NPs show spherical shape with smooth surface and particle size of approximately 200 nm. PCN-224 NPs can be stable in acid and aqueous solutions, as confirmed by powder X-ray diffraction. Gatifloxacin (GTF) adsorption measurements showed that PCN-224 NPs exhibit a high adsorption capacity of 876 mg×g-1. Meanwhile, the adsorption factors, adsorption characteristics, and mechanisms of GTF were investigated in batch adsorption experiments.

**KEYWORDS:** gatifloxacin; Zr(IV)-based porphyrinic metal-organic frameworks; adsorption

**PAPER ID:** CEST2019_00732

# One-step Synthesis of $TiO_2/ZnO$ Nanocomposites by Refluxing Methods for Photochemical Degradation of Humic Acid

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## ABSTRACT

Synthesis of $TiO_2/ZnO$ nanocomposites (TZN) through the one-step refluxing method for photochemical degradation of humic acid (HA) in aqueous solution has been studied. Titanium isopropoxide (TTIP) and $ZnSO_4$.7H2O were used as a starting material under base solution at 120 ºC for 24 hours. TZN materials were characterized by x-ray diffraction (XRD), scanning electron microscope (SEM), the thermogravimetric analysis and differential thermal analysis (TG-DTA). The characterization showed that there is a specific diffraction peak from TiO2 ($2\theta$ = 25.30) and ZnO ($2\theta$ = 36.33) as a composite with the crystal size 41.55 and 15.76 nm, respectively. The material morphology showed the granular shape of the composite and have good thermal stability. The photochemical activity was evaluated by photocatalytic degradation of HA under UV254 light. The optimum condition was found at pH 4.0, and times at 30 minutes. This study confirmed that the TZN material can decrease the HA concentration. Furthermore, the maximum result of the experiment was a 95-98% degradation of HA in aqueous solution.

**KEYWORDS:** degradation, humic acid, photochemical, $TiO_2$, ZnO

**PAPER ID:** CEST2019_00148

# Enhanced of $TiO_2$-Ag photocatalysis performance for removal of methylene blue in the presence of acetone

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## ABSTRACT

In the present study, the photocatalytic degradation of methylene blue (MB), using $TiO_2$-Ag synthesized by solgel method, as a catalyst under UV light, was studied. Tests were carried out in a batch reactor, magnetically stirred, with external irradiation using an UV-B. The effects of some parameters, such as catalyst dosage and initial acetone concentration were investigated. Results showed that the optimal catalyst concentration was 0.03 g/L, at a concentration of MB of 1.25·10-5 mol/L. The results are very promising using $TiO_2$-Ag as photocatalyst, especially in the presence of acetone as photosensitizer; the degradation degree increases from 60% for raw $TiO_2$, to 92.38% for $TiO_2$-Ag and 0.1% acetone and respectively, 97.25% for 0.2% acetone. The photocatalysis followed a pseudo-first order reaction kinetics, with rate constants ranging from 0.0009 to 0.11 min-1 under the studied conditions.

**KEYWORDS:** $TiO_2$-Ag, photocatalytic degradation, Methylene blue, acetone, kinetics

**PAPER ID:** CEST2019_00261

# Evaluation of risk and the beneficial effects of synthesized nano silver-based disinfectant on poultry mortality and health

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## ABSTRACT

This study was evaluated for the potential use of nanosilver (nAg) as a disinfectant and antimicrobial growth promoter supplement for the poultry. The experiments were conducted in the Kangsabati river basin region, in West Medinipur district, West Bengal, India for six months. Two poultry farms were adopted for the experiment. The rural economy of this region from Jhargram to Barkola is heavily dependent on contract poultry farming. The water samples were collected from the water source of poultry farm which has been used for poultry drinking purpose. The bacteriological analysis of water sample revealed that the total bacterial count (total coliform and E. coli) were higher than the acceptable standards. The bacterial loads badly affected the growth performance and health of the poultry. For disinfection, a number of chemical compounds (like formaldehyde, calcium hypochloride, sodium hypochloride, and sodium bicarbonate) have been used in typical commercial formulations. However, the effects of all these chemical compounds have not been significant over time. As a part of our research-to-market initiative, we used nanosilver (nAg) formulation as a disinfectant. The nAg formulation was synthesized by hydrothermal technique and characterized by UV-visible, TEM, SEM, and EDX. The obtained results revealed that the mortality rate of poultry was reduced due to nAg formulation compared to the mortality rate of the negative control. Moreover, the income of the farmer family was increased by 10-20% due to less mortality and better health of the poultry.

**KEYWORDS:** Farm water, nanosilver, field application, and poultry performance.

**PAPER ID:** CEST2019_00505

# Cobalt-and copper-modified fly ash nanozeolites for environmental protection systems

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## ABSTRACT

In the present study, copper- (Cu-FAZ) and cobaltmodified (Co-FAZ) fly ash zeolites (FAZ) were prepared by an incipient wetness impregnation technique, and the loading of 6 wt. % copper or cobalt in the zeolite Na-X framework was achieved. Cu-FAZ and Co-FAZ were investigated by X-ray diffraction to clarify the state of Cu and Co into the FAZ matrix, while surface studies by nitrogen adsorption/desorption technique were carried out to study the effect of modification on the FAZ surface characteristics. Modified FAZ were investigated as heterogeneous Fenton-type catalysts for oxidative degradation of organic pollutants from waters.

**KEYWORDS:** Fly ash zeolites, Modified fly ash zeolites, Fenton process, Degradation of organic pollutants

**PAPER ID:** CEST2019_00563

# Structuring efficient photocatalysts into bespoke fiber shaped systems for applied water treatment

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## ABSTRACT

In this study structured photocatalytic systems were successfully developed by a facile method. Polymeric (Alginate) molds, settled the basis in order to effectively disperse and stabilize nanoparticles of an efficient, copper augmented photocatalyst (Degussa P25), which after removal of the polymer by a pyrolytic or calcinationsintering procedure, were shaped in the form of allceramic hollow fibers (HFs) with enhanced photocatalytic and mechanical properties and excellent resistance to attrition. The structural and morphological properties have been studied using LN2 porosimetry, XRD, SEM and Raman spectroscopy. The experimental campaign for elucidating the photocatalytic performance encompassed batch experiments, where the abatement of a prototype organic pollutant (Methyl Orange) was investigated in the dark and under UV irradiation. The obtained performance was benchmarked against that of a prototype photocatalyst implemented in slurry or thin film reactors. The role and the contribution of zero-valent Cu nanoparticles in the photocatalytic mechanism, as well as of carbon residues from the pyrolytic procedure, were also examined.

**KEYWORDS:** Photocatalysis; Alginate; Titania; Batch reactor; MO degradation

**PAPER ID:** CEST2019_00627

# The influence of graphene addition on the properties of composite membranes RG/PAN and their potential application

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## ABSTRACT

PAN is an inexpensive and popular engineering polymer, which is widely used in membrane techniques: ultrafiltration (UF), nanofiltration (NF), reverse osmosis (RO) and pervaporation (PV). It is characterized by good thermal stability, high thermal conductivity, chemical resistance, solubility in many classic solvents, resistance to UV radiation and good mechanical properties. It can be easily modified both chemically and physically. The paper describes the method of obtaining composite membranes by the phase inversion method of homogeneous dispersion of graphene (RG) in a solution of polyacrylonitrile (PAN) dissolved in N, Ndimethylformamide (DMF). The influence of RG concentration on physicochemical properties, transport and separation properties (removing microplastic), and resistance to fouling of composite was investigated.

**KEYWORDS:** graphene, polyacrylonitrile, composite membranes, microplastic

**PAPER ID:** CEST2019_00645

# Evaluation of Soil Loaded with Green Iron Nanoparticles for Hexavalent Chromium Reduction

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## ABSTRACT

Chromate is a pollutant often found in groundwater and considered a serious threat for humans and ecosystem. Iron nanoparticles produced by green tea polyphenols (GT-nZVI) is a powerful reductant, appropriate for the reduction of Cr(VI) to Cr(III). GT-nZVI suspension was initially conceived ideal for direct injection in the contaminated aquifers. However, many studies demonstrated that this suspension presents very low mobility in calcareous aquifers, which are typical in Mediterrannean countries. An alternative mode of GTnZVI application is the incorporation of nanoiron in a permeable reactive barrier. This option was evaluated experimentally, assuming that the permeable barrier is filled with a calcareous soil previously loaded with nZVI. Namely an amount of soil was loaded with 0.40 mmol of nZVI per gram of soil (S-nZVI) and its efficiency for Cr(VI) removal was evaluated by conducting batch and column tests. Batch tests were carried out by mixing SnZVI with contaminated groundwater (GW) containing 1300 μg/L Cr(VI), at five doses from 5 to 50 grams of SnZVI per liter of GW. Chromate concentration dropped below detection limit within 1 day at the highest dose. Reduction kinetics was slower with the other doses but after 20 days Cr(VI) dropped below the limit of 50 ppb at all doses except the lowest. Column tests confirmed the effectiveness of S-nZVI. Chromate concentration in column's effluents remained below detection limit after the introduction of 390 pore volumes of GW.

**KEYWORDS:** hexavalent chromium, soil loaded nZVI, green nano-iron, calcareous soils.

**PAPER ID:** CEST2019_00724

# Electrochemical properties of SnO2/rGO nanocomposites

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## ABSTRACT

SnO2 nanoparticles were deposited on reduced graphene oxide (rGO) to obtain $SnO_2$/rGO composites with high energy storage capacitance. For this purpose, graphite oxide (GtO) was synthesized and hydrothermally treated in presence of Sn precursor. The quantity of GtO was varied to tune the heterostructures' composition and the particles size of the $SnO_2$. The XRD and SEM analyses revealed that the GtO was exfoliated, reduced and decorated with $SnO_2$ nanoparticles during the hydrothermal treatment. With the increase of GtO quantity the $SnO_2$ particle size decreased from ~30 nm to ~14 nm. The Cyclic Voltammetry analysis showed that the pure rGO exhibited typical supercapacitor behavior. All the SnO2/rGO composites exhibited significantly increased specific capacitance in comparison to the pure $SnO_2$. The $SnO_2$/rGO with the highest GtO content showed capacitance ~ 200 $F.g^{-1}$ that was comparable to that of the pure rGO. The result was related to the small particles size of $SnO_2$ and their distribution between the rGO sheets.

**KEYWORDS:** graphene, $SnO_2$, composites, supercapacitor

**PAPER ID:** CEST2019_00885

# Application of Ni loaded FAU zeolites in catalytic conversion of 1,2-dichloroethane towards value-added products

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## ABSTRACT

The catalytic performance of nickel loaded zeolite materials was found to be dependent on their acidic feature that influenced metal speciation and its dispersion. The selectivity to ethane and ethane of the Ni loaded catalysts increased when reducing both the number of acid sites and average nickel particle size in zeolite catalysts.

**KEYWORDS:** nickel, zeolites, 1,2-dichloroethane hydrodechlorination, IR spectroscopy

**PAPER ID:** CEST2019_00886

# $TiO_2$/Graphene Oxide Heterostructures for Photocatalytic Applications

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## ABSTRACT

In the present work, $TiO_2$/graphene oxide (GO) heterostructures with different concentrations of GO were synthesized by hydrothermal transformation of Na-titanate in basic solution. The morphology of the prepared materials was observed by X-ray diffraction analysis (XRD) and transmission electron microscopy (TEM). The transient absorption spectra of the pure $TiO_2$ and composite $TiO_2$/GO materials were collected using laser flash photolysis technique in order to assess photoinduced charge transfer kinetics. Finally, the materials were tested for photocatalytic hydrogen production under solar light irradiation.

**KEYWORDS:** graphene oxide, $TiO_2$, heterostructure, photocatalysis, $H_2$ production

**PAPER ID:** CEST2019_00899

# Photocatalytic Degradation of Tebuconazole Fungicide using Palygorskite-$TiO_2$ Nanocomposites.

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## ABSTRACT

In our study a combination of Palygorskite clay mineral with $TiO_2$ nanoparticles used for the decomposition of the common tebuconazole (TEB), C16H22ClN3O, [(RS)- 1-p-chlorophenyl-4,4-dimethyl-3-(1H-1,2,4-triazol-1- ylmethyl)-pentan-3-ol], fungicide in water. For this purpose, Palygorskite-$TiO_2$ nanocomposites fabricated using the sol-gel process combined with hydrothermal treatment of the samples under mild conditions. The Palygorskite-$TiO_2$ nanocomposites were characterized by X-Ray diffraction (XRD), scanning electron microscopy (SEM), and $N_2$ specific surface area (SSA) analysis by BET. The total pore volume and SBET was 0.49 $cm^3$ /g and 258 $m^2$ /g for the Palygorskite 40% - $TiO_2$ 60% sample. The Palygorskite 10% - $TiO_2$ 90% sample has 0.33 $cm^3$ /g and 220 $m^2$ /g pore volume and SBET respectively. The highest degradation efficiency 88.4% was achieved for Palygorskite 40% - TiO2 60% sample while commercial $TiO_2$ nanopowder Degussa P25 sample exhibited 33.0% degradation efficiency which is much lower. The Palygorskite-$TiO_2$ nanocomposites show that they are effective and promising new class of materials for the photocatalytic degradation of TEB fungicide in water.

**KEYWORDS:** Fungicides, Photocatalysis, Palygorskite, $TiO_2$, Nanocomposites

**PAPER ID:** CEST2019_00928

# Session 47 – Agroforestry, forest and agricultural sustainability (2)

## *Saturday 7 September 2019 - morning*

# The AGROF-MM ERASMUS+ Educational Project

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## ABSTRACT

Agroforestry is a traditional land use system that may represent the answer to many present and future environmental problems. However, many farmers who practice agroforestry do not identity it as agroforestry nor even accept such identification. So far, there is has not been an organized training method on agroforestry apart the Agrof MM method. The Agrof MM, "Agroforesterie – Formation - Mediterannee et Montagne", was a 3-year KA-2 ERASMUS+ educational project that aimed to i. Train between 130 and 150 agricultural professionals in Europe, ii. Improve and develop the education tools to enable agroforestry training to be sustainable, and, iii. Develop a unique agroforestry qualification program in each European country. It was coordinated by AgroSup Dijon, France. Thirteen partners from ten different countries participated in the program by contributing a wide range of knowledge, experiences and ideas. Within the framework of the Agrof MM project, European stakeholders were trained based on a general format (Core content) that differentiated based on the location. The trainings contained lectures, examples and a field trip per training. All participants were asked to fill in a questionnaire on their opinion on the trainings, their knowledge on agroforestry before and after the trainings as well as their opinion on ways to improve future trainings. These questionnaires are important assets derived from the project and should be used as a tool for policy makers to improve environmental education and decisions on environmental protection and management. As expected, the priorities of the participants differed depending on their educational level and their age. European stakeholders were satisfied by the training format and stressed the need and willingness for interaction with other farmers and experts. In concrete, most undergraduate students (L5 and L6), appreciated the trainings for it has s given them the opportunity to advance their knowledge on agroforestry. They positively commended the field trips as an opportunity to witness agroforestry in "real life" and as an opportunity to meet people that practice it (farmers and counselors) and possibly discuss with them. Being students, they valued the training tools available to them (PCs, KDB and, other in-formation), even if they would have appreciated more. Overall, they were pleased with their trainers and fellow students. Farmers comprised an important component and target group of the participants. It is noteworthy the high educational level of the farmers who participated in the trainings. They were mostly living in small cities and were quite aware of agroforestry and its advantages. Those who were practicing agroforestry were willing to continue, mostly silvopastoralism, and were looking for more in-formation and trainings on this subject. As general conclusions it can be said that the trainings fully succeed accomplishing the initial goals set by the project giving the opportunity to many and diverse stakeholders, throughout the Mediterranean Mountains and Mediterranean areas, to be informed and trained at a high competence level. As a next step it is suggested that more applied trainings can be incorporated incorporated into the core content or, at least, to create different ones depending on the knowledge level of the participants. The knowledge acquired by these trainings could be an excellent and useful component in the curricula of studies of all educational levels, adapted, of course, accordingly to each level that is addressed to.

**KEYWORDS:** education, Mediterranean, mountain, European, stakeholders

**PAPER ID:** CEST2019_00836

# Agroforestry Innovations Networks in Europe

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## ABSTRACT

Agroforestry (AF) is a climate-smart agriculture (CSA) practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or animal systems to benefit from the resulting ecological and economic interactions. It is recognized as a proactive “negative emissions technologies” (Intergovernmental Panel on Climate change (IPCC) 1.5SR) that can foster sustainability in the current changing climate conditions. However, there are knowledge gaps to be filled regarding agroforestry, as well as bottlenecks and challenges. These could be solved by providing greater access to research findings (either published or unpublished) and identifying and extending good practices that farmers are already implementing.

**KEYWORDS:** AFINET, RAIN, Stakeholders, Thematic

**PAPER ID:** CEST2019_00863

# Understory Evolution Related to Organic Fertilization in a Silvopastoral System Established under Pinus Radiata D. Don. In an Acidic Soil

**Mosquera-Losada M.R.*, Rodríguez-Rigueiro F.J., Santiago-Freijanes J.J., Rigueiro-Rodríguez A. , Ferreiro-Domínguez N.**

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## ABSTRACT

Mixed pasture establishment is considered as a key point to increase livestock production due to the higher quality it has compared with unmanaged shrubby species. They also provide a set of ecosystem services such as carbon sequestration and higher biodiversity. Moreover, herbaceous pasture establishment effectively contributes to biomass production while replacing shrubs therefore reducing forest fire risk. Two of the main factors promoting the establishment of the herbaceous pasture are sowing and fertilisation. This study evaluates the understory composition evolution of a silvopastoral system established with cocksfoot and clover in an acidic forest soil under Pinus radiata D. Don with four treatments that consist of no fertilization, fertilization with mineral fertilizers (500 kg of mineral 8:24:16) and fertilization with three doses of sewage sludge (160, 320 and 480 kg N $ha^{-1}$), in Galicia (NW Spain). Botanical composition data were analysed through species abundance diagrams in a time window of 20 years. Results showed a clear evolution in understory composition from the initial situation. Organic fertilization was found to ease sown-mixture persistence on time as well as avoiding shrub colonisation with regard to mineral and no fertilization treatments. Nutritional and sun light high-demanding species were mostly replaced in favour of autochthonous ones after sewage sludge fertilization stopped and tree canopy intercepted light that reached the understory.

**KEYWORDS:** Agroforestry, sewage sludge, biodiversity, pasture

**PAPER ID:** CEST2019_00864

# Pasture biodiversity after five years of establishment of a walnut silvopastoral system fertilized with different types of sewage sludge

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## ABSTRACT

Silvopasture is the combination of woody vegetation with forage and animal production on the same land that allows the diversification of agricultural income and productivity. In the silvopastoral systems, the fertilisation with sewage sludge could increase tree growth and pasture production at the same time that the pasture biodiversity is modified. The objective of this study was to evaluate pasture biodiversity of a walnut silvopastoral system grazed by sheep and fertilized with three types of sewage sludge (anaerobic, composted and pelletized) and with mineral fertilisation after five years of establishment. At the beginning of the experiment all plots were sown with Dactylis glomerata L., Lolium perenne L. and Trifolium repens L. Nevertheless, their presence diminished over the years probably due to the shade generated by the trees, the competence with native and less demanding species and cattle trampling. Moreover, the nitrogenous fertilisation benefited the native species such as Agrostis capillaris L., Bromus hordeaceus L. and Holcus lanatus L., which are less productive and of lower quality but more frugal and nitrophile shade-tolerant species with a higher soil seed bank compared with the sown species.

**KEYWORDS:** agroforestry, waste, grazing, sowing, water treatment plant

**PAPER ID:** CEST2019_00865

# Photosynthetic response of spring oilseed rape to heat, drought, nutrient deficiency and combined stress

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## ABSTRACT

This study aimed to determine the photosynthetic response of spring oilseed rape to heatwave (HW), drought, nutrient deficiency (N-D) and combined stress. HW and drought acted in a different manner. Under both adequate and deprived soil nutrient conditions, in the presence of adequate water supply, HW up regulated the photosynthetic performance of rape. However, drought-induced stress was highly exacerbated under HW, leading to the incomplete recovery that was additionally impaired by nutrient deficiency.

**KEYWORDS:** photosynthesis, oilseed rape, heat, drought, nutrient deficiency

**PAPER ID:** CEST2019_00612

# Effect of summer drought in the natural regeneration of valonia oak

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## ABSTRACT

This paper presents an initial attempt to investigate the effect of drought in the mortality of valonia oak (Quercus ithaburensis subsp. macrolepis) seedlings and young saplings in a silvopastoral system in western Greece. The experiment was conducted in fenced experimental plots where the number of seedlings and young samplings was measured in May and October before and after the dry summer period for the years 2015, 2016, 2017 and 2018. The results show that the number of seedlings and young saplings decreased on average by 24.7% in October attributed mainly to the effect of summer drought.

**KEYWORDS:** silvopastoral systems, regeneration, Quercus ithaburensis subsp. macrolepis, climate change

**PAPER ID:** CEST2019_00794

# Session 48 - Environmental planning, management and policies (2)

## *Saturday 7 September 2019 - morning*

# The need for setting optimal geographical and temporal boundaries for infrastructure project design and EIA, and how science and technology can help

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## ABSTRACT

All infrastructure projects generate significant effects on the environment and their surrounding communities, but to varying degrees depending on their nature, scale and context. The environmental impact assessment process, despite its title, attempts to assess the social effects of projects alongside environmental impacts. However, EIAs are often undertaken after the overall scope of the project has been settled. Strategic environmental assessment (SEA), on the other hand, is a framework for ensuring that environmental and sustainability impacts are integrated into high-level government policy, planning and programme making, and provides a systematic process that is aimed at bringing up-to-date scientific methods to environmental assessments. Major infrastructure projects lie somewhere in between, because they often have impacts at a wide range of scales, and often visit their benefits and adverse impacts unequally to different communities and other stakeholder groups. This paper examines the challenge of optimising geographical and temporal boundaries for the overall framing of infrastructure projects with the objective of minimising the significant adverse impacts and the number of people affected, and maximising the benefits to the greatest number of people. It concludes with comment on how science & technology might help support this process.

**KEYWORDS:** Infrastructure; Planning; EIA; SEA; Societal Impacts

**PAPER ID:** CEST2019_00297

# The Environmental Impact of Tourism and their Effect on Cultural Heritage

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## ABSTRACT

The natural and cultural heritage, peculiar and living cultures are great tourist attraction. The intensive and inefficient management of tourism and the association with this development can damage the nature, integrity and the dominant characteristics of these. In this way the ecological structure, cultural features and life style of the host community can also be degraded, as is the experience of the visitor in this place. The architecture of tourism in Greece is "pressed" by overexploitation and the need to offer more and more benefits and amenities. It is therefore necessary to search for and formulate a new architectural example. An architecture that will look for the "less" form, the unintentional materiality and will aim at the minimal (environmental) footprint. The purpose of this lecture is to underline that the relevant legislation for the protection of sites, buildings and residential complexes did not have the expected results. The architecture of tourism in Greece, the morphological integration of new buildings into traditional architectural ensembles, overexploitation of natural resources and the alteration of the environment lead to the distortion of the truth about the concept of authentic and truly traditional architecture. The subject approach will be made through the presentation of examples.

**KEYWORDS:** Architecture, cultural heritage, environmental protection

**PAPER ID:** CEST2019_00317

# Innovative methods of ground improvement for two problematic UK railway earthwork materials

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## ABSTRACT

The paper focuses on emerging (bio-) chemical techniques used to improve engineering properties of two problematic earthwork materials of the UK rail network to address transport earthwork infrastructure resilience in view of climate change. Studied techniques include novel cementing agents (e.g. alkali-activated cements), and/or soil cementation through calcite precipitation mediated by screened and isolated non-pathogenic indigenous bacteria, enhanced by bioaugmentation and electrokinetic treatment. The proposed treatments were evaluated based on unconfined compressive strength (UCS). For the ash, regular cement gave the best results however the feasibility of using alternative stabilisers merits further study. UCS and $CaCO_3$ measurements proved biocementation of peat for a number of treatment combinations. Electrokinetic treatment enhanced the strength of the peat. Ongoing work is carried out to optimise treatments and implementation methods towards the upscaling of the techniques.

**KEYWORDS:** Disaster risk management; Solid waste management; sustainability; innovative cements; calcite precipitation; electrokinetics; ground improvement.

**PAPER ID:** CEST2019_00336

# Strategic Spatial Planning for Green Infrastructure. The Case of the Metropolitan Area of Thessaloniki

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## ABSTRACT

Intense and varying environmental challenges have become one of the most pressuring goals that contemporary cities struggle to meet. Climate change, excessive urbanization and fragmentation of space are just some of the issues that contemporary cities are called to respond to. Thus, finding an effective approach to improve the quality of urban areas has proved crucial to cities all around the world. Green Infrastructure (GI) practices emerge as a key measure for cities that seek to increase their resilience to climate change and provide a quality place for people. Through strategic spatial planning, GI can be considered as one of the most appropriate multi-faceted approaches to reciprocate to a constantly changing urban landscape. In the metropolitan area of Thessaloniki there has been no GI planning so far. However, existing and prospective green, open and natural areas can play a catalytic role in the development of a GI network. To address this gap, the paper presents the methodology used for the development of a strategic spatial planning approach for GI in the metropolitan area of Thessaloniki.

**KEYWORDS:** Green Infrastructure, strategic spatial planning, metropolitan resilience

**PAPER ID:** CEST2019_00348

# Assessing the Ecological Footprint of Natural Science Students: A Case Study of Düzce University

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## ABSTRACT

People are consuming the nature's products and services because all people act on earth. The concept of ecological footprint is accepted as an important indicator of sustainable life issue and calculating human impact on nature. Education should be started from the relevant part of the society which are the natural science students in order to enable people to realize the negative effects they have on nature and to direct them to reduce their ecological footprints. Educators and youngsters working in the field of natural sciences, adopting sustainable living principles as a way of life, are accepted as the most effective stakeholders creating environmental awareness and understanding the importance of the subject. In this study, ecological footprints were calculated and evaluated according to the consciousness and consumption habits of Düzce University forestry faculty landscape architecture and forest engineering students. In the study, ecological footprint calculation questionnaire was used as the data collection tool. Full counting method was used in the data collection stage. A questionnaire was applied to the students. Descriptive and descriptive statistical methods were used to analyze the data. As a result of the calculations, suggestions were made to reduce ecological footprint averages and to increase environmental awareness.

**KEYWORDS:** Ecological Footprint, Environmental Impact, Sustainability, Düzce

**PAPER ID:** CEST2019_00386

# Assessment of Green Campuses for Sustainable Cities and Society with UI Green Metric: A Case Study of Düzce University

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## ABSTRACT

Sustainability is a very important issue for universities. This situation concerning with size of area that they have, number of students, academicians, administrative staff, their excessive consumption of energy and materials. Related to these conditions, Universities have big impacts on environment and nature either explicit or implicit. Certain leading universities have performed comprehensive projects to develop sustainability of the campuses. To understand and assess the efficient sustainability of campuses and universities, lots of evaluation tools have been improved. In this research, Green Metric Index has been used which was developed by Indonesia University (UI) in 2010. This model is one of the most used in the world and evaluates the sustainability of the campuses. This tool uses six main criteria: Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR) and Education (ED). Several indicators describe each of the six main categories and these define the significant issues of sustainability. In this paper with the use of observational analyses, Konuralp Campus of Düzce University has been evaluated with using Green Metric Index in terms of Sustainable Campus. In consequence of the research, positive and negative conditions in terms of Green Metrics have been determined and provided suggestions have been developed.

**KEYWORDS:** Green campus, Green metric, Ecological footprint, Düzce, Sustainability

**PAPER ID:** CEST2019_00387

# Market and Trade Network Analysis of the EU Emission Trading System

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## ABSTRACT

The European Union Emission Trading System (EU ETS) is the world's largest cap-and-trade system. The observed price instabilities and the oversupply of the allowances are two characteristics that affect the objectives and the efficiency of the policy. In this article, we investigate the impact of storing allowances, i.e. banking, in terms of the price level, transaction volume and importance in the underlying trading network. To that end, we used data from the EU Transaction Log (EUTL) until 2014 in conjunction with a variety of important price determinants. Using a sectoral analysis through the years, we observe that the regulated actors' participation increases in the transaction network, in contrast to the purely financial actors that exhibit an opposite trend. Furthermore, we quantify the relationship between banking and the carbon price by applying multiple regression on the price, considering many possible price determinants, both financial and EU ETS systemic in nature. We claim that after considering these factors, banking is a notable price determinant. Finally, we examine the network of transactions of allowances with respect to the role of financial and regulated nodes. We identify the intermediary role of financial nodes from their significance in the network structure.

**KEYWORDS:** EU ETS, trading network, Banking, EUA price

**PAPER ID:** CEST2019_00696

# Dynamic heat map as a part of the regional energy transition

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## ABSTRACT

Heat maps show the heat and cold demand of residential, commercial and industrial buildings as well as the waste heat from industry. They combine these two aspects in order to plan new heating/cooling networks. By planning the thermal energy supply in a central way, the efficiency of the energy production and the overall exergy rate are also increased. The paper will present the methods of modern web-based heat mapping with a user oriented interface in the example of Saarland region, Germany. An overview of the heat demand survey including development of building and settlement typology by clustering as a base of the heat mapping will be given.

**KEYWORDS:** Heat map, heat demand, clustering, building and settlement structure

**PAPER ID:** CEST2019_00082

# Session 49 - Water and wastewater reuse

## *Saturday 7 September 2019 - afternoon*

# Advanced approaches to treat contaminants of emerging concern for water reuse

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## ABSTRACT

Contaminants of emerging concern (CECs) are frequently detected in treated wastewater effluent, because the traditional treatment train is not designed to eliminate them. The removal of CECs by conventional activated sludge is highly variable for different compounds depending on their biodegradability. To remove the CECs from wastewater more effectively for water reuse purpose, various advanced treatment technologies are adopted, including membrane separation (i.e., microfiltration, ultrafiltration, nanofiltration, reverse osmosis, multifunctional membranes, and membrane bioreactors), adsorption (granular, powdered, and biological activated carbon), ozonation, as well as advanced oxidation processes (Fenton-like, UV-based photochemical oxidation, and photocatalytic processes). Normally, these advanced approaches are applied as part of the overall process train in wastewater treatment to significantly reduce the level of CECs and improve the quality of the effluent. In this presentation, Prof. Dionysiou will elucidate several combinations of these technologies for water reuse application. Special attention will be given to the advantages and challenges those strategies are facing.

**KEYWORDS:** Contaminants of emerging concern; water reuse; advantages and challenges

**PAPER ID:** CEST2019_00436

# Grey Water and Rain Water as Alternative Sources of Flush Water and Irrigational Water in and around Households: A Case Study from Istanbul Atakoy District

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## ABSTRACT

Grey water and rain water are two options as alternative sources to alleviate water stress/scarcity across the world. This paper aims to investigate possible use of reclaimed grey water and harvested rain water from on-site premises as sources of flush water and irrigational water in and around households in the popular settlement district Atakoy of the water-stressed Turkish megacity Istanbul. Calculations using demographic and meteorological data along with an analysis of current municipal plans reveal that the rain water potential is 544 434 and grey water potential 2 070 662 (total)/880 032 (light grey water) m 3 /year in Atakoy. This indicates that 78% of 3 347 669 m 3 /year demand for flushes and irrigation of the entire green areas of privately-owned housing complexes may be covered by rain water and grey water in the area. While the entire flush water demand may be covered by light grey water only, 79% of flush water may be supplied if rain water is used. 98% of irrigational demand may be provided using both light grey water and rain water. The results show that considerable water savings may be achieved through the use of grey water/rain water which will aid sustainability.

**KEYWORDS:** Grey water / rain water as alternative water sources, flush water, irrigation, sustainability.

**PAPER ID:** CEST2019_00801

# Technical Optimization of a Treatment Process on Abe Effluent by Membrane Technologies

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## ABSTRACT

In the last decades, the interest in biofuel production is sensibly growing as a good source of sustainable energy and a valid alternative to fossil ones. One of the most promising biofuel is butanol and might be produced by starting from different substrates, such as second generation ones, that have the advantage to be in the future more cost effective, as soon as the relevant production processes will be fully developed and optimized. In this case, the entering lignocellulosic material undergoes biological digestion up to a mixture mainly of acetone, butanol and ethanol, respectively. The digestion product, called ABE, requires the separation of almost pure butanol from the other components, in order to qualify as a biofuel. A possibility to perform this separation is by fractioned distillation, which has the advantage to be operated with ease, but leads to very high operating costs. In this work, the separation of n-butanol from ABE was performed by means of membrane technology in four subsequent steps: ultrafiltration (UF), pervaporation (PV), nanofiltration (NF) and a last step of demixing once the n-butanol concentration reaches values within the miscibility gap. The study focused on the productivity, selectivity and longevity of the adopted membranes; in particular, it was observed by experimental campaign that membrane fouling must be strongly inhibited to achieve technical and economic feasibility of the overall proposed process.

**KEYWORDS:** ABE wastewater, biofuel, butanol, membranes, fouling

**PAPER ID:** CEST2019_00355

# Water microbiota in a recirculating aquaculture system for environmental sustainability and fish welfare

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## ABSTRACT

Recirculating aquaculture systems (RAS) are a promising technology of fish production to reduce aquaculture environmental impact. Water recirculation relies on the stability of physical, chemical and biological processes to increase biosecurity. Although, disruptions in RAS systems can cause fish disease outbreaks by opportunistic pathogenic bacteria with an economic impact. The aim of this study was to characterize the water microbiota across the different sectors of a flatfish (Solea senegalensis) RAS unit, and understand its relation with the water quality parameters. Analysis was focused on the beneficial microbial community for a better environmental sustainability, but also on the opportunistic agents that threaten the fish welfare. Water samples were collected from four sectors at different filtration stages. For microbial diversity, DNA was extracted from the water samples, sequenced by Illumina MiSeq® and sequences output analyzed by SilvaNGS. Results show that Proteobacteria and Bacteroidetes were the most abundant phyla, and potential pathogenic bacteria were detected. They also indicate that salinity shifts can affect the structure of the bacterial community.

**KEYWORDS:** RAS, microbial community, physicochemical parameters.

**PAPER ID:** CEST2019_00633

# Water reuse integration in the holistic water cycle

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## ABSTRACT

Wastewater reclamation and reuse (WRR) is an emerging water generation tool for combating water stress. The objective of this paper is to develop a conceptual approach which will pave the way to WRR sustainable integration in a multi-resources regional or local system. For that purpose, a holistic Water Cycle Concept has been developed. The water cycle is divided into two partly overlapping circles: (a) Potable production circle, consisting of natural surface and ground water, desalinated water and rainwater, and (b) Recycled water circle, mainly for irrigation, industrial uses and streams rehabilitation. Greywater and direct potable use are developing options. The resulting water quality encounters are being analyzed, e.g. excess boron and magnesium deficiency in effluents originated from domestic desalinated water use are both detrimental to crops, lack of magnesium also endangers soil stability and food nutrition value. Innovative technologies for complementing the holistic approach have been developed, e.g. minerals recovery from seawater and brine, electrochemical and natural processes hybridization for nutrients and hormones removal and biofilms prevention by nanoparticles injection. In conclusion, holistic water cycle approach enables management of water quality challenges and directs innovative solutions that protect food resources and eliminate long term threats to public health.

**KEYWORDS:** Water reuse; water cycle; water treatment; desalination; innovation

**PAPER ID:** CEST2019_00657

# Greening walls for treatment and reuse of domestic greywater

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## ABSTRACT

In this study, we describe a sustainable system for treatment and reuse of grey wastewater in urban areas through vertical green walls constructed on unused surfaces of buildings. The system integrates the benefits linked to the introduction of green spaces in urban areas with the advantages connected with the reuse of purified greywater (non-potable reuse) and the reduction of potable water use, allowing a sustainable use of water resources. We constructed a vertical green wall composed of modular panels with 12 vegetated pots per panel. The green wall was irrigated with synthetic greywater, and the removal efficiency was monitored weekly with regards to different parameters (e.g., $BOD_5$, COD, nitrogen, phosphorus). The results showed good results in terms of treatment performances, indicating the suitability of the green wall for treatment of greywater.

**KEYWORDS:** domestic wastewater, green walls, greywater treatment, nature-based solutions, sustainable water management

**PAPER ID:** CEST2019_00318

# Membrane technology for the purification of solutions containing cationic surfactant

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## ABSTRACT

The objective of the study was to evaluate the effectiveness of cationic surfactant (Tequat LC90i, TEAQ) removal from aqueous solutions with the use of tubular ceramic ultrafiltration and microfiltration modules. Research included an assessment of the feed solution parameters (surfactant concentration, presence of electrolyte) and process conditions (transmembrane pressure and linear velocity) on the transport and separation properties of the membranes. It was found that pressure-driven membrane processes enable cationic surfactants solutions purification – TEAQ retention coefficients exceeded 80%.

**KEYWORDS:** esterquat, quaternary ammonium compound, ceramic membranes, fabric softener

**PAPER ID:** CEST2019_00226

# Recovery and separation of valuable metals (copper and zinc) from acidic mine waters by ion-exchange resins

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## ABSTRACT

Mining wastewaters, containing heavy metals such as copper (Cu) and zinc (Zn), have a huge impact on the environment due to they are not biodegradable and tend to bioaccumulate in plants or living organisms. Therefore, in this work the performance of ion-exchange and solvent-impregnated resins were compared for the separation and recovery of valuable metals (Cu, Zn) from acidic mine waters (AMW). Lewatit 207 as an ion exchange resin, and an impregnated resin containing Di2-ethylhexylphosphate, named Lewatit 1026, were evaluated for extract both metal ions. Additionally, the metal extraction was determined as a function of pH (from 1 to 5) when an AMW was used to carry out the experiments. Batch experiments results showed that best extraction of Zn was obtained using Lewatit 1026 being around 96% (pH=2.5-3); whereas Lewatit 207 performance was optimum for Cu extraction (about 99%) at pH=3-4. Moreover, using a fixed-bed configuration column, it was possible to separate and concentrate Zn (10 times) and Cu (40 times) by using Lewatit 1026 and 207, respectively. Overall, the application of an ion exchange process showed a great potential in the recovery of valuable metals from mine waters to promote a circular economy scheme in the metallurgical industries.

**KEYWORDS:** Mining wastewaters; metal recovery; ion exchange process

**PAPER ID:** CEST2019_00320

# Recovery of sulphuric acid and valuable metals (Zn, Cu and REE) from acidic mine waters using nanofiltration

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## ABSTRACT

Acidic mine waters (AMWs) contains moderate concentrations of sulphuric acid, relatively high concentrations of metals (Al, Fe, Cu and Zn) and minor amounts or rare earth elements (REE). The established management routes for AMW treatment include a neutralization-precipitation step, which implies a high cost due to the reagents consumption. Nanofiltration (NF) membranes are emerging as an alternative to conventional methods to treat AMW due to a good passage of mono-charged ions (e.g. hydrogen sulphate, proton) for further recovery of sulphuric acid and high rejection of multi-charged ions, such as transition metals and REE. The behavior of one typical NF membrane (NF270, poly(piperazinamide)) was tested in a cross-flow experimental set-up with model solutions at pH 1.0. Moreover, experimental results were modelled according to Solution-Electro-Diffusion Model coupled with reactive transport to characterize the transport of species across the membrane, by means of the membrane permeances. Finally, the performance of NF270 working at batch mode was predicted with the obtained membrane permeances.

**KEYWORDS:** Acidic mine waters, rare earth elements, nanofiltration, NF270, membrane permeances

**PAPER ID:** CEST2019_00321

# Installation of a Sewer Mining Unit in the Athens Urban Tree Nursery

**Plevri A.[1,*], Samios S.[1], Lytras E.[1], Papadopoulos K.[1], Lioumis C.[2], Lazari A.[2], Tazes N.[2], Monokrousou K.[3], Makropoulos C.[3]**

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## ABSTRACT

Within the framework of the Horizon 2020, a European project called NextGen evaluates and champions transformational circular economy solutions and systems around resource use in the water sector. The Athens demo site is located in the Athens Urban Tree Nursery which is part of the Goudi Park, an area in the process of redevelopment and regeneration to become the key metropolitan park of the capital. The innovations that are being implemented within the project are the installation of a sewer mining modular unit for urban green irrigation at the point of demand with a capacity of 25m3 /d. Additionally, compost-based eco-engineered growing media products will be reused as an onsite fertilizer, as part of a portfolio of autonomous, decentralized water, energy and materials circular solutions for cities in water scarce area. This paper involves information about the way the sewer mining will be implemented and also information about the wastewater treatment, the compost that will be produced and the energy balance of the whole system.

**KEYWORDS:** sewer mining; wastewater reuse; circular economy;

**PAPER ID:** CEST2019_00760

# Mine water management in abandoned mine sites: from waste to resource

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## ABSTRACT

Text Mine water usually supposes one of the most important environmental problems of the extractive industry, where water quality is dependent of a great number of factors relatives to the ore deposit characteristics and to the exploitation method typology. But if water quality by nature or after convenient treatments stays inside the acceptable limits, according to the legislative quality standards, mine waters could be used for different uses. Then, new studies on the framework of the circular economy paradigm have led to found new possibilities for mine water, which in some cases can be considered as a potential water resource, generating new economic activities in the mining regions.

**KEYWORDS:** Mine water, water quality, water resource, circular economy

**PAPER ID:** CEST2019_00792

# Session 50 - Air pollution

## *Saturday 7 September 2019 - afternoon*

# The Influence of Methane Emission and Hard Coal Production on Air Quality and Greenhouse Effect in 1994-2017 in the Upper Silesian Coal Basin (Poland)

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## ABSTRACT

The Upper Silesian Coal Basin (USCB) is the largest coal basin in Poland and one of the largest in Europe. It is the most industrialized region in Poland. The main natural resource and energy raw material is hard coal which was produced by 65 mines in the early nineties. The USCB geology is very diverse and not homogeneous. Coal deposits situated in the central, southern and western regions are mostly covered by impermeable Miocene deposits which helped methane ($CH_4$) to accumulate in the past. Methane is one of the most dangerous natural hazard in Polish underground mining because it is explosive gas. $CH_4$ is also the second strongest greenhouse gas after the carbon dioxide, but its radiative power is 21-25 times stronger than the radiative power of $CO_2$. Polish coal mines releases 568.9 million m3 (average) of $CH_4$ yearly and it provides to greenhouse effect increasing. From one year to another, the Upper Silesian coal mines are going to extract hard coal from deeper seams when the methane content is much higher. To keep workers safe, $CH_4$ need to be captured and released to the open air atmosphere or used to power and heat production.

**KEYWORDS:** hard coal production, methane emission, greenhouse effect, air pollution

**PAPER ID:** CEST2019_00211

# Statistical Prediction Models for the Odour Quantificaton in Terms of Odour Concentration: Analysis and Comparison

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## ABSTRACT

Measuring odour concentration is a significant step to achieve efficient environmental odour management in continuous, objective and repeatable manner. To deal with this, researchers developed instrumental odour monitoring systems (IOMS) by applying odour monitoring models (OMM) for prediction. At present, limited data are available in the literature regarding the exploration of different prediction models to quantify the odour emissions in terms of odour concentration. This study presents and compares different types of parametric and nonparametric predictive models (i.e., artificial neural network (ANN), multivariate adaptive regression splines (MARSpline), partial least squares (PLS), multiple linear regression (MLR), response surface regression (RSR)) with the aim to increase the reliability of the odour concentration prediction by using IOMS for environmental odour monitoring. The experimental studies are carried out considering odour samples collected from the organic fractions in municipal solid waste. All samples undergone seed OA eNose and dynamic olfactometry analysis as reference methods. The coefficient of determination (R2 ) and root mean square error (RMSE) were used to measure the goodness-of-fit of the models. Results indicate the strengths and weaknesses of the analyzed models and highlight their accuracy in terms of odour concentration prediction.

**KEYWORDS:** artificial neural network, dynamic olfactometry, environmental odour, instrumental odour monitoring system, municipal solid waste

**PAPER ID:** CEST2019_00391

# Advanced Instrumental Odour Monitoring System for the Continuous Management and Control of Environmental Odour in Complex Industrial Plants

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## ABSTRACT

Odour emissions from complex industrial plants may cause potential impacts on the surrounding areas and, as consequence, complaints with the local residents. The identification of specific odour control plan is therefore needed in the plant management. The current challenge is the definition of Instrumental Odour Monitoring Systems (IOMSs) that allow the continuous odour characterization. No regulation or standardized procedure exist at present. Limited data are available in the literature with reference to the characteristics and operational procedure of this systems for the environmental odours monitoring. The study presents a novel prototype of intelligent and integrated IOMS for the continuous classification and quantification of the odours emitted in ambient air by complex industrial plants, with the scope to control the plants emissions in an objective and continuous manner, thus avoiding odour impact. The architecture and the principal components of the IOMS are highlighted. The operational procedures are presented and discussed. Results highlights the importance and the flexibility of the proposed IOMS in the odour monitoring. Real-time and accurate information are provided by the system about the source and concentration of the odour emissions.

**KEYWORDS:** environmental odour, odour classification, petroleum refinery, training, validation procedure.

**PAPER ID:** CEST2019_00394

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# Impact of traffic management strategies on air quality and health in a Portuguese urban area

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## ABSTRACT

This paper aims to assess the air quality improvement and resulting health implications in a Portuguese urban area, by testing traffic management scenarios focused on nitrogen dioxide ($NO_2$) emission reduction. To that end, an integrated multiscale modelling system was developed and applied for a typical traffic-activity day using dynamical downscaling to the street level. At this finer scale, the tested scenarios contributed to a reduction of the daily maximum $NO_2$ concentration and health benefits, though the LEZ effect is more felt within its influence area.

**KEYWORDS:** Urban NO2 pollution; Traffic management scenarios; Microscale modelling; Health benefits.

**PAPER ID:** CEST2019_00438

# Odorous gases monitoring on industrial sites and algae decomposition using Cairsens smart sensors

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## ABSTRACT

The appearance of natural odors sources (Sargassum beaching events) or odors generated by the human activity (industrial sites) represent a major challenge for municipalities. Combined with intolerance of nuisances by residents, and/or tourists, it forces municipalities and industrial players to manage and control diffused emissions of odors in a more stringent and efficient way. Hydrogen sulphide ($H_2S$) and ammonia ($NH_3$) have been identified as the main odorous nuisance sources, they also have high adverse effects on health, and therefore they must be monitored and controlled. Real-time and continuous monitoring of both $H_2S$ and $NH_3$ emissions near industrial sites using advanced micro-sensors, based on amperometric detection, has been carried out in this study. Compared to reference and standardized analyzers, providing precise measurements at a single place, micro-sensors are an effective and cheaper solution that can be easily deployed on large areas. This paper presents the monitoring of odorous gases emitted by algae putrefaction, fertilizers and waste treatment plants across Atlantic coast by Cairnet stations network combined with the Caircloud software monitoring platform. The results show the contribution of micro-sensors network in order to improve the management of odorous gas emissions from industrial or natural sources.

**KEYWORDS:** Sargassum odors, emissions monitoring, micro-sensors, Cairnet Mini-Station, Caircloud software

**PAPER ID:** CEST2019_00608

# Daily wind gusts in relation to mean daily wind speed and atmospheric circulation

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## ABSTRACT

An important aspect in the design of wind farms and consequently in wind power production, is the sensitivity of wind turbines to wind gusts. This study aims at estimating the probability of occurrence of daily wind gusts for different atmospheric circulation regimes. The analysis is performed for a 31-year period (1979-2009) for the Hellinikon station in Athens, Greece. The proposed methodology estimates wind gust speed values from the mean daily wind speed observations for a given atmospheric circulation pattern. The large-scale atmospheric circulation classification is based on a two-stage clustering approach, using Self-Organizing Maps as a clustering methodology. The classification is based on the Sea Level Pressure, the geopotential at 500hPa, the zonal and meridional wind components at 10m and at 850hPa, the specific humidity at 700hPa and the air and dew-point temperature at 2m. Following the gust factor method, different statistical models are trained for each of the eight identified atmospheric modes. The results demonstrate the suitability of associating wind gusts and mean wind speeds. The adopted gust factor method provides accurate estimates of daily wind gust speeds and that the atmospheric circulation enhances the precision of the statistical models.

**KEYWORDS:** wind gusts, wind speed, atmospheric circulation

**PAPER ID:** CEST2019_00611

# Co-creating data based on human nose perceptions to study odour nuisance from an oilseed industry

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## ABSTRACT

Odour nuisance is the second environmental problem with more citizen complaints after noise. This fact and the lack of odour regulation in Portugal led way to develop a bottom-up approach focused on citizens to co-create the analysis. Despite the existence of odour measuring instruments, the human nose is a universal sensor with high sensitivity that allows to assess the impact of discomfort on human receptors. A sensorial method was conducted in a community neighbor of an oilseed industry that cause impact on their daily life because of the "cereal/flours/feeds" odour (based on citizens' complaints, industry type, exploratory survey). Two monitoring campaigns were conducted with the help of a group of citizens forming an observers panel (OP) whose function was to record odour observations. A road circuit was outlined by the technical team also to register odour observations but essentially to verify the OP registers. For both cases a meteorological analysis was conducted with a weather station. Results showed that the "cereal/flours/feeds" kind of odour was registered by the OP 150 times during a six month period. The intensity level, although week, was several times perceived when the meteorological conditions were week wind and wind blowing from the northwest which led the plume towards the population.

**KEYWORDS:** Odour nuisance; odour assessment; sensorial methodology; bottom-up approach.

**PAPER ID:** CEST2019_00651

# Ultrafine and nanoparticles emissions from clinical waste incineration: characterization and chemical speciation.

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## ABSTRACT

Present paper reports the main results of an extended field scale investigation of UFP and nanoparticle size fractions emitted from a clinical waste incineration facility. Measurements were conducted at stack emissions with an electric low-pressure impactor counting system for the evaluation of total particle number concentrations and size distributions in the range 7 nm - 10 µm. Sampled fractions were also evaluated for their content of trace metals of concern (As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn), analyzed in terms of total concentrations and size distributions within fine, ultrafine and nanoparticle fractions. Results obtained are reported and analyzed for total concentrations and size distributions observed, with measurements also discussed in comparative terms, in order to figure out the investigated activities in perspective within the general issue of UFP emissions from other types of sources.

**KEYWORDS:** emissions, ultrafine particles, incineration, hospital waste, trace toxics.

**PAPER ID:** CEST2019_00677

# Influence of Varying Concentration of Toluene in a Soil Biofilter

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## ABSTRACT

Contaminant concentrations and their variability affect rate of removal of air contaminant in biofiltration. In this study with toluene as the air contaminant, extent of degradation rate at varying concentrations (from 50 to 700 ppm) in terms of elimination capacity (EC) was measured using a soil biofilter run for 215 days. It appears that no inhibition or oxygen limitation was observed at 700 ppm as EC went higher at this concentration reaching 58 g $m^{-3}$ $hr^{-1}$. Results show that at low toluene concentrations in the gas stream, toluene was degraded faster than it could diffuse into the biofilm while at high toluene concentrations, the whole biofilm was fully penetrated and there was no increase in EC due to biological activity limitation. Oxygen limitation may influence removal rates even if oxygen is not completely depleted in the biofilm with biofilm thickness as another factor in oxygen limitation. There was growth in the biofilm but it did not produce a biofilm thick enough to give rise to oxygen limitation. Though toluene inhibition and/or oxygen limitation could eventually become influencing factors, biofiltration may be used as an air pollution control technology at varying contaminant concentration.

**KEYWORDS:** biofiltration, toluene, concentration, soil

**PAPER ID:** CEST2019_00686

# The effect of Boundary Layer Meteorology in GHGs concentrations –The case study over 3 European cities using an aerial platform

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## ABSTRACT

In the frame of an EC Horizon 2020 project named "ICARUS" (Integrated Climate forcing and Air pollution reduction in Urban Systems), a newly constructed N.A.S.A Awarded light aircraft equipped with high-tech scientific instrumentation was used to perform an aerial mapping over Athens, Thessaloniki and Ljubljana greater Area. The main goal of the current study was to evaluate the effect of atmospheric boundary layer (ABL) on Green House Gases (GHGs) concentrations over three different areas of the cities. Detailed meteorological information were provided by aircraft instrumentation, radiosonde data as well as regional modelling results available from the Atmospheric Modelling group of University of Athens. The estimation of the mixing height of the ABL was based on the synoptic scale atmospheric circulation and the prevailing background wind. It was generally found that the mixing height variation following the prevailing meteorological conditions results in different concentration profiles in the lower troposphere over the examined regions.

**KEYWORDS:** GHG, boundary layer meteorology, mixing height

**PAPER ID:** CEST2019_00688

# Moss-specific accumulation of atmospheric element deposition?

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## ABSTRACT

This article presents statistical analyses of elements concentrations in mosses which were collected in 1990, 1995, 2000, 2005 and 2015 throughout Germany at 592, 1026, 1028, 726 and 400 sites, respectively, and chemically analysed according to harmonised methods throughout Europe. The evaluations intended to examine whether the element concentrations are specific to moss species and whether conversion factors should be used. Such observations and recommendations have so far been limited to spatially confined areas with relatively few moss samples and were derived from studies without methodological harmonisation. The data collected 1990-2015 across Germany was analysed by percentile statistics. The samplings from 2015 were additionally evaluated by bivariate correlation analyses and multivariate techniques to identify and rank the statistical relevance of site-specific and regional characteristics for the concentrations of 12 heavy metals and nitrogen in mosses. The strongest predictor for Cd, Cu, Ni, Pb, Zn and N concentrations was the sampled moss species. In 2015, the atmospheric deposition showed a lower predictive power compared to earlier campaigns. However, the present study does not refute the hypothesis of moss species-specific element concentrations which are in the range of local and metrological variance. It is therefore advisable to continue dispensing with conversion factors.

**Keywords**. Conversion factors; heavy metals; Random Forest Regression; Multiple Linear Regression; Commonality Analysis.

**PAPER ID:** CEST2019_00955

# Biomass burning tracers in urban and rural particles in Silesia - Poland

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## ABSTRACT

The major tracers are thermal degradation products from the biopolymer cellulose, namely the didehydromonosaccharide derivatives levoglucosan (LG), galactosan (GA) and mannosan (MN) and the resin acid derivative dehydroabietic acid, with minor β-sitosterol. The relative proportions of levoglucosan to mannosan (LG/MN) have been used for source reconstruction of combustion derived byproducts in atmospheric aerosols. Major tracers eg. levoglucosan, galactosan and mannosan were measured at two sites in Silesia region and health resort (Krynica) during winter season 2017/2018. Levoglucosan, mannosan and galactosan were quantified using a validated gas chromatography mass spectrometry (GC/MS) method described in detail by [Klejnowski et al, 2017]. The obtained results showed that mean concentrations of the total tracers determined in air in winter season were 522.6 ng/m$^3$ for Zabrze sampling point, 465.2 ng/m3 in the case Rokitno and 156.75ng/m$^3$ for Krynica. Levoglucosan was most abundant tracer of biomass burning, it was 83.2 % of determined tracers in Zabrze, 78.1 % in Rokitno and 88.9 % in case of Krynica.

**KEYWORDS:** biomass burning, tracers, winter season

**PAPER ID:** CEST2019_00184

# Statistical modeling of meteorological conditions and air pollution over Athens, Greece

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## ABSTRACT

The importance of meteorological parameters and topography in determining the air pollution levels in a specific area is well established. The aim of this study is to model the association between air pollution levels and meteorological parameters for a single site in Athens, Greece. The statistical analysis is based on the Multiple Linear Regression (MLR) models for simulating the relationship amongst primary and secondary pollutants (CO, NO, $NO_2$, $O_3$ and $SO_2$) and air temperature, wind speed, relative humidity and atmospheric boundary layer (ABL) depth. The meteorological variables are used as explanatory variables for training different statistical models for each pollutant. The analysis is performed for a twentyyear period (1990-2009) at 00Z and 12Z. Special emphasis is given to the most accurate representation of the ABL depth by using three different methods (i.e. Holzworth, virtual Richardson number and potential temperature gradient). The modeling results indicate the superior performance in the case where the ABL depth was calculated by the virtual Richardson number method. The results indicate the importance of meteorology in air quality along with the significance of other factors that increase air pollution variability in urban environments.

**KEYWORDS:** air pollution, meteorology, multiple linear regression

**PAPER ID:** CEST2019_00613

# Remote sensing measurements and investigation of the ABL temperature profile over large and broad mountain basin


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## ABSTRACT

Continuous Atmospheric Boundary Layer (ABL) temperature profile measurements are of particular interest in a variety of applications and studies, including air pollution and pollutants dispersion, agricultural meteorology, aeronautical meteorology, mesoscale meteorology, weather forecasting, climate studies, energy applications. Several methods have developed and are applied for these measurements, being both direct (in situ) by using sensors located on tower structures, balloon-borne instrumentation, until aircraft techniques and indirect or remote sensing techniques. The latest mainly involve transmitted acoustic, radio, or light energy, and the detection of the scattered energy due to atmospheric targets. Passive techniques involve the measurement of radiation naturally emitted from the atmosphere, for example, as in microwave and infrared radiometry. In this work, the technique of passive microwave radiometry for the measurement of the temperature profile in ABL is described and some measurements are presented and analyzed. These measurements carried out in the industrial area of Western Macedonia, a large and broad mountain basin in NW Greece, by using the MTP-5 system. MTP-5 is a remote sensing instrument that measures microwave radiation emitted from the lower 1000 m of the atmosphere, within the Planetary Boundary Layer. The measurements of the temperature profile during two typical cases (hot and cold season) are analyzed and the ABL development are being investigated. Finally, some concluding remarks are provided.



**KEYWORDS:** Atmospheric Boundary Layer, temperature profile, passive microwave radiometry

**PAPER ID:** CEST2019_00850

# Monitoring of bio-aerosols, gaseous and Particulate Matter (PM) pollution of Wawel Royal Castle in Krakow, Poland.

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## ABSTRACT

Krakow is now firmly established as one of the Europe's top tourist destinations and, at the same time, it is one of the cities with the worst air quality in Europe. The Wawel Royal Castle is of the most important museum and predominating visited attraction of the city of Krakow (in 2017, the Castle was visited by over 1.4 million tourists). Taking this into account, and in accordance with the guidelines of European Standards, the Wawel Royal Castle has been implemented the Integrated Pest Management (IPM) for protection of cultural heritage (CSN EN 16790:2016). As a part of the preventive conservation strategy, the monitoring of Indoor Air Pollution (IAP)has been carried out in addition to the standard control of climate parameters.Air samples were collected in rooms with various intensity of tourist traffic including: State Rooms, Royal Private Apartments, as well as warehouses and conservation workrooms. The highest concentrations of PM, selected chemical compounds and microorganismsin the air were observedin the first halls at the entrance to Castle and in some conservation workshops.

**KEYWORDS:** cultural heritage, particulate matter pollution, microbiological contamination, air pollution, preventive conservation

**PAPER ID:** CEST2019_00887

# Session 51 - Environmental health (3)

## *Saturday 7 September 2019 - afternoon*

# Potential Links between Precipitation and Anthrax Outbreak at North-West Siberia

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## ABSTRACT

West Siberia is a region subject to fast warming and unstable precipitation regime. In 2016, the most devastating anthrax outbreak in seventy years occurred in the northern part of the region. A working hypothesis suggests that permafrost thawing led to an exposure of old infected carcasses. We performed a thorough analysis of climatic factors in the region. Our analysis of soil temperature observations from the last 20 years indeed reveals rapid permafrost thawing near outbreak localization starting from 2010. We further analyzed meteorological observations to estimate the effect of warming and precipitation on permafrost. We showed that permafrost thawing was significantly accelerated during two consequent years with anomalously thick snow cover. Furthermore, spread of the disease was possibly intensified by an extremely dry summer. Precipitation in June-July 2016 did not exceed 10% of the climatological normals in the region. We conclude that epidemiological situation concerning anthrax remains highly unstable in the region due to the drastic decrease in summer precipitation and potential winter precipitation extremes.

**KEYWORDS:** anthrax, permafrost, snow, precipitation, CALM

**PAPER ID:** CEST2019_00826

# Flame Retardants (Polybrominated Diphenyl Ethers, Pbdes) and Organophoshates, Opfrs) in Dust from Canadian Fire Stations

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## ABSTRACT

Dust is a good medium to assess indoor exposures to many persistent organics, including flame retardants. With concerns regarding persistence, bioaccumulation and toxicity of many flame retardants, a series of bans and regulations have created shifts in their usage. For firefighters, exposures to flame retardants on and off duty is a high concern. In 2018 we measured flame retardants in Canadian fire station dust and compared our findings with those of our 2015 US fire stations study. We used isotope dilution HRMS for PBDEs and GC-MS/MS for OPFRs. The same flame retardants were present in all stations with high within- and between-station variability. The most prominent among PBDEs was BDE-209, followed by BDE-99. TDCIPP and TPhP were the dominant OPFRs. Overall, data from 2015 (US) and 2018 (Canada) show that OPFRs have surpassed PBDEs in fire station dust, probably reflecting shifts in flame retardant use in consumer products and building materials.

**KEYWORDS:** flame retardants, PBDEs, OPFRs, fire stations, dust

**PAPER ID:** CEST2019_00871

# Bottled Water Microbiological Quality in Estonia

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## ABSTRACT

Nowadays people often prefer to buy bottled water instead of drinking the tap water. Stores are full of different bottled waters and studies have demonstrated that people tend to consider the bottled water to have high quality (Ward et al 2009, Akpinar et al 2014). The aim of this research was to find out the compliance of bottled water sold in Estonia with the established microbiological normatives. The study included bottled drinking water available in retail stores. A total of 63 bottles of water from 21 different sale items were analyzed. These 21 items included also carbonized waters and flavoured waters. All different waters (21 bottles) were analysed for coliforms, E. coli, Enterococcus sp and Pseudomonas aeruginosa (filtration method, cfu/250 mL), and all 63 bottles were analysed for total bacterial count at 22 °C and 37 °C (pour-plate technique, cfu/1mL). No coliforms, E. coli, Enterococcus sp nor P. aeruginosa were detected in the analyzed waters. Several deviations were noted for total microbial count: 14 bottles out of 63 had bacteria level higher than the established normatives allow, thus 22.22% of bottles were microbiologically contaminated. Study results suggest that carbonization of bottled water has an inhibitory effect on the total bacterial count; sweetened waters richer in bacterial nutrients did not show higher bacterial counts. Experiments of storage conditions showed that only waters with initially low microbial counts can be stored for longer time, in bottles with initially high microbial counts have risk for increase in time.

**KEYWORDS:** bottled water, microbiological quality

**PAPER ID:** CEST2019_00570

# Experimental approach for metabolic disorders as a tool to investigate impact of environment on human health

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## ABSTRACT

The epidemics of obesity and diabetes have occurred contemporaneously with increasing use and exposure to environmental endocrine disrupting chemicals. Metabolic disorders affect male reproductive potential due to low sperm count and quality, reduced sperm motility and suppression of testosterone production. In this respect our study aimed to evaluate testiscular cell populations and steroidogenic function in tandem with expression of cellular marker tACE (testiscular angiotensin converting enzyme) for germ cell development in experimental conditions of diabetes mellitus (DM) induced on day 1 (neonatally, NDM) or on day 10 (prepubertally, PDM) in rats; short and long high-fat diet (HFD) induced obesity in rats since puberty. Our data indicate that metabolic disorders (DM and HFD) affected macro-parameters (decreased gonado-somatic index, increased fat accumulation). Long-term obesity negatively influenced Leydig cell number and testosterone production. Expression of tACE in postmeiotic germ cells showed that prepubertal DM but not neonatal DM caused delay in the first spermatogenesis associated with suppressed Leydig cell development and steroidogenesis in adulthood. Our data indicate that metabolic syndrom involving obesity and diabetes exerts negative impact on male reproductive development and function and therefore environmental aspects of endocrine disorders should be considered as a risk factor for male reproductive health.

**KEYWORDS:** Reproductive health, Endocrine disruptors, Metabolic disorders, Obesity, Diabetes Mellitus

**PAPER ID:** CEST2019_00571

# Emissions of Volatile Organic Compounds from Flex Printing Facility

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## ABSTRACT

The present study was undertaken to investigate, the level of volatile organic compounds (VOCs) in working zone of flex printing facility in Novi Sad, Serbia. The levels of VOCs were determined at four sampling positions: at the machine; at a distance of 3 m from the machine; at the outlet of machine, at the entrance of the digester and at the exit of the digester. The quantitative determination of VOCs compounds was performed using portable Voc Pro Photovac. VOCs concentrations varied within the 8h-sampling period and differed between sampling positions. The highest concentration was measured at the outlet of machine, entrance in digester, while the lowest at a distance of 3 m from the machine. The obtained levels of VOCs exceed the levels advised by OSHA and NIOSH standards. Therefore, this paper provides propositions on improving the process of flexographic printing, and therefore, human health.

**KEYWORDS:** flex printing, VOCs, occupational safety and health

**PAPER ID:** CEST2019_00919

# Session 52 - Biowaste

## *Saturday 7 September 2019 - afternoon*

# Hydrothermal Pretreatment Optimization for Enhanced Anaerobic Digestion of Willow Sawdust

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## ABSTRACT

In this study, hydrothermal pretreatment in combination with HCl, at a chemical loading of 2 g /100 g TS was carried out as a pretreatment method to enhance anaerobic digestion of willow sawdust. Regarding hydrothermal pretreatment, various temperatures (130.5- 230ºC) and process times (15.5 -60 min) were studied, using a Central Composite Design so as to optimize pretreatment conditions and the methane potential.

**KEYWORDS:** willow sawdust, methane production, hydrotherrmal pretreatment

**PAPER ID:** CEST2019_00470

# Organic Solid Waste Mechanical Pretreatment for the Optimization of Anaerobic Digestion Processes

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## ABSTRACT

Anaerobic digestion has been recognized as the most demanding process for the valorization of organic solid waste towards the generation of valuable intermediates, that can be converted into a methane rich-gas to meet the current needs for renewable energy. In this regard, press-extrusion has raised as a promising mechanical pretreatment to enhance methane production by increasing the organic loading rate to the digester as well as by adequately mixing the liquid and the solid fractions from this pretreatment. This study aimed at verifying the significance of both the organic loading rate and the mixing ratio between the liquid and solid fraction from press-extrusion by using a factorial design of experiment. Results were discussed and statistically elaborated to identify the operating conditions to be further tested for the optimization of the integrated process.

**KEYWORDS:** biological process; hydrolysis; organic load; press-extrusion.

**PAPER ID:** CEST2019_00129

# Biogas production from sunflower residues: effect of pretreatment

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## ABSTRACT

Sunflower residues are a prominent substrate of renewable source for biogas production during anaerobic digestion (AD). However, due to its recalcitrant structure, pretreatment is necessary to increase its biodegradability. The objective of the present work was to evaluate the effect of the NaOH pretreatment on the methane production from sunflower residues. The residues were separated into stalks and heads after seed removal. It was observed that pretreatment caused an increase in the biochemical methane potential (BMP) during batch tests, but a decrease was recorded during continuous experiments.

**KEYWORDS:** anaerobic digestion; lignocellulosic biomass;; NaOH pretreatment;

**PAPER ID:** CEST2019_00145

# Valorisation of ovine cheese whey through PHA production

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## ABSTRACT

In the present study, PHA production from ovine cheese whey (oCW) through a 3-step process (dark fermentation, biomass selection and PHA accumulation process) was investigated. Different operating pHs were adopted during the fermentation step and no external nutrients were supplied at any step of the process. Results showed that the production of PHA from oCW is a promising valorisation approach.

**KEYWORDS:** ovine cheese whey; PHA; mixed microbial cultures

**PAPER ID:** CEST2019_00714

# Sewage Sludge Agricultural Use

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## ABSTRACT

Sewage sludge use in agriculture is promoted by the European Union since the normative of cleaning waters related to the compulsory use of depuration plants in all cities over 2000 inhabitants was finally implemented in 2005. The University of Santiago de Compostela (USC) has been conducted long-term experiment research about the application of different sewage sludge doses in silvopastoral systems. Main results shown that sewage sludge can be successfully used as fertilizer for both tree and pasture development, with reduced toxicity for animals when plant production is considered in both very acidic and acidic-neutral soils. This paper provides an overview of the main findings in acidic soils of the long-term results after application of sewage sludge in soils.

**KEYWORDS:** fertilization, inorganic, lime, tree growth, silvopasture

**PAPER ID:** CEST2019_00913

# Expansion of the 3T method for the assessment of various Energy-from-Waste technologies

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## ABSTRACT

The term "energy from waste" refers to technologies that utilize waste streams for energy production. However, for the energy production by means of thermal treatment of non-hazardous waste it is usually the term "waste-to-energy" that is commonly used. The Waste Framework Directive 2008/98/EU separates the waste management strategies into Recovery Operations and Disposal Operations (ANNEXES I and II respectively). Waste-to-energy technologies that use waste as fuel for energy generation are considered Recovery Operations, i.e. R 1. When the scope is the destruction/ reduction of the waste before landfilling, the waste-to-energy technologies are considered Disposal Operations, i.e. D 10. This issue has been of high importance because each waste-to-energy facility can potentially fall into both categories according to the assessment tool that sets the bar. In order to address this issue European Commission integrated the R1 formula in the second revision of the Waste Framework Directive of 2008 and improved it in the Directive 2015/1127/EU that entered into force from July 31st, 2016. It should be stated for the record that the R1 formula has been a very helpful tool for assessing waste-to-energy plants and has set the general framework. The problems with the use of the R1 formula start from the fact the formula is not thermodynamically consistent since it is self-proclaimed to be more a "utilization efficiency" formula rather than a pure energy efficiency. In addition, modern technologies that treat thermally municipal solid waste are polygeneration facilities because they produce several output streams. Such typical cases are the waste gasification facilities that produce several streams in addition to CHP production like char or sometimes even reformed fuels like methanol. Also, waste-to-energy facilities are effectively metal recovery units. These parameters are not taken into consideration by the R1 formula. Vakalis et al. addressed this issue by introducing the 3T method which calculates the overall efficiency of waste-to-energy plants by taking into consideration also the quality of the produced materials except for the CHP production. Thus, different waste-to-energy technologies, like combustion or gasification, can now be directly compared. On a second level, the 3T method aims to set a common framework for waste management strategies. A first possible step can be the assessment of other facilities like biorefineries and compare them with waste-to-energy plants. The application of the method becomes very interesting for the case of gasification or pyrolysis plants where the R1 formula is not able to take into consideration of the final products except the CHP, like char or bio-oil.

**KEYWORDS:** Waste-to-Energy, Energy Efficiency, Thermodynamics, Policy, Polygeneration

**PAPER ID:** CEST2019_00966

# Biosolids as soil-amendment: evaluation of nutrient leaching in loamy-silty soil

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## ABSTRACT

Sewage sludge (SS) is a by-product of wastewater treatment. Anaerobic digestion is a worldwide technology used in SS stabilization and pre-treatment step is used to improve its biodegradability. Once SS is stabilized they are named biosolids (BS). Biosolids composition makes them attractive as a soil amendment. But also, BS could be a source of contamination. Therefore, the objective of this study was to evaluate the nutrient leaching in loamysilty soil of BS stabilized with conventional and advanced anaerobic digestion. Thus, two biosolids from conventional and advanced anaerobic digestion were evaluated in soil leaching columns using loamy-silty soil to evaluated phosphorus and nitrogen flux. The results show that the leaching rate of nutrients is not influenced by the pre-treatment, but the application rate of biosolids influences the leaching rate of nutrients.

**KEYWORDS:** pre-treatment, advanced anaerobic digestion, waste management, sewage sludge

**PAPER ID:** CEST2019_00493

# Session 53 - Lakes, rivers, estuaries and ecosystem health

## *Saturday 7 September 2019 - afternoon*

# Evaluation of Water Quality of Kosynthos River in North Greece, using Water Quality Indices

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## ABSTRACT

The water quality of Kosynthos river, located in Xanthi Prefecture, Northern Greece, was evaluated using Water Quality Indices (WQIs). A water quantity and quality monitoring program was undertaken from December 2016 to November 2017 on a weekly basis at three stations along the main course of Kosynthos river. Discharge, temperature (T), dissolved oxygen (DO), pH and electrical conductivity (EC) were measured in situ. Moreover, water samples were collected and analyzed for the determination of biochemical oxygen demand (BOD5), chemical oxygen demand (COD), total suspended solids (TSS), total phosphorus (TP), and ammonium nitrogen ($NH_4$-N), according to the standard methods. Anions (i.e., $SO_4^{-2}$ , $Cl^-$), $NO_3$-N, $NO_2$-N, and cations (i.e., $Na^+$ , $K^+$ , $Mg^{+2}$, $Ca^{+2}$) were determined using ion chromatography. The applied WQIs were the Canadian (CCME) WQI, the Oregon WQI, the National Sanitation Foundation (NSF) WQI and the Prati's Index of Pollution. According to the CCME, NSF and Prati's WQIs the water quality of Kosynthos river for both monitoring periods (e.g., 1998-1999 and 2016-2017) was classified in the higher quality classes, while according to the Oregon WQI it was classified in the lowest quality class.

**KEYWORDS:** Water quality index, surface water bodies, water pollution

**PAPER ID:** CEST2019_00135

# Managing the Risk of Cyanobacteria through Water Quality Characteristics Analysis: a Case Study of two Warm Mediterranean Reservoirs

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## ABSTRACT

This study correlated the trophic condition of two Mediterranean water bodies with different typology with their water quality characteristics. The two studied cases included Polemidia Dam, a reservoir enriched with tertiary treated wastewater in Cyprus and Lake Karla, a re-established reservoir in Greece. The aim was to identify the key environmental variables driving cyanobacteria blooming and their cyanotoxicity and therefore to address effective management tools for each case. Monitoring data collected from both sites were analyzed using mathematical models (linear regression models) and statistical tools (Principal Component Analysis) in order to first correlate the water quality characteristics with the eutrophic state of the dam and to find which component mostly explains the variation in our dataset. As expected, temperature is not a limiting factor for bloom formation for both waterbodies. Among the variables tested, phosphorus (P) was found to be the key element for the growth of cyano-HABs in Lake Karla, while a significant reduction in the TP concentration of the recycled water used to enrich Polemidia reservoir following year 2010 altered the trends of cyano-HABs formation and their characteristics. It is anticipated that the outcomes of this study will assist in identifying the most challenging issues related to cyano-HABs in warm reservoirs in the near future conditions.

**KEYWORDS:** eutrophication, cyanobacteria, PCA, multiple linear regression, cyanotoxins

**PAPER ID:** CEST2019_00315

# Greenhouse Gas Emissions from Natural and Artificial Lakes in Western Macedonia, Greece

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## ABSTRACT

Formation of artificial lakes is a common practice for hydroelectric power generation. Hydroelectricity is considered to be a green and renewable energy source in terms of factory operation. However, hydroelectricity generation may have environmental impact arisen from greenhouse gas (GHG) emissions induced by biomass degradation within water reservoir. Depending on area (rocks, cultivation fields, etc) flooded, an artificial lake may emit significant amounts of GHG, especially in the first years of its formation. In this study, the GHGs emission and water quality of two artificial lakes (Polyfytos and Ilarionas formatted in 1974 and 2012 respectively) and of one natural lake (Zazari) in the area of Western Macedonia were measured and evaluated. Results show that the old Polyfytos lake is stabilized and emits low amounts of $CO_2$ (maximum flux 568 mg/m$^2$ /day) and zero $CH_4$.The fresh Ilarionas lake and the natural lake emit higher amounts of $CH_4$ (maximum fluxes 19 and 2200 mg/m$^2$ /day respectively). The $CO_2$ emissions depend strongly on time of year and chlorophyll concentration in water (indicator of photosynthetic activity) and even negative fluxes were found in Ilarionas and Zazari (-395 and -732 mg/m$^2$ /day respectively). A simple model is used to correlate and predict future GHG emissions by the lakes.

**KEYWORDS:** Hydroelectricity, Artificial lake, Greenhouse Gases, Water quality

**PAPER ID:** CEST2019_00769

# Prediction of Algal Bloom Occurrence in Laguna Lake, Philippines using Artificial Neural Networks (ANN)

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## ABSTRACT

Algal blooms pertain to an undesirable formation of unicellular freely-floating algal scum caused by the rapid growth of phytoplankton, which can become a hazard for the water body ecosystem. Laguna Lake serves as both a source of livelihood and water supply for the residents in the region and the risk of algal blooms should be detected for safe and efficient management. The research presents a method for predicting the amount of phytoplankton to alert the monitoring agencies of incidences of high phytoplankton as a scalable and inexpensive earlywarning tool. The study focuses on the development of a prediction model based on water quality parameters measured by the Laguna Lake Development Authority (LLDA) from 2008 to 2018: nitrate, orthophosphate, water temperature, turbidity, chlorophyll-a, and phytoplankton counts. The system predicts the phytoplankton counts of the next month using three months of previous values of the water quality parameters, modeled through the multilayer perceptron neural network method. The research uses a walk-forward validation method to obtain the root-mean-square-error (RMSE) of the model. The model was used on three stations and these predicted values that had statistically less RMSE than the ordinary least square regression.

**KEYWORDS:** algal blooms, phytoplankton counts, artificial neural networks, Laguna de Bay, water quality prediction

**PAPER ID:** CEST2019_00927

# Improved LC/LU maps and flood models through crowdsourced information

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## ABSTRACT

Flood risk prediction has been traditionally based on models that are developed from time-series of data collected over long periods of time from expensive and hard to maintain in situ sensors available only in specific areas. SCENT is a H2020 project which provides an integrated toolbox of smart collaborative and innovating technologies that augment costly in situ infrastructure, enabling citizens to become the 'eyes' of the policy makers by monitoring LC/LU changes in their everyday activities and related environmental phenomena like floods by crowdsourcing relevant information. Policy makers and relevant stakeholders are able to set-up citizen science campaigns in areas where specific environmental information is needed. These data may include images that are processed through an intelligent engine and classified based on a LC/LU taxonomy, sensor measurements with low-cost portable environmental sensor or river measurements. The crowdsourced LC/LU information is used to created improved and more detailed maps of the area of interest where taxonomy elements such as river banks are identified and categorized base on their coverage, such as low grass and stone. The produced LC/LU maps along with the sensor and river measurements are used to create flood models, used by public authorities and stakeholders to better understand the area of interest, its needs and the steps needed to support its sustainability.

**KEYWORDS:** LC/LU maps, citizen science, flood models

**PAPER ID:** CEST2019_00330

Proceedings of the 16th International Conference on Environmental Science and Technology
Rhodes, Greece, 4-7 September 2019

# The DPSIR Framework for Integrating the Ecosystem Services in River Nestos Lagoons-Greece

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## ABSTRACT

It is well documented that conservation and management of water resources are directly related to the sustainable living, i.e. to social, economic and environmental aspects. There has been much effort by the European research community to provide tools to support the implementation of freshwater sustainability and management policy instruments. In this context the DPSIR model was used as an analytical framework for determining pressures and impacts under the WFD as it is considered as an effective tool for both society and policy makers concerning water resources management. There is also an increasing interest about the importance of key ecosystem services in maintaining of human well being sustaining also water related services. Thus, there is much political and scientific drive to embrace the "Ecosystem Services" (ES) based approach. Based on the linking of these processes we present an integration of the DPSIR model with the ES concept using as case-study the River Nestos lagoons (Greece). According to the DPSIR approach the major driving forces leading to pressures were the agriculture, the irrigation, the unrestrained livestock, the industry and the urban wastewater. We outline the main changes in the State and in the Ecosystem Services which are essential to support sustainability. Our results show that integrating pressure analysis with Ecosystem Services we provide a useful tool for implementing management policies.

**KEYWORDS:** DPSIR, Ecosystem Services, Nestos lagoons

**PAPER ID:** CEST2019_00382

CEST 2019

*Proceedings of the 16th International Conference on Environmental Science and Technology*
*Rhodes, Greece, 4-7 September 2019*

# Assessment of water quality of Asopos River in central Greece using multivariate analysis

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## ABSTRACT

The main objective of this study was to assess the quality of water from five monitoring stations in Asopos River (central Greece), and evaluate the main factors that affect water quality. Fifty one biochemical parameters measured both in situ and in the laboratory three times a year for two consecutive years. Multivariate analysis of Hierarchical cluster analysis and Principal component analysis were used to interpret water quality characteristics. Cluster analysis grouped the samples in two main clusters (classes) corresponding to different main activities which affect water quality characteristics. The first cluster includes the two sampling stations located near the industrial areas and the second one the three stations located in areas affected by agricultural activities. Principal Component Analysis identified two factors which explain 84,5% of the variability of the original mean data set. The first factor explaining 50,5 % of the whole data variability related mainly to “chemical quality parameters”, while the second factor explaining 34% of total data variability related mainly to “biological quality parameters”. This study showed that multivariate statistical techniques proved effective in river water quality classification based on large and complex water quality data sets.

**KEYWORDS:** water quality, industrial pollution, agricultural practices, multivariate analysis

**PAPER ID:** CEST2019_00349

# The effect of alkaline activated reservoir sediments used as a binder in concrete on its compressive strength

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## ABSTRACT

Sediment as the product of erosion processes is found in every water body and reduces the storage capacity and the lifetime of water reservoirs. The quantity of sediment which affects downstream areas and also their quality complicate sediment management. Dredged sediments are on the borderline of soils, water and waste. The favourite dredged material management options are natural options. Beneficial re-use is a way to encourage the use of dredged material as a potential resource and not as a waste. Sediments are regarded as a suitable raw material in construction industry. This paper is focused on the study of the effect of sodium hydroxide as a pozzolanic activator of sediments from Ruzin reservoir (Slovakia) used as a binder in concrete on the compressive strength of hardened concrete. Reservoir sediments are mechanochemically and chemically activated with the addition of solid sodium hydroxide into milling process. Hardened mixtures containing 40% of binder replacement by activated sediments were tested for compressive strengths after 28, 90 and 365 days of curing. The results show that sodium hydroxide is not an effective pozzolanic activator for sediments.

**KEYWORDS:** Sodium hydroxide, sediment, compressive strength, pozzolanic activator

**PAPER ID:** CEST2019_00553

# Session 54 - Environmental planning, management and policies (3)

## *Saturday 7 September 2019 - afternoon*

# Onshore wind farm siting and energy carrying capacity in the municipality of Aristotle in Chalkidiki – Greece

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## ABSTRACT

Wind power is one of the most environmentally friendly Renewable Energy Sources, as well as one of the rapidly growing and economically viable forms of renewable energy. Today's wind turbines can be considered as a mature and cost-effective technology with reasonable efficiency rates and high reliability. The aim of this paper is to identify the appropriate areas for onshore wind farm siting, considering the restrictions imposed by the national (Greek) institutional framework for wind farm siting (Special Framework for Spatial Planning and Sustainable Development for renewable energy sources / SFSPSD-RES) as well as several exclusion criteria found in the international literature. Wind velocity, slope, distances from specific areas (e.g. protected areas, settlements, monasteries, surface waters, mines) as well as from specific infrastructures (e.g. road network, electricity grid, antennas) are considered as exclusion criteria used in defining sustainable sites for wind farm deployment. The proposed methodology is applied in the Municipality of Aristotle in Chalkidiki – Greece and the main tool used in the analysis is Geographic Information System. The ownership status as well as the energy carrying capacity of the selected sites are further investigated.

**KEYWORDS:** onshore wind farm siting, Geographic Information System, energy carrying capacity, Municipality of Aristotle

**PAPER ID:** CEST2019_00697

# The Adoption of Key Performance (KPIs) to Increase the Implementation of EMAS

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## ABSTRACT

EMAS (Eco-Management and Audit Scheme) is European Voluntary environmental management tool designed to support organizations to improve their environmental performance. Under the BRAVER (LIFE15 ENV/IT/000509 which is co funded from the EU), an effort to identify, develop and testing of effective measures for better regulation has been done. In the field testing of the "better regulation" proposals were assessment regarding their feasibility and their cost effective for both organizations and institutions / authorities. A total number of 35 proposed measures were tested, which most of them concerned economic and financial relief, public procurement, reduced inspections and funding support. Six of them already successfully adopted in the legislative framework of participating EU Member States, especially at regional level. Specifically, 4 measures adopted in Spain (2 in Catalonia; 2 in the Basque Country), 2 in Italy (Emilia – Romagna Region), 1 in Slovenia (national level) and 1 in Cyprus. Regardless the regulatory relief measures and incentives for EMAS organizations which have been adopted in the legislative framework, it's also very important to determine the key performance indicator that an organization must set to monitor and control in order to achieve their goals. Key performance indicators define a set of values against which to measure and based on which evaluate the success of an organization or of a particular activity in which it engages.

**KEYWORDS:** EMAS, regulatory relief, key performance indicators, BRAVER

**PAPER ID:** CEST2019_00700

# Site selection of hybrid solar/wind renewable energy systems: A case study from Andros, Greece

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## ABSTRACT

The combination of two or more forms of Renewable Energy Sources at the same spatial scale is a highly promising sector, resulting in an increase in the number of installations of hybrid RES systems. In Greece, where abundant resources such as wind and sun are available, the combination of these two renewable forms of energy can contribute to reducing dependence on conventional energy resources, as in hybrid power systems the weakness of a source is offset by the forces of the other. The purpose of this paper is the development of a methodology for selecting suitable sites for the installation of Hybrid Wind and Solar Energy Systems (HWSES) using Geographic Information Systems (GIS). The implementation focuses on the island of Andros, Greece, and the proposed methodology includes the exclusion of areas defined by the Greek legislation and the international experience for both forms of energy. The site selection corresponds to a multi-dimensional process, which includes multiple criteria such as wind speed, solar radiation, distance from settlements, technical infrastructure, environmental and cultural interest and slope. Finally, the areas occupied by wind and solar farms in different licensing stages are excluded from the areas that are available for HWSES siting.

**KEYWORDS:** site selection, Hybrid Wind and Solar Energy Systems, Geographical Information Systems, exclusion criteria, Andros

**PAPER ID:** CEST2019_00735

# Can Cell-Phone Tower Signals Help Fight Malaria in Africa?

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## ABSTRACT

Malaria is one of the major causes of mortality in the world today. Sub-Saharan African countries suffer most acutely from outbreaks of the disease and some 90% of cases of death (hundreds of thousands of people each year) occur in this region. High intensity rainfall is a central parameter leading to severe outbreaks of the disease, which typically lag the rain event by several weeks. However, current rainfall monitoring tools deployed in Africa do not provide sufficient response due to very limited spread in the continent. During the last dozen years, the ability to monitor rain using microwave communication networks has been demonstrated. However, the tens of research papers published thus far have shown the contribution of the method mainly for hydro-meteorological needs. This note points to the potential of microwave communication networks for providing rainfall information critically required to predict malaria outbreaks and to support planning of preventive measures.

**KEYWORDS:** Malaria, Africa, Rainfall, Commercial microwave links

**PAPER ID:** CEST2019_00758

# Maritime Spatial Planning (MSP) in Greece: lessons learnt from the case of the Inner Ionian Sea – Corinthian Gulf

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## ABSTRACT

The marine area of the Inner Ionian Sea and the Corinthian Gulf was studied in terms of MSP in the framework of the SUPREME EU project, which was undertaken by the Ministry for the Environment and Energy, with the collaboration of NTUA, UTh and NKUA. Key task of the project was all countries participating in the project (Italy, Greece, Croatia, Slovenia) to perform analysis and maritime spatial planning at the national level. The lessons learnt from this project, and especially from the study of the Inner Ionian Sea-Corinthian Gulf, showed that, in order to perform efficient MSP, Greece should advance: the engagement of the maritime regime and stakeholders in governance schemes, the wise managment of the geo-spatial data, the consideration of the transboundary nature of the sea and of the land-sea interactions.

**KEYWORDS:** Maritime Spatial Planning, SUPREME project, place-based approach, Greece

**PAPER ID:** CEST2019_00954

# An Ignition Probability Index for the Early Detection of Wildfires in the Eastern Mediterranean Region

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## ABSTRACT

Wildfires continue to form a major disturbance factor in Mediterranean ecosystems, often associated with significant loss of properties and human lives. Fast detection and suppression within the first minutes after ignition constitute one of the pillars for successful wildfire management and prevention of its catastrophic consequences. The current study aims to develop a Fire Ignition Probability Index (IPI) which will be integrated in an automatic fire detection system composed by optical and thermal land cameras and UAV. The IPI index will be calculated based on the pyric history, the anthropogenic influence and the simulated fire behavior in a study areas in Southern Greece. The pyric history will be represented by point data and through a Kernel Density Estimation will calculate a risk factor. The anthropogenic influence will be estimated based on an inverse relationship with the Euclidean distance from roads and settlements. Finally, fire behavior will be calculated using fire simulation models and data on fuel properties, estimated using state of the art remote sensing methods and field data. The integration of the IPI in the automatic fire detection system is expected to form a significant contribution to its improved accuracy.

**KEYWORDS:** Forest Fires, Ignition Probability Index, Remote Sensing, Fire Detection.

**PAPER ID:** CEST2019_00187

# The contribution of the cadaster to the protection of urban forests. The case study of Seich Sou.

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## ABSTRACT

This paper studies the way in which modern land-forest map design contributes to the protection of urban forests generally and the Seich Sou urban forest of Thessaloniki in particular. We also examine the role of cadastre and forest maps in protecting urban forests from abuses such as pressure for housing, which are particularly acute due to their proximity to urban centers. Particular emphasis is given to the Seich Sou urban forest, which provides important protection from erosion and pollution to the city of Thessaloniki. Thessaloniki is characterized by a low proportion of green areas per inhabitant and a high pollution burden. The history of the forest, its ownership status, its legal framework of protection, the problems it faces, as well as the role of the cadastre and forest maps in their resolution are presented. Finally, we conclude by proposing ways of strengthening the protective framework governing Seich Sou, as well as the urban forests of the country in general. The rational management of urban forests via the development of good forest policy with tools such as cadastre and forest maps can be the key to protecting urban forests effectively and exploiting their multiple benefits in perpetuity.

**KEYWORDS:** land register, forest maps, urban forests, Seich Sou, protection

**PAPER ID:** CEST2019_00602

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*Rhodes, Greece, 4-7 September 2019*

# Quantifying the impact of volunteerism in the framework of waste management strategies in Cyprus

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## ABSTRACT

Waste Management strategies as a result of the production and consumption line (not cycle) are on the top of the global challenges, within the framework of the seventeen United Nations (UN) Sustainable Development Goals (SDGs). Based on the World Bank projections, the global waste generation levels have been increasing in a steady rate from 1.3 billion tonnes per year in 2012, to 2.2 billion tonnes per year by 2025. This represents a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per person of which

**PAPER ID:** CEST2019_00703

# Ofire+: A Pioneer Solution on Wildfire Incident Planning and Response for Enhancing the Resilience of Individual Infrastructures

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## ABSTRACT

*Ofire+* is a commercial human-centralized early warning system which aims in supporting managers on making informed decisions about proper management of human and material resources and the available response time towards threats from sub-urban wildland fires. The system consists of an administrator application as well as a user mobile application providing a direct communication channel between the two. The impact of the system is that it bridges the gap between informed decisions and coordinated actions by incorporating scientific and timely operational data which are transformed into critical information. *Ofire+* aligns with current EU priorities and can help in reducing societies' vulnerability and strengthening resilience, mitigating negative effects on economic activities, rationalizing insurance risk-based premiums and compensations, invigorating individual action, lessening governmental financial exposures and even in shaping concrete EU wildland fire safety policies. Furthermore, the implemented methodology is based on open satellite data which makes the system versatile and scalable. *Ofire+* is currently in operational implementation in the Municipality of Dimos Thermis (administrator appl.) and is scheduled to be completed by the end of summer 2019.

**KEYWORDS:** incident planning; wildfire prevention; risk response; infrastructure resilience

**PAPER ID:** CEST2019_00725

# Rainwater harvesting from roads enhanced indigenous pasture establishment in a typical African dryland environment

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## ABSTRACT

African drylands are a key source forage for pastoral livestock herds. However, land degradation and recurrent droughts have resulted to shrinkage of natural grazing pastures. This poses the greatest challenge to livestock production in African drylands. Combining innovative sustainable land management practices notably rainwater harvesting from roads and grass seeding using native grasses have been identified as a viable option for increased pasture production and rehabilitation of degraded pasturelands. Morpho-ecological characteristics of indigenous grasses Cenchrus ciliaris L. (African foxtail grass), Eragrostis superba Peyr. (Maasai love grass) and Enteropogon macrostachyus (Hochst. Ex A. Rich.) Monro ex Benth. (Wild rye grass) were planted to determine the suitability of rainwater harvesting from roads using trenches for pasture establishment and rehabilitation in a semi-arid landscape in Africa. Plant densities (plants m-2), plant frequency (%) and biomass yields (DM g $m^{-2}$) significantly declined ($P < 0.05$) with distance away from the water trenches (0 m, 5 m and 10 m). In conclusion, harvesting and diverting runoff from roads into trenches prolong soil moisture availability to enhance indigenous pasture production and rehabilitation of degraded grazing lands in African dryland environments.

**KEYWORDS:** Indigenous Pastures, Runoff, Roads, Rainwater Harvesting, African Drylands

**PAPER ID:** CEST2019_00802

# Part B: Poster presentations

# Life cycle analysis

## *Thursday 5 September 2019*

# Life cycle assessment of the use of biomass as energy source in Northern Greece

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## ABSTRACT

Decrease of fossil fuel consumption in the energy sector is an important step towards more sustainable energy production. On the other hand, domestic and imported biomass or biofuels used for energy purposes play an important role in many future energy scenarios and national policies. Generally speaking, biofuels have been evaluated as an ecologically benign alternative to fossil fuels. The aim of this paper is the life cycle analysis (LCA) using biomass for energy purposes. The LCA is applied as a computational tool for assessing systems to biofuel feedstocks. Specifically, the LCA of the wood pellet will be studied, which was selected as biomass. Furthermore, the LCA will be analyzed (such as the stages are mentioned and what it involves and is intended for) and for this reason there will be a case study of wood pellet production from a pellet factory in the area of Western Macedonia (Kozani). In fact, a techno-economic study will be carried out (the case study, which will include all the costs, the calculation of all pollutant emissions, solid and liquid waste from the birth of the raw material to final consumption of pellets based on the characteristics, dynamics and customer base of the plant pellet production.

**KEYWORDS:** biomass; Life cycle analysis; pellet energy; Western Macedonia

**PAPER ID:** CEST2019_00452

# Wastewater Treatment

## *Thursday 5 September 2019*

# Optimization of decentralized treatment and sanitation of domestic wastewaters via constructed wetlands: The DOMUS_CW project

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## ABSTRACT

Two free surface flow CWs constructed in one Greek and one Cypriot community, were upgraded in order to serve as case studies to be further optimized via modeling. Through the systematic and detailed monitoring of the two CWs their operational efficiency was evaluated, and the response to operational factors that have not been extensively studied yet, such as supply variations and recirculation, were recorded and incorporated into the model. In addition, the effect and fate of xenobiotics, the interactions among plants and microorganisms, the toxic potency of effluents an the cropping frequency were evaluated aiming to the better understanding and thus further improvement of the operation of the systems. An exploitation plan for CW effluents and plant biomass is also proposed investigated, aiming at the recovery of water and nutrients, contributing thus to the European goals for Sustainable Development. The main outcome of the project is the creation of a generic assessment tool, a model platform via which the feasibility of CW technology application in different sites could be evaluated based on minimal initial data.

**KEYWORDS:** constructed wetlands, modeling, toxic assessment, composting, anaerobic digestion

**PAPER ID:** CEST2019_00468

# Wastewater disinfection applying solar energy

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## ABSTRACT

Solar Water Disinfection Process (SODIS) is a simple technology using solar UV-A radiation (wavelength 320-400 nm) and elevated water temperature to inactivate pathogens. In the present survey, the effect of solar radiation on the disinfection of domestic secondary treated wastewater from the Wastewater Treatment Plant (WWTP) of the Municipality of Chania (Crete, Greece) was investigated during the day hours in summer. The used secondary treated wastewater samples had initial turbidity of 6 NTU, $BOD_5$ of 23 mgO2/L, and concentration of $4.6 \times 10^4$ and $2.6 \times 10^4$ CFU/100ml for the total heterotrophic bacteria cultivated at 37ºC and at 22ºC respectively, $5.5 \times 10^5$ CFU/100ml for the total coliforms, $1.5 \times 10^5$ CFU/100ml for the fecal coliforms, and $2 \times 10^4$ CFU/100ml for the fecal Enterococcus. The experiments were carried out in transparent Polyethylene Terephthalate plastic bottles during the months July, August and September. An average reduction of 97-99% of the concentration of the total heterotrophic bacteria, and of 99.5-99.9% of the total and fecal coliforms, as well as of the fecal Enterococcus was obtained after 6 hours of exposition in solar radiation with intensity ranging from 500 to 1,280 W/m$^2$ and temperature from 33ºC to 49ºC in the wastewater. The results showed that solar disinfection of secondary treated domestic wastewater with turbidity less than 6 NTU could be applied during the period of sunlight in WWTPs of settlements ≤15,000 equivalent population, of at least 6 hours in tanks with deepness of 10cm or tubes with a diameter of 10cm

**KEYWORDS:** Wastewater, Solar Water Disinfection (SODIS), Total Coliforms, Fecal Coliforms

**PAPER ID:** CEST2019_00475

# Modeling and optimization of two-phase olive-oil washing wastewater phenolic compounds recovery and treatment by novel weak-base ion exchange resins

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## ABSTRACT

In the present work, the concentration and recovery of high-added value phenolic compounds from two-phase olive mill wastewater (OMW) and the simultaneous effluent treatment by a 'green process' based on resins adsorption/ion exchange was studied. Olive oil is produced by a technological procedure based on physical operations, without use of chemicals. This industry is concerned to make the whole process environmentally friendly, which includes the treatment of the wastewater produced in the mills. The proposed weak-based IE process was statistically optimized and modelled. Results showed the resin performance was optimal at the raw effluent pH and ambient temperature conditions, which means no acidification or basification, nor cooling or heating would be needed. This would imply important savings for the scale-up of the process in real mills. The examined resin ensured minimum 72.4% phenols adsorption after 2 h contact time. The effluent could be partially discharged on suitable terrains or disposed to biological treatments, avoiding phytotoxicity or inhibition due to the phenolic content. The obtention of this concentrated pool of added-value antioxidant compounds for food, cosmetics, pharmaceutical and biotechnological industrial sectors could help counter-balance the economic feasibility of the reclamation process.

**KEYWORDS:** Olive mill wastewater, Ion exchange, Resins, Phenols, Wastewater reclamation, Sustainability

**PAPER ID:** CEST2019_00981

# Impact of reuse of the purified wastewater on some properties of soil. Case study of Ain Defla station (Northwestern Algeria)

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## ABSTRACT

Purified wastewater (PWW) is a major source of water and nutrients for many farmers in arid and semi-arid climates. The aim objective of this study is to follow the change of soil characteristics i.e permeability porosity, total calcium, electrical conductivity (extract diluted) and pH before and after an irrigation event. Two plots were selected near wastewater treatment plant of Ain Defla, the first one irrigated by fresh well water and the second one by PWW. Geostatistical analysis and soil mapping of the two plots showed that the risk of soil salinity is present with a rate of increase may be up to 0.5 ds / m after each watering. The spatiotemporal variability of soil Stalinization and total calcium levels can lead to a possible accumulation of persistent contaminants in the soil after prolonged irrigation (over 10 years) in this region.

**KEYWORDS:** Purified wastewater, soil, salinization, irrigation, Algeria.

**PAPER ID:** CEST2019_00889

# Soil and groundwater contamination and remediation

## *Thursday 5 September 2019*

# Combining phytoremediation with bioenergy production: Developing a multi-criteria decision matrix for species selection

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## ABSTRACT

Plant species required for both phytoremediation and bioenergy generation needs to satisfy certain important criteria such as translocation index, metal and drought tolerance, fast growth rate, high lignocellulosic content, good biomass production, adequate calorific value, and a good rooting system. It is therefore necessary to develop a set of comprehensive selection criteria to select the most appropriate plant species suited to attaining desired outcomes. In this study, we used a systematic review approach to develop a multicriteria decision matrix for species selection. Eight species (sunflower, Indian mustard, soybean, willow, poplar, Typha, Miscanthus, switch grass) were selected. Data from the literature relating to relevant species suitability criteria were aggregated, normalized and their suitability was analyzed and compared. Utility scores were assigned after criteria were weighted according to stipulated research objectives. The results showed that soybean has the best translocation index rate; silvergrass and switchgrass were the fastest growers; switchgrass, willow and poplar have better metal tolerance. On their bioenergy potentials, the lignocellulosic biomass percentage of poplar and sunflower scored the highest; with sunflower having the highest biomass production and poplar having the best calorific value among the species. These results are subject to differing priority ratings according to user preference.

**KEYWORDS:** bioenergy, heavy metals, phytoremediation, multicriteria matrix, decision making.

**PAPER ID:** CEST2019_00409

# The Characteristics of Soil Contamination in Industrial Complex in Korea

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## ABSTRACT

It is expected that the possibility of soil contamination will be high as industrial complex will be treated with many harmful chemicals during industrial activities. Therefore, the Korea Environment Corporation has been conducting a detailed survey of Korea's industrial complex since 2004.

There are about 1,193 industrial complexes in Korea. A total of 60 industrial complexes, 6,201 business companies, were surveyed between 2004 and 2018. Among them, 347 companies exceeded the standard for soil contamination, with a rate of about 5.5 percent.

The contaminated soil area of industrial complex is about 383,199 $m^2$, the amount of contaminated soil is 663,849 $m^3$. 282 companies are contaminated with soil, 17 are contaminated with groundwater, and 48 are contaminated with both soil and groundwater. The most significant excess of these contaminants were TPH, Zn, BTEX, Pb, and Ni.

The source of contaminants includes leaked storage facilities, mishandling and mismanagement, and brought in contaminated materials or contaminated land during industrial activities.

In the future, based on the results of this survey, the manual will be improved so that efficient investigations can be carried out in terms of time and cost, and used as promotional materials to prevent soil contamination.

**KEYWORDS:** Soil Contamination, Industrial Complex in Korea, Contaminants, Source of contaminants.

**PAPER ID:** CEST2019_00182

# Modeling the spatial evolution of nitrogen pollution in groundwater and the amount of nitrogen leached under potato crops in the Khemis Miliana Plain

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## ABSTRACT

The maximum concentration of nitrate in drinking water admitted by the World Health Organization is 50 mg/l. Europe recommends a standard content of 25 mg NO3-/l according to the interdisciplinary research program on the environment. The present work quantifies spatially the evolution of this pollution and determines and estimates the influence of agricultural practices "calendars of irrigation and fertilization" on the quantity of nitrates leached under the potato crops towards the groundwater of the Khemis-Miliana plain usin Pilote N model. The spatial evolution of the average nitrate concentrations above the norms in the groundwater of the Khemis-Miliana plain represents 80% of the total area of the plain. The transfer of nitrates through the unsaturated zone was simulated by the PiloteN model giving an estimate of the amount of N leached under the potato crops, which represents, according to the model 40% of the total N supplied 300 KgN/ha on the ground. According to the model, the nitrogen leaching period is greater with the days of fertigation. In this context, a field study was conducted to get an idea of the agricultural practices brought to the soil of the Khemis-Miliana plain in order to know, on average, the quantities of nitrogen leached by calculating the nitrogen balance at the potato plot scale using an empirical method and the PiloteN.

**KEYWORDS:** Nitrogen pollution, PiloteN, fertigation, Potato, Khemis-Miliana, Algeria

**PAPER ID:** CEST2019_00480

# Interactions between rhizosphere microorganisms and spontaneous plant species inhabiting smelter wastelands

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## ABSTRACT

The role of microorganisms in colonizing toxic smelter waste deposits by plants has not been sufficiently understood. The aim of the work was to assess interactions between microorganisms and most frequent spontaneous plants inhabiting two waste deposits in Piekary, Poland. The samples were collected in the summer of 2018 from rhizosphere of 8 plant species inhabiting the waste pile: 1. Thymus serpyllum; 2. Silene vulgaris; 3. Solidago virgaurea; 4. Echium vulgare; 5. Rumex acetosa; 6. Verbascum thapsus; 7. Solidago gigantea; 8. Eupatorium cannabinum. The samples were subjected to analyzes of enzymatic activity, abundance of microorganisms, functional (System Biolog) and genetic diversity (NGS), physicochemical properties (pH, metal content and solubility, nutrient content) and subsequently compared with the unplanted reference samples. Plant samples were analyzed for metals and nutrient contents.

**KEYWORDS:** microorganisms, rhizosphere, smelter wasteland, trace metals

**PAPER ID:** CEST2019_00646

# Applications of Remote Sensing in Remediation of Contaminated Water and Soil

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## ABSTRACT

This paper reviews the use of remote sensing for practical applications in remediation of contaminated water and soil. Due to their flexibility of use, the Unmanned Aerial Vehicles open interesting new prospects in the management of remediation of contaminated water and soil regarding various aspects such as sources of contamination, spatial dimension of contamination, level of contamination. However, the specificity of this kind of vehicles and of the sensors that they are capable to transport still requires detailed research work before making it fully operational for most of the unspecialized human resource existing in remediation of contaminated water and soil sectors.

**KEYWORDS:** remote sensing, Unmanned Aerial Vehicles, remediation

**PAPER ID:** CEST2019_00930

# Microplastics in the marine environment

## *Thursday 5 September 2019*

# A methodological protocol to extract microplastics from river sediments (bed, bank and floodplain)


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## ABSTRACT

Identifying and quantifying the entry of microplastics into the environment is fundamental to develop effective mitigation strategies. So far, microplastic research has mainly focused on marine environments and large rivers. However, it is the small-scale rivers systems, often adjacent to agricultural areas and waste water treatment plants, which have been suggested to play an important role in the entry of microplastics to aquatic habitats. Therefore, the aim of our ongoing research is to map the Hessian river Lahn, exemplary as small-scale river system, in high resolution to assess microplastic pollution and to identify sources. As river sediments differ from marine sediments, a different methodological protocol is required. Here, we present a methodological protocol to purify samples from the river bed, bank and flood plain and show first results of microplastic pollution. These results indicate that small-scale rivers act as (possibly temporary) sink for terrestrial microplastics.



**KEYWORDS:** microplastics, methodological protocol, river sediments, small-scale spatial distribution

**PAPER ID:** CEST2019_00487

# Do polyethylene terephthalate microparticles (PET-μPs) affect the oxidative status of the clam *Ruditapes Philippinarum*?

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## ABSTRACT

Microplastics represent a major concern in the marine ecosystems because of their widespread distribution and potential hazard towards organisms. In the present study we investigated the effects induced by two concentrations of micronized polyethylene terephthalate microparticles (PET-μPs) on the oxidative status of the clam Ruditapes philippinarum. Although PET-μPs were ingested and egested by organisms, they did not imbalance the oxidative status and did not cause oxidative damage on clam digestive gland. Our results suggest a low risk related to PET-μPs towards clams, at least at the tested concentrations and for short-term exposure periods.

**KEYWORDS:** clam; microplastics; polyethylene terephthalate; oxidative stress

**PAPER ID:** CEST2019_00110

# Advanced oxidation processes

## *Thursday 5 September 2019*

# Fenton Oxidation of Pharmaceutical Wastewaters Containing Antibiotics with Taguchi's Orthogonal Array Design

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## ABSTRACT

In this study, treatabilities of synthetic and real wastewaters containing antibiotics were investigated with Fenton oxidation processes. Taguchi's L25 and L9 orthogonal design methods were used for the optimization of parameters. At the conditions of pH 3, $Fe^{2+}$: 1mM, $H_2O_2$: 40mM; 86,26% COD, 67,5% TOC and 99,7% antibiotic active substance removals were obtained for synthetic wastewater. For the real wastewater samples; 91,16% COD and 75% TOC removals were obtained at the conditions of pH 6, 0,7mM $H_2O_2$ and 0,5mM $Fe^{+2}$ as the best results. According to the results of the study, optimization of the process parameters with Taguchi's experimental design was found to be very useful in design of advanced oxidation processes for treatability of wastewaters containing antibiotics due to the simplification of the analysis and calculations and obtaining high removal efficiencies in a short time.

**KEYWORDS:** advanced oxidation, antibiotic, Fenton, Taguchi, wastewater

**PAPER ID:** CEST2019_00039

# The Effect of Different Parameters on Electrochemical Removal of Ampicillin Using New Generation Sn/Sb/Ni-Ti Anodes

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## ABSTRACT

In this study, it was aimed to investigate the feasibility of new generation and stable Sn/Sb/Ni-Ti anodes for treatment of wastewater containing Ampicillin (AMP) antibiotic by electrochemical oxidation processes. Ampicillin concentration was 0.05 g L-1 in the aqueous solution. Residual ampicillin conc. was measured with Ultra-Performance Liquid Chromatography (UPLC) – Photodiode Array Detector (PDA). While, several parameters were evaluated such salt type and concentration, pH, current density, and anode-cathode distance; salt type and concentration was found as the most effective parameter for the removal of COD, TOC and AMP. Two different type of salts were used for this purpose; sodium chloride (NaCl) and potassium chloride (KCl). However, the removal efficiencies were found more higher in the presence of potassium chloride (KCl) when compared to sodium chloride (NaCl), generally. In the presence of KCl, ≥99% removal of COD and AMP after 60 min, pH 8, 50 mA/cm2, 750 mg/L and 1cm distance between anodes. However, in the presence of sodium chloride (NaCl), complete removal of COD and AMP after 90 min, pH 8, 50 mA cm-2, 2500 mg/L and 1cm distance between anodes.

**KEYWORDS:** Sn/Sb/Ni-Ti anodes, electrochemical oxidation, ampicillin, wastewater treatment, anode production

**PAPER ID:** CEST2019_00384

# Immobilized rGO/$TiO_2$ photocatalyst for water purification

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## ABSTRACT

The preparation of immobilized graphene–based photocatalyst layers is highly desired for environmental applications. In this study, the preparation of an immobilized reduced graphene oxide (rGO)/$TiO_2$ composite by electrophoretic deposition (EPD) was optimized. It enabled quantitative deposition without sintering and without the use of any dispersive additive. The presence of rGO had beneficial effects on the photocatalytic degradation of 4-chlorophenol in an aqueous solution. A marked increase in the photocatalytic degradation rate was observed, even at very low concentrations of rGO. Compared with the $TiO_2$ and GO/$TiO_2$ reference layers, use of the rGO/$TiO_2$ composite (0.5 wt% of rGO) increased the first-order reaction rate constant by about 70%. This enhanced performance was due to the increased formation of hydroxyl radicals that attacked the 4-chlorophenol molecules. The direct charge transfer mechanism had only limited effect on the degradation. Thus, EPD-prepared rGO/$TiO_2$ layers appear to be suitable for environmental application.

**KEYWORDS:** electrophoretic deposition, photocatalysis, $TiO_2$, reduced graphene oxide, water purification.

**PAPER ID:** CEST2019_00978

# Solid waste management

## *Thursday 5 September 2019*

# Characterisation of Rare Earth Elements in Waste Printed Circuit Boards (WPCBs) and their bioleaching potential

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## ABSTRACT

Printed circuit boards (PCBs) are part of everyday items such as cellular phones and computers, and they constitute a significant proportion of e-waste. PCBs contain hazardous components but also valuable and critical materials such as copper, gold, silver and rare earth elements. Rare earth elements (REE) are crucial to modern hardware and due to their increasing demand and high supply risk, they are now considered to be amongst the most critical elements in the world. In this research, WPCBs were supplied by local recycling companies after crushing/grinding process and metal analysis of the material was carried out. The concentration of the REE and their distributions in particle sizes is determined, and the potential of WPCBs for REE bioleaching is also discussed.

**KEYWORDS:** Bioleaching, PCBs, Rare earth elements, WEEE.

**PAPER ID:** CEST2019_00201

# A new sustainable approach in recovering Cobalt from "hard metal" production by-products

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## ABSTRACT

The present work shows the capability of Maleic Acid solutions to tune the amount of Co in cemented carbide-based recovery powders with a Co content exceeding the threshold (10% Co) for industrial manufacturing in Hard Metal production and required by safety regulations. Maleic acid solutions react promptly and selectively in very mild conditions (0.5M, room temperature and pressure, EtOH as solvent) with Co contained in WC-Co sintered powders obtaining the [Co(Mal)2(H2O)4] compound almost quantitatively. Characterization of the resultant recovery powders (SEM-EDS, XRD) and reaction solutions (ICP-OES) after treatments confirmed the almost complete Co removal and high leaching efficiency. Recovery powders deprived of Co demonstrated proper quality to be re-employed in the production process. These results seem really promising in providing a novel, tunable and effective remediation of this hazardous industrial waste and preserve raw material depletion.

**KEYWORDS:** Hard Metal, Critical Metals, Recycling, Cobalt, Maleic Acid

**PAPER ID:** CEST2019_00856

# Composition of municipal solid waste at Kara Tepe refugee camp in Lesvos, Greece

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## ABSTRACT

In order to accommodate asylum seekers, who entered island Lesvos, Greece, refugee camp Kara Tepe was constructed. The solid waste of the camp are disposed at the landfill after they are gathered by the garbage trucks of Lesvos Municipality. In the current study preliminary values of the composition of solid waste analysis and estimated generation rate are presented. Main object is the proposal of an integrated and beneficial system of solid waste management in the refugee camp.

**KEYWORDS:** solid waste management, refugee camps, composition, generation rate

**PAPER ID:** CEST2019_00985

# Heavy metals in the environment

## *Thursday 5 September 2019*

# Seasonal variation and spatial distribution of Arsenic in groundwater in a Ryolithic Volcanic area of Lesvos Island, Greece

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## ABSTRACT

A research conducted in water wells located in the rhyolithic volcanic area of Mandamados, Lesvos Island, Greece, indicated that significant seasonal variation of arsenic concentration in groundwater exists mainly in wells near the coastal zone. However, there were differences among those coastal wells with regard to the processes and factors responsible for the observed seasonal variability of the element, although they are all located in a small homogeneous area. On the other hand, in wells located in higher relief regions, the concentration of As in groundwater followed a fairly constant pattern throughout the year, which is probably related to the faster groundwater flow in this region due to a higher hydraulic gradient. In general, seasonal variation of As in groundwater in the study area was found to be related to geology, recharge rate, topography—distance from coast, and well depth.

**KEYWORDS:** Arsenic, Groundwater, Volcanic geological substrate, Seasonal variation, Spatial variation

**PAPER ID:** CEST2019_00473

# Trace metals in soils and water in the area of a small - medium waste electrical and electronic equipment recycling plant

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## ABSTRACT

A research conducted in order to investigate the environmental impact of an e-waste recycling plant to the soil and water resources of the surrounding area. Therefore trace elements in both water and soil samples were determined with Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Heavy metals in water comply with drinking water criteria, except Pb. Pb, Concentrations of Pb, Cr, Ni, Cu, Mn, Zn were higher in the rainwater collection tank (43.50, 10.90, 18.87, 81.17, 177.99, 330.17 μg/L) than the surficial water inside (8.93, 1.27, 4.97, 17.0, 91.87, 72.97 μg/L) and outside the plant (4.18, 1.28, 1.60, 10.35, 26.21, 12.10 μg/L). Ecological risk of soil samples was assessed with Enrichment Factors. Enrichment factor, for soils showed low to moderate enrichment. The more enriched soil samples in Cu, Pb, Zn, Cd and Hg were two collected west of the company S19 and S20 and two samples collected east S9 and S10.

**KEYWORDS:** e-waste, WEEE, heavy metals, recycling area; enrichment factor

**PAPER ID:** CEST2019_00474

# Selenium accumulation in unicellular photosynthetic algae Chlamydomonas reinhardtii and Thalassiosira weissflogii grown in Se-contaminated media

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## ABSTRACT

The objective of this study was to investigate the accumulation of Se (IV) and Se (VI) and their effect on the growth of two unicellular photosynthetic algae, Chlamydomonas reinhardtii and Thalassiosira weissflogii. For this purpose, a cell growth rate experiment was conducted, in nutrient media spiked with several non-lethal levels of Se salts of both oxidation states, and the growth curves were constructed spectrophotometrically for all the conditions under examination. Cells were also grown in larger volumes in all conditions and the selenium contents of individual Chlamydomonas reinhardtii and Thalassiosira weissflogii cells were quantitated through the use of conventional ICP-MS and SC ICP-MS. Comparisons are being made between cell suspensions grown in different selenium salts in the two organisms. Our data show that the cell growth rates depend on the Se species (IV or VI) in the growth media. Similar observations were made with the Inductively Coupled Plasma – Mass Spectrometrry analysis regarding the accumulation of the different Se species in the cells.

**KEYWORDS:** Selenium accumulation, single cell-ICP-MS, Chlamydomonas reinhardtii, Thalassiosira weissflogii

**PAPER ID:** CEST2019_00738

# The comparison of sediment quality in the rivers the Eastern Slovakia by Potential ecological risk index

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## ABSTRACT

The current pollution of sedimentary environment is very serious and exceeds load capacity limit and it is influenced by other external factors such as climate, hydrodynamic conditions, pH, salinity, Eh, temperature and other. This influences can cause the heavy metals are re-released from the sediments which were long-term accumulated what can lead to the deterioration of ecological environment and even pose a threat to the organisms through the food chain.

Distribution, enrichment characteristics of heavy metals (such as lead, cadmium, copper, zinc, mercury and arsenic) in the sediments in the rivers of Eastern of Slovakia, were measured and analyzed in 2017 and 2018. River sediment quality in the territory of East of Slovakia, representing the water basins of the rivers Hornad, Laborec and Torysa, was investigated. Sampling points were selected based on the current surface water quality monitoring network.

The aim of the study is compare sediment quality of monitored rivers between 2017 and 2018 by method Potential Ecological Risk Index Method (PERI).

**KEYWORDS:** heavy metals, pollution, potential ecological risk index

**PAPER ID:** CEST2019_00880

# Mobilisation of Arsenic in groundwater, Lesvos Island, Greece

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## ABSTRACT

In the present study, a geochemical analysis was conducted to investigate the As occurrence and release in groundwater from two different geological environments on Lesvos island: (i) the volcanic area of Mandamados (ignimbrite) and (ii) the metamorphic area of Tarti that comprises the geologic basement under ignimbrite. Seven sampling campaigns were conducted between October 2010 and October 2011 including 65 groundwater samples from 11 wells and springs. Chemical analyses showed As concentrations exceeding the 10 μg/L national drinking water limit in 46% of the samples from Mandamados. Groundwater composition in Mandamados evolved from Ca-HCO3 type, to mixed type and finally to Na-Cl type along the groundwater flow direction, indicating the contribution of ion exchange in groundwater chemical composition, while Ca-HCO3 type waters were observed in the Tarti area. Arsenic speciation analysis showed that As(V) was the main species in all samples, indicating that As was released under oxidizing conditions. Statistical analysis suggested silicate weathering as the prime mechanism of As release in groundwater in both cases, while, in the Tarti area, carbonate dissolution may represent a secondary mechanism which could be related to the observed relatively low As concentrations in the region. In both areas, pH related desorption of As, primarily from Fe mineral phases, was found to be the most important factor controlling the mobilisation of As, while the contribution of the redox control to As release in groundwater was generally found to be less significant.

**KEYWORDS:** Arsenic, Groundwater, Volcanic geological substrate, Lesvos, Greece

**PAPER ID:** CEST2019_00976

# Efficient water resources management in Cr(VI) impacted water bodies

## *Thursday 5 September 2019*

# Effects of Cr(VI)-contaminated irrigation water on growth and development of selected crop species

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## ABSTRACT

Chromium (Cr) is a metal well-known to cause environmental pollution due to its association with a number of industrial processes involving leather, steel, electroplating, chemicals, dyes and paints. It is toxic to plants and microorganisms, and its study is attracting a lot of attention due to its increasing occurrence in groundwater under current changing climate scenaria. Of the several valence states of Cr, the trivalent [Cr(III)] and the hexavalent [Cr(VI)] species are the stable forms. Cr(VI) is considered as more toxic than the relatively innocuous and less mobile Cr(III), and is easily taken up by cells where it is subsequently reduced to Cr(III) and other intermediate oxidation states [Cr(V), (IV)] generating reactive oxygen species (ROS) in the process. A greenhouse experiment has been initiated at the Agricultural Research Institute aiming at evaluating the effects of various Cr(VI) concentrations in irrigation water on growth, development and yield of major cultivated crops, such as alfalfa, tomato, wheat and lettuce. Plants were irrigated with tap water spiked with Cr(VI) at concentrations of 0 (Control), 0.05, 0.5, 1, 5 and 10 mg L-1. Physiological processes and cellular damage levels were monitored in leaves by means of spectrophotometric determination of lipid peroxidation, chlorophyll loss and H2O2 content, further supported by stomatal conductance measurements, fresh/dry weight and SPAD units in leaves. Tomato, wheat and lettuce were not affected by Cr(VI) contaminated irrigation water, whereas phenotypic observations revealed that high Cr(VI) concentrations dramatically impacted growth and development of alfalfa plants. Alfalfa plants displayed increased damage levels and ROS content as concentrations of Cr(VI) in the contaminated irrigation water increase, while leaves showed lower stomatal conductance, fresh/dry weight, leaf area and SPAD units. ICP-OES method was performed for the quantification of Cr(VI) concentration, which yielded increasing rates for concentrations of 5 and 10 mg L-1 compared with control plants. Biochemical, enzymatic and molecular analysis is currently underway for alfalfa plants in order to elucidate the effect of Cr(VI) contamination in alfalfa plants.

**KEYWORDS:** alfalfa, Cr(VI), reactive oxygen species, cellular damage levels

**PAPER ID:** CEST2019_00829

# Natural presence of hexavalent chromium in spring waters of South-West Mountain Vermion, Greece

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## ABSTRACT

Hexavalent chromium in water occurs as oxoanions that are toxic for plants and animals. Furthermore, they are soluble and extremely mobile under environmental conditions. Chromium in its other common oxidative state ($Cr^{+3}$) is less toxic and in general immobile. Chromium is found in nature mainly in the $Cr^{+3}$ form. However, human activities and natural occurring Mn oxides that can oxidize $Cr^{+3}$ to $Cr^{+6}$, increase the concentration of the toxic form of $Cr^{+6}$ in nature. The extended worldwide problem of $Cr^{+6}$ pollution makes essential the understanding of the oxidation mechanism of $Cr^{+3}$ from Mn oxides, for assessing the danger of $Cr^{+3}$ oxidation as well as for developing processes to reduce its formation and presence. In this study, the natural occurrence of $Cr^{+6}$ was examined in ground and surface waters of the South-West part of mountain Vermio (Kozani, Greece), an area where human activity is absent. The aim is to identify a natural background for $Cr^{+6}$ concentration which can assist in legislation limit definition. Results show that in cases of waters exiting ophiolite or water permeable limestone having underlying layers of ophiolithic rocks, $Cr^{+6}$ is detected. On the contrary when a thin layer of water impermeable schistolith interposes between limestone and ophiolite, then $Cr^{+6}$ is not detected.

**KEYWORDS:** hexavalent chromium, natural occurrence, ophiolite

**PAPER ID:** CEST2019_00768

# Environmental Impact of maritime transport

## *Thursday 5 September 2019*

# Participatory Street-Level Noise Monitoring in the City of Chios

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## ABSTRACT

The noise at the streets of Chios was measured in November 2018 using low cost instrumentation and a student participatory experimental design. The higher noise levels detected were connected with port traffic and entairtainemed activities.

**KEYWORDS:** ambient noise, low cost sound level meters, transport noise

**PAPER ID:** CEST2019_00944

# Environmental odour, monitoring and control

## *Thursday 5 September 2019*

# Comparison of Sensory Odour Intensity Scales for Inexperienced Assessors

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## ABSTRACT

Odours discharged from various human activities may cause severe damage to local residents. Odour intensity is one of main odour characterization parameters. For ordinary environmental odour monitoring by neighborhood and routine odour management at emission sources, reliable and user-friendly sensory odour intensity scale even for inexperienced assessors is desired. In this study, four odour intensity scales, including conventional six-point scale, 1-butanol reference scale, line segment scale and metronome scale, were applied to odour intensity measurement of 1-butanol and ethyl acetate solutions by inexperienced assessors. As a result, the line segment scale seemed to be the most appropriate for discriminating odour intensity. On the other hand, the improvement of the odour intensity evaluation procedure using metronome scale was thought to be necessary.

**KEYWORDS:** odour intensity, inexperienced assessor, line segment scale, metronome scale

**PAPER ID:** CEST2019_00507

# Wastewater Treatment

## *Friday 6 September 2019*

# Removal of heavy metals from sewage sludge using combined hydrothermal pretreatment and chelate extraction

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## ABSTRACT

The removal of heavy metals from sewage sludge using the combined influence of hydrothermal pretreatment and chelate extraction was tested. The classical method of batch extraction with chelates and the advanced hydrothermal pretreatment (HTP) extraction process with chelates were compared. Both experiments with removal of selected HMs were performed with 0.1 M solutions of 5 different chelating agents: citric acid (CA), S-carboxymethyl-L-cysteine (SCLC), ethylenediamine disuccinic acid (EDDS), methylglycine diacetic acid (MGDA) and ethylenediaminetetraacetic acid (EDTA). The sequential order of potential extraction efficiency at chelates was found as EDDS > EDTA > MGDA >>> SCLC > KC. The mixture of sewage sludge with high sand content soil (A) had in all cases the higher removal efficiency in comparison to the sewage sludge mixture with clay soil (B). The removal of the tested HMs from mixture A and B was better than from the sewage sludge alone. HTP extraction method showed better removal efficiency and significantly shorter time of the process. Also, this extraction method had the higher potential of efficiency in the mixture of soils and sewage sludge. More detailed research on this topic is desirable.

**KEYWORDS:** sewage sludge; heavy metals; hydrothermal pretreatment; chelate extraction

**PAPER ID:** CEST2019_00870

# The importance of water for life on the planet: Education for Global Citizenship

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## ABSTRACT

The water shortage observed is due to the fact that the environment has undergone significant interventions that led to a qualitative degradation of water resources, overexploitation, pollution, the dropping of water level, salivation of aquifers, etc. The prevailing situation seems to be perpetuated possibly due to the interests involved, attitudes, perceptions, and lack of awareness of the seriousness of the problem. In order to solve the problem through Education for Sustainable Development, this paper is an exploratory tool of a broader research aiming to record the knowledge and views of the sample in order to develop the appropriate educational programme on issues related to the environment, water pollution, tackling water pollution, water scarcity and wastewater recovery systems. The results of the survey show that students have poor knowledge of water scarcity, water pollution, and how to deal with them, as well as the role of wastewater treatment in integrated water management.

**KEYWORDS:** Water, pollution, water scarcity, Education for Global Citizenship.

**PAPER ID:** CEST2019_00951

# Marine Environment and coastal management

## *Friday 6 September 2019*

# Storm identification and assessment of potential impacts in Rhodes Island, Greece

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## ABSTRACT

Coastal areas are threatened by extreme meteorological phenomena, such as wave storms. The analysis of wave storms is a key element in coastal management, as providing information for the assessment of their potential hazards on shores. In this study, a classification of storm events in Rhodes Island, Greece, is presented by means of cluster analysis. Storms were defined in terms of significant wave height, peak period and duration which are the main parameters reflecting their intensity, and they were classified into five groups, namely I-weak, II-moderate, III-significant, IV-severe, V-extreme. An assessment of storm impacts on shores was also carried out in terms of flooding and wave run-up was estimated by applying an 1-DH numerical model (MIKE21 BW).

**KEYWORDS:** wave storms classification, coastal hazards, run-up, coastal flooding, Aegean Sea

**PAPER ID:** CEST2019_00122

# Environmental data analysis and modelling

## *Friday 6 September 2019*

# Multivariate Statistical Analyses of Groundwater Hydrochemical Data of Tirnavos Sub-basin (Central Greece)

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## ABSTRACT

Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) were applied in the groundwater hydrochemical parameters dataset of the Tirnavos alluvial sub basin-central Greece. PCA results suggest occurrence of four principal components both for dry and wet periods. Results of HCA application enabled to divide groundwater samples into two major groups with a large disparity in the number of samples for both periods. Implementation of these methods and spatial distribution of their corresponding results assist revealing key hydrodynamic evolution patterns and hydrochemical dependencies to anthropogenic and geogenic factors.

**KEYWORDS:** hydrochemistry, principal components, cluster analysis, geographical distribution

**PAPER ID:** CEST2019_00799

# The integration of three field survey datasets in Athens, Greece: transformation of five-point to seven-point thermal sensation scale

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## ABSTRACT

The integration of the datasets from three different field surveys on thermal sensation conducted at eight different sites of the area of Athens, Greece was examined. All three surveys were carried out with similar methodologies so data integration can be considered meaningful. The surveys included micrometeorological measurements and questionnaire-based interviews during different seasons focusing on human thermal sensation. The participants self-reported their thermal sensation classified in predetermined classes, i.e. very cold, cold, cool, neither cool nor warm, warm, hot, very hot. However, despite the similarities, one of the surveys used a five-point (±2, ±1, 0) thermal sensation scale whereas the other two a seven-point (±3, ±2, ±1, 0) scale. The present study focused on the transformation of the five-point to a seven-point thermal sensation scale. The middle and extreme classes of both scales were considered to coincide, so the rescaling method involved fitting a common sigmoid curve in all three datasets and reassigning points ±1 of the five-point scale to ±1 and ±2 of the seven-point one. For this purpose, air temperature, grey-globe temperature and Physiological Equivalent Temperature were used as possible independent variables.

**KEYWORDS:** field surveys; thermal sensation; data integration; PET

**PAPER ID:** CEST2019_00216

# Emerging pollutants

## *Friday 6 September 2019*

# Occurrence and spatiotemporal variability of sunscreen agents along the polish part of the Baltic Sea coast

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## ABSTRACT

UV-filters accumulate in tissues of aquatic organisms and induce negative effects on fertility and reproduction. Since they are "new emerging pollutants" general monitoring programs are rare and mainly conducted in touristic places, where high temperatures are recorded throughout the year (Spain, the Gulf of Mexico, the Mediterranean coast). This study is focused on benzophenones and derivatives of camphor. The concentration of UV-filters was monitored seasonally in core sediments collected in four Polish beaches (Ustka, Rowy, Darłowo, Czołpino) characterized by various level of touristic pressure along a transect perpendicular to the shoreline over a period of 1 year. Analysis of target compounds in sand cores was performed by means of dispersive liquid-liquid microextraction method followed by high performance liquid chromatography equipped with diode array detector (HPLC-DAD). In samples collected in the most touristic attractive location the presence of benzophenones was confirmed.

**KEYWORDS:** sunscreen agents, river water, sludge, sand sediments, toxicity

**PAPER ID:** CEST2019_00088

# Triclosan occurrence in European Sewage Treatment Plants and risk assessment for the European rivers

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## ABSTRACT

UV-filters accumulate in tissues of aquatic organisms and induce negative effects on fertility and reproduction. Since they are "new emerging pollutants" general monitoring programs are rare and mainly conducted in touristic places, where high temperatures are recorded throughout the year (Spain, the Gulf of Mexico, the Mediterranean coast). This study is focused on benzophenones and derivatives of camphor. The concentration of UV-filters was monitored seasonally in core sediments collected in four Polish beaches (Ustka, Rowy, Darłowo, Czołpino) characterized by various level of touristic pressure along a transect perpendicular to the shoreline over a period of 1 year. Analysis of target compounds in sand cores was performed by means of dispersive liquid-liquid microextraction method followed by high performance liquid chromatography equipped with diode array detector (HPLC-DAD). In samples collected in the most touristic attractive location the presence of benzophenones was confirmed.

**KEYWORDS:** sunscreen agents, river water, sludge, sand sediments, toxicity

**PAPER ID:** CEST2019_00290

# Fast and Comprehensive Analysis of Major use Antibiotics by UHPLC-High Resolution and High Mass Accuracy Hybrid Linear Ion-Trap-Orbitrap Mass Spectrometry

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## ABSTRACT

In this study, antibiotics of multiple classes (sulfonamides, quinolones, penicillins, macrolides, tetracyclines, pyrimidines) were selected to be accurately detected with modern chromatographic systems based on hybrid mass analyzers. For that purpose 13 antibiotics of major use were separated and detected with ultra-high performance liquid chromatography (UHPLC) high-resolution LTQ/Orbitrap mass spectrometry. The recent trend is focused toward the use of powerful high resolution MS detectors like Orbitrap which has become the technique of choice because of its high selectivity and sensitivity. Compounds were successfully identified in spiked samples from their accurate mass and LC retention times from the acquired full-scan chromatogram.

**KEYWORDS:** antibiotics, residues, UHPLC-Orbitrap-MS

**PAPER ID:** CEST2019_00524

# Biological activity of flufenamic acid and synthesized derivatives (PFCs) that may occur in the environment

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## ABSTRACT

Polyfluorinated compounds (PFCs) are used in the field of pharmaceuticals, pesticides, impregnating agents, etc. These are predominantly compounds that are difficult to degrade in the environment, and therefore are highly persistent. Many these compounds are known to have toxic effects and thus a negative effect on humans and the entire ecosystem. PFCs include, for example, flufenamic acid (antipyretic). The aim of the study is to verify the biological activity of flufenamic acid and derivatives prepared from this initial compound by organic synthesis. Flufenamic acid is a known substance, however the prepared derivatives are chemical compounds that have not been described and characterized in detail.

In the synthesis of prepared compounds, whose structure was confirmed by NMR spectroscopy, antimicrobial potential was tested against a wide range of microorganisms by the disc diffusion method and microdilution method in microtiter plates. Some antimicrobial properties of some of the prepared derivatives have been found to be close to the antimicrobial effect of the previously described and known antibiotic agents. These are significant and extremely stable pollutants in the environment, which, however, may have interesting antimicrobial properties according to the obtained results.

**KEYWORDS:** flufenamic acid, biological activity, antimicrobial activity, inhibitory concentration

**PAPER ID:** CEST2019_00968

# Determination of Emerging Contaminants in Surface Water Resources of EYDAP following wide-scope Target and Non-Target Screening

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## ABSTRACT

The aim of the study was to perform extended monitoring of emerging contaminants in the water samples from three reservoirs of drinking water of EYDAP, Evinos, Mornos and Marathonas. Solid-Phase Extraction (SPE) by mixed-mode sorbent was used during the sample preparation to ensure the extraction of compounds with a wide range of physicochemical properties and very low limits of detection. The extracts were analyzed by complimentary chromatographic techniques, including Reversed Phase (RP) and Hydrophilic Interaction Liquid Chromatography (HILIC) coupled to Quadrupole-Time-of-Flight Mass Spectrometry (QToF-MS) due to its increased selectivity. Wide-scope target screening was performed by in-house databases consisting of 3,000 compounds, including several classes of emerging contaminants, naturally occurring compounds and endogenous metabolites. For the suspect screening, a database of approximately 40,000 compounds (REACH chemicals, industrial chemicals, biocides, PPCPs, surfactants and compounds from the NORMAN network monitoring programs) was used. Non-target screening was also performed for the identification of unknown unknowns in the analyzed samples.

**KEYWORDS:** *Emerging Contaminants, Extended Monitoring, Surface Water Resources, HRMS*

**PAPER ID:** CEST2019_00974

# Influence of pH on the toxicity, uptake and biotransformation potential of citalopram in zebrafish (Danio rerio) embryos

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## ABSTRACT

The contamination of the aquatic environment has raised concerns in the scientific community and regulatory authorities. Given the large number of xenobiotics, for most of them there is a striking deficit in the literature concerning their adverse effects on aquatic organisms. Citalopram (CTR) is a worldwide highly consumed antidepressant which has demonstrated incomplete removal by conventional wastewater treatment, hence resulting in the contamination of aquatic ecosystems. Consequently, it is urgent to evaluate its potentially toxic effects on aquatic organisms.

The fish embryo test (FET) with zebrafish (Danio rerio) is a well-established and standardised (OECD Guideline 236) in vivo toxicity test that is commonly used to evaluate potential adverse effects on early development of fish. Thus, it is a helpful tool for risk assessment in aquatic environments. However, until now, neither pH nor the particular properties of ionisable organic compounds (IOC), like CTR, have sufficiently been considered in risk assessment. Characteristics of IOC vary, depending on their presence either as ions or as neutral species, in particular in respect to the uptake into organisms. Due to their electrical charge, ions pass poorly through biological membranes, whereas neutral species permeate more easily through membranes and are, thus, potentially of higher toxicity. The pH is one major factor influencing the proportion of dissociated and non-dissociated ions. Shifts in ambient pH cause alterations of the ionic proportions and thus, are key to IOC toxicity. Although many IOC are

partly or completely ionized under environmental relevant conditions and already slight variances of pH can cause considerable changes in toxicity, little attention has been paid to pH and its consequences in toxicity testing.

The objectives of the current study were (1) to assess to what extent CTR induces toxicity to zebrafish embryos. In addition (2), we evaluated the uptake and biotransformation processes of CTR by zebrafish and examined whether biotransformation data could be used in a complementary way to the concentration of the parent compound to interpret the induced toxicity. The final goal was to evaluate to which extent the pH is influencing CTR's uptake, potential bioaccumulation and biotransformation, as well as toxicity.

More specifically, the zebrafish embryo toxicity assay was used to calculate the LC50 of CTR, as well as to evaluate potential sub-lethal endpoints (e.g. the hatching rate). Exposure experiments were conducted at three different pH values (6, 8 and 9), to assess potential pH-dependent differences in an environmental relevant pH range. Concerning the toxicokinetic part of the study, exposure experiments were conducted at the LC50 value of each pH.

The extraction was carried out with the tissue homogenizer Cryolis Evolution® (Bertin Technologies, France) operating at 8200 rpm for 5 cycles of 15 sec with a 60 s break at 4ºC. Two different organic solvent mixtures (methanol-water and methanol-dichloromethane) were used for the extraction of zebrafish embryos in order to cover a very wide range of physicochemical properties. Exposure water samples and zebrafish extracts were analysed by RPLC and HILIC methods, in both positive and negative ionization mode, to cover the widest possible range of polarities, using LC-QTOF-HR-MS/MS. Detection and identification of tentative CTR biotransformation products (bio-TPs) were performed through in-house developed suspect and non-target screening workflows. Internal concentration of parent CTR and its bio-TPs was determined. Potential pH dependent differences of CTR's uptake and biotransformation were evaluated as well. . Finally, the biotransformation pathway of CTR in zebrafish embryos was proposed.

**KEYWORDS:** citalopram, zebrafish embryo, pH dependent toxicity, biotransformation

**PAPER ID:** CEST2019_00979

# Detection of Cyanobacterial Toxins and Oligopeptides from the Polemidia Dam in Cyprus

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## ABSTRACT

Cyanobacterial harmful algal blooms are becoming more spatially persistent worldwide. The formation and release, through cell-death and/or excretion, of bioactive metabolites (cyanotoxins) is comprising a reoccurring concern to environmental protection agencies. Cyanotoxins can negatively impact mammalian health in various ways by causing cytotoxicity, hepatotoxicity, and neurotoxicity. Besides conventional toxins some genera can produce an array of oligopeptides characterized as microginin, cyanopeptolins, and aeruginosins. In this work we studied the occurrence of both conventional cyanotoxins as well as oligopeptides in a eutrophic dam located in Cyprus (Polemidia Dam) in years 2014-2018. To identify those oligopeptides advanced analytical techniques have been employed; specifically, tandem mass spectrometry at different modes (for screening and for quantitative analysis). Our initial results indicate that the detection of conventional cyanotoxins was lower than the method detection limits and for their detection in the ng/L range the analysis was conducted in the MRM mode. An array of oligopeptides was detected such as microcin SF608 (m/z 609.34), anabaenopeptin F (m/z 851.49), and aeruginosin 602 (m/z 609.34). There were no seasonal variations for the years 2014 and 2015 sampling events, while some of the oligopeptides (m/z 726.6) detected have not been previously reported in the cited literature.

**KEYWORDS:** cyanotoxins, oligopeptides, tandem mass spectrometry, cyanobacteria, toxicity

**PAPER ID:** CEST2019_00911

# Environmental biotechnology and bioenergy

## *Friday 6 September 2019*

# Characterizing activated carbon synthesized from corn straw aiming water treatment

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## ABSTRACT

The emerging agenda for sustainable development and global warming control searches urgent researches to reduce environmental impacts. In this sense, activated carbons from agroindustrial wastes are widely used as adsorbents in food and pharmaceuticals industries, mainly for the separation and purification of biomolecules, due to their complex pore structure and high surface area. This research evaluates the corn straw activated carbon obtained from the chemical impregnating with phosphoric acid under stirring for 30 min, being sequentially drying at 50 °C and characterized looking for water treatment application. The adsorption of methylene blue from aqueous solutions was investigated by batch experiments carried out at 30 °C and 100 rpm, obtaining 99 mg $g^{-1}$ as the maximum adsorption capacity. The activated carbon had different functional groups when compared to its precursor material, an iodine value of 405.83 mg $I_2$ $g^{-1}$ and $pH_{PZC}$ of 5.75, characterizing it as slightly acidic, with a surface area of 409.314 $m^2$ $g^{-1}$, presenting potential as a biosorbent for technological application.

**KEYWORDS:** corn straw, adsorption, methylene blue, activated carbon

**PAPER ID:** CEST2019_00202

# Production of PHAs with enhanced properties from sugar-based wastewater in a two stage process

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## ABSTRACT

The experimental design of the study was based on two different microbial processes, i.e. anaerobic fermentation of a sugar-based wastewater via mixed acidogenic cultures and aerobic polymerization of the produced acids and alcohols for poly-hydroxy-alkanoates (PHAs) production, via enriched cultures. For the first stage of the combined process, a continuous up-flow column reactor (UFCR) and a continuous stirred tank reactor (CSTR) were developed. For the optimization of the performance of both reactors, the effect of main parameters influencing the distribution of the produced acids was investigated. The liquid effluents of the reactors, containing fatty acids and ethanol were forwarded to the second stage of the combined process. A sequential batch reactor (SBR) was used for the second, aerobic stage of PHAs production.

**KEYWORDS:** PHAs, acids, sugar-based wastewater

**PAPER ID:** CEST2019_00281

# Anaerobic co-digestion of poultry manure and used cooking oil for enhanced biogas production

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## ABSTRACT

Aim of this study was to evaluate the anaerobic co-digestion of diluted poultry manure (DPM) and used cooking oil (UCO). Mixtures of DPM with different UCO dosages (1 to 6% v/v) were prepared using a high-shear emulsifier and digested in batch anaerobic reactors. Increasing the UCO dosage resulted in a respective increase of the emulsion COD (from initially 64 to 182 g/L) however the stability of the emulsion was adversely affected. The optimum UCO dosage (1.5-2.0% v/v) was further digested in a semi-continuous mesophilic anaerobic reactor, to assess the feasibility of the process at OLR up to 8 g/Ld. The anaerobic reactor was stable, giving a biogas yield of 0.45 L/gCOD, with low supernatant COD (6 g/L), negligible VFA accumulation and without foaming.

**KEYWORDS:** anaerobic digestion; pre-treatment; fat oil and grease; poultry manure, biogas

**PAPER ID:** CEST2019_00959

# Circular economy and industrial symbiosis

## *Friday 6 September 2019*

# Challenges for the development of green organizations

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## ABSTRACT

The ecological nature and similarity of the organizations to the ecosystem, is one of the important topics discussed in the field of the theory durable and sustainable development practices. What is more, being a "green organization" has become not only fashionable, but also beneficial. Ecological issues are discussed in many documents formulated by both private and public entities. Many organizations try to call themselves "green" or "sustainable", therefore there is no consistent definition of such green organization. The aim of this article is to present a chosen definition of a green organization and to identify challenges for their development. The article adopts qualitative methods that distinguishes two main aspect of the possible defining of green organizations and then to biggest issues they have to face.

**KEYWORDS:** green jobs, green management, qualitative analysis

**PAPER ID:** CEST2019_00466

# The green projects as a source of proecological transformation


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## ABSTRACT

Green projects are unique, complex, one-time and intertwined activities that serve to preserve and protect the natural environment. The implementation of green projects may affect the greening of some enterprises. At the same time, so-called "brown" enterprises will have the chance to reduce their pressure on the natural environment. It is possible to make a cyclical implementation of some green projects. Therefore, they may become the beginning of new and green processes, and over time affect the main operational processes. The purpose of this article is to define a green project and to indicate its role in proecological transformation. In this article, the qualitative method was used.



**KEYWORDS:** green and lean processes, green organization, green economy

**PAPER ID:** CEST2019_00471

# Biomining - recovery of high-tech critical metals

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## ABSTRACT

Critical metals were defined as those metals essential for high-tech, medical and defense industry but with low availability due to uneven geographical distribution, thus resulting a high price volatility. The challenge of the future is to assure a stable supply of critical materials and implicitly of critical high-tech metals and this will be possible through multiple approaches such as intelligent mining, urban mining, extensive recycling and reutilization. The reports of European Commission regarding critical raw materials will be reviewed. In the same time, potential alternative sources and possible new biotechnologies for the future will be explored. Extraction of metals by means of microorganisms is an established biotechnology and is applied worldwide for processing of sulfidic low-grade ores. The mineral processing using microorganisms has been extended for copper, gold, nickel, cobalt, zinc, and uranium. Here, we shall explore the possibility of biomining for the recovery of critical metals from secondary sources.

**KEYWORDS:** critical metals, biomining, secondary sources, biotechnology

**PAPER ID:** CEST2019_00929

# Agroforestry, forest and agricultural sustainability

## *Saturday 7 September 2019*

# Monitoring of Vitis vinifera endophyte population

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## ABSTRACT

Due to increasing demands to agricultural production it is necessary to fine processes which will increase health of cultural plants and will have positive impact on landscape with potential to increase production. Our work is concerned on grapevine plants (Vitis vinifera) endophytic population. We monitor endophytic population in leaves and stems of four grapevine varieties Pinot Gris, Pinot Noir, Rhine Riesling and Müller Thurgau during year from two vineyards with different ways of wine production, biodynamic production and conventional with use of pesticides. Our concern is to monitor functional and structural changes in endophyte populations and its seasonal changes. Functional changes were determined by measurement of selected plant growth promoting properties of endophyte populations. For monitoring changes in population structure fatty acids methyl esters analysis was used.

**KEYWORDS:** grapevine, endophyte

**PAPER ID:** CEST2019_00814

# Environmental health

## *Saturday 7 September 2019*

# Antibiotic Resistance of *Clavibacter michiganensis* subsp. *sepedonicus* Georgian Isolates

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## ABSTRACT

*Clavibacter michiganensis* subsp. *sepedonicus* (Cms) is a causative pathogen of potato bacterial ring rot. This devastative pathogen poses a constant threat to potato growers worldwide. It was regarded as a disease of cool northen regions but is currently spreading within Europe, including some southern areas (Crete, Cyprus and Spain). The pathogen damages vascular system of tubers, stems and leaves with slow or no development of symptoms on plants. Management of ring rot of potato are especially difficult in storage places, where the pathogen, being in a latent form, may infect almost all tubers. The aim is the study of antibiotic resistance of potato ring rot causative *Cms* geographically and temporarely representative isolates in Geogia. Cms were initially detected in collected in different regions of Georgia both symptomatic and asymptomatic potato tubers by specific molecular method. Dozens of pure Cms isolates were recovered from these samples and identified by PCR using the pathogen-specific primer set PSA-1 and PSA-R. Relation of 19 virulent strains towards 9 antibiotics: tobramycin, penicillin, trimethoprim, erythromycin, kanamycin, ofloxacin, chloramphenicol, tetracycline and streptomycin by disc-diffusion method have been studied. The isolates demonstrate different susceptibility to the antibiotics, independently they were obtained from symptomatic or asymptomatic tubers.

**KEYWORDS:** *Clavibacter michiganensis* subsp. *sepedonicus*, potato ring rot, antibiotic resistance

**PAPER ID:** CEST2019_00138

# Water treatment

## *Saturday 7 September 2019*

# Successful use of UV light driven photocatalytic oxidation for the removal of an emergent water contaminant

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## ABSTRACT

The degradation of a new anti-epileptic drug, named levetiracetam in aqueous solution has been investigated by heterogeneous photocatalysis, under UV light irradiation. For the photocatalytic assays, the photocatalytic activity of two different commercial catalysts ($TiO_2$ Aeroxide® P25 and $TiO_2$ Kronos uvlp 7500) was compared. The influence of some operating conditions (catalyst dosage, UV light irradiation, initial pollutant concentration, pH and water matrix was studied) and the main kinetic parameters were determined. For optimal degradation conditions an elimination yield of 99% was achieved. Kinetic studies have shown that the degradation of target molecule can be described by the Langmuir-Hinshelwood model. Toxicity tests were also carried out to evaluate the potential of detoxification of the considered oxidation process.

**KEYWORDS:** photocatalytic degradation, antiepileptic drug, toxicity

**PAPER ID:** CEST2019_00257

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# Water resources management in education for sustainable development

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## ABSTRACT

Issues relating to water resources are included among the most serious environmental problems. Pollution and deterioration of the receiving surface water and groundwater, mainly from human activities, pose an immediate threat to natural ecosystems and the functions of biosphere reserves, the balance of which is a prerequisite for the survival of every life form on the planet. In this light, the aim of the current study is to record second grade high school Rhodes students' knowledge of matters concerning water. For the purposes of the investigation, a questionnaire was used consisting of 19 main questions, which was distributed to 292 students. The survey results indicate a general lack of adequate knowledge in matters relating to pollution and water scarcity, as well as ways of dealing with them, and managing water resources. These data require the development of appropriate teaching interventions in education for sustainable development. This teaching procedure can contribute to the formation of active citizens, with knowledge, sensitivity and willingness to defend the right to life by preserving and maintaining healthy aquatic systems for the present and the future of humanity.

**KEYWORDS:** Water resources management, education for sustainable development

**PAPER ID:** CEST2019_00270

# Microbiological treatment of water by cold plasma at atmospheric pressure

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## ABSTRACT

Ensuring the world's population access to drinking water is one of the millennium's challenges, for although our planet is made up of 70% of water, poor distribution and water quality are problems that concern world leaders, being among the objectives of development 2030 agenda set by the ONU. The proposed work aimed at the microbiological treatment of water through cold plasma technology at atmospheric pressure, the control to confirm the efficiency of the treatment was through the analysis of thermotolerant coliforms. The reduction was 93.33% for thermotolerant coliforms and cold plasma technology reduces the time of microbiological treatment of water by 90% over traditional methods due to high energy density, ozone generation and ultraviolet radiation, thus reducing costs because the energy expenditure was low and there is no need to add chemicals.

**KEYWORDS:** microbiological treatment; cold plasma; non-thermal plasma; *E. coli* inactivation; air plasma gas

**PAPER ID:** CEST2019_00286

# Arsenic Removal using Electrocoagulation Process

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## ABSTRACT

Contamination of water resources with Arsenic poses serious health concerns because of its toxic and carcinogenic nature. Detection of Arsenic at concentrations higher than 10 parts per billion (ppb) in some Philippine water resources confirmed the need for further studies on the contamination and for the investigation of potential treatment technologies.

This study examined the removal of Arsenic from synthetic contaminated water, with initial concentrations of 100 ppb and 300 ppb, using electrocoagulation process. The electrocoagulation batch reactor utilized combined iron and aluminum electrodes, in parallel configuration. Employing a Box-Behnken experiment design for response surface modeling (RSM), three factors were investigated with each factor varied at three levels – pH of the wastewater solution current density and reaction time.

Results showed that at optimum parameters of pH 7, 25 A/m2 current density and 40 minutes reaction time, the electro coagulation reactor is able to reduce the 100 ppb Arsenic in water by 99.20%. At optimum parameters of pH 7, 20 A/m2 current density, and 40 minutes reaction time, the reactor is cable to reduce 300 ppb Arsenic in water by 98.23%.

**KEYWORDS:** arsenic removal, electrocoagulation

**PAPER ID:** CEST2019_00706

# Biosorption of Mn(II) ions from water solutions by natural sorbent: equilibrium study

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## ABSTRACT

In the modern society, the problem of the treatment of natural and wastewater resources and their management, is becoming very important.

Of particular interest is the definition of adequate and sophisticated procedures for the treatment of natural and wastewater resources, regardless of whether the source of pollution is of geogenic or anthropogenic origin.

Sustainable development of separation processes has recently been increasingly imposed by the need to develop modern, non-conventional bioseparation processes for the elimination of toxic metals from wastewater, by applying low cost unconventional sorbents.

The purpose of this paper is to remove Mn (II) ions from aqueous solutions by applying a natural adsorbent (grape branches - agricultural waste). To accomplish the established goal, the experiments were carried out with model solutions with known initial concentrations of Mn(II) ions in a laboratory batch reactor, with the purpose of studying the effect of adsorption time on adsorbate concentration and on the adsorbed amount of Mn(II) ions.

The raw material was characterized in terms of its chemical composition and particle size distribution.

The obtained results were applied to model the adsorption equilibrium using several adsorption isotherms such as Langmuir, Freundlich, Langmuir-Freundlich and Redlich-Peterson, using the MATLAB/Curve fitting toolbox software package.

**KEYWORDS:** adsorption, toxic metals, biosorbent, grape branches, wastewater

**PAPER ID:** CEST2019_00852

# Phase Diagram Modeling of a Multicomponent Aqueous Solution of Katwe Salt Lake, Uganda

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## ABSTRACT

A methodology is developed to compute the phase diagram of a hexary system and to determine the mineral precipitation sequence upon removal of water. The methodology is applied to construct the phase diagram and precipitation sequence of the system ($Na^+$, $K^+$)($Cl^-$, $So_4^{2-}$, $CO_3^{2-}$ & $HCO_3^-$) in water. The thermodynamic model chosen is the Extended UNIQUAC. A 3D grid is constructed in order to solve this model in MATLAB. On the basis of this grid, a 3D phase diagram is calculated and a Jänecke projection is obtained. The precipitation sequence due to evaporation is calculated thus obtaining the coordinates of the solution along this path as well as the order of precipitation. The numerical model is also able to calculate all these steps for temperatures 0-110°C. In addition, the number of ions and the composition of the system can be varied in order to model other elective systems. The obtained results are well suited to be used for the design of sustainable salt extraction processes for both Sea and Lake brines.

**KEYWORDS:** Evaporation, Extended UNIQUAC, Precipitation, Phase diagram, MATLAB

**PAPER ID:** CEST2019_00835

# Environmental planning, management and policies

## *Saturday 7 September 2019*

# Sustainable Development and Digital Literacy in Educational Practice and Politics. Case study on participative geospatial technologies applications of Greek secondary students

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## ABSTRACT

In the 21st century, our world faces various challenges that greatly affect modern life and show the dynamic relationship and interaction of human activities with space and the environment and the immediate need to ensure sustainable development. The answers on how to achieve this interaction and raise sustainable development issues from the education sector are presented in this research. Specifically it is explored the participative geospatial technologies applications (PGST) of Greek secondary students in geographical and environmental learning for sustainability. Data analysis from these applications showed that students acquired skills such as participatory interaction, interpersonal communication, geospatial thinking and high cognitive functions (collaboration, crisis and feedback).

**KEYWORDS:** PGST, Sustainable Development, Educational practice, Spatial environmental planning

**PAPER ID:** CEST2019_00027

# Start-up farm: Skills for future ecofarmers

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## ABSTRACT

A series of courses in environmental education, specialized in sustainable agribusiness, was given in the framework of the «Geo-ergon Paideia» project (in Greek: Γεωργών Παιδεία – Γεωργών Παιδιά). «Geo-ergon Paideia» was a transnational exchange program which aimed at training school students of the secondary level of education in becoming future eco-farmers. The main purpose of this work was to implement a sustainable strategic partnership between European universities -research centers, municipalities and schools in order to reinforce the concept of agricultural education and sustainable development in rural areas through an integrated interdisciplinary approach. It was addressed to students attending the second class of lower secondary school (gymnasium), who live in the selected rural areas in Greece and Romania. Apart from the students, the participants of the project (around 200) include farmers, the parents of the students, local and governmental authorities, young entrepreneurs, academic professionals, and researchers and stakeholders. Project implementation included learning/teaching activities and multiplier events and has led to the production of intellectual outputs with open courses and entrepreneurship guide for teachers amongst others. The intellectual outputs produced by the project will be available to the wider public through the e-learning platform, managed by the University of Aegean. An open access policy will be maintained throughout the duration of the project and at least two years after the completion of the project.

**KEYWORDS:** open courses; ecofarmers, environmental education

**PAPER ID:** CEST2019_00354

# Lakes, rivers, estuaries and ecosystem health

## *Saturday 7 September 2019*

# Environment Gradient related Dissimilatory Nitrate Reduction to Ammonium in Huangmao Sea Estuary: Rates and Spatial distribution

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## ABSTRACT

The potential rates of dissimilatory reduction of nitrate to ammonium (DNRA) in the sediments collected from Huangmao Sea Estuary (HSE), one of Pearl River Estuaries in China, were investigated. The research covers a one-year period at 20 sites of HSE based on the 15N isotope and molecular biology analysis. The results showed that the environment gradients of nitrogen pollutants decreased from the estuary to the sea, and the characteristics of terrestrial pollutant export were obvious. (_^15)N H_4^+ was detected in all sites in continuous-flow systems, which showed that DNRA existed in HSE potentially. In which the maximum (_^15)N H_4^+ was 1948.5ug/L, accordingly in situ rate of DNRA was 6.3 ug/L.h in 72h. The high transcripts of nrfA gene were found at the same site, with values of 1159715 copics/(g wet sediment). Correspondingly, a very low transcripts of nrfA were found at other sites. Principal components analysis (PCA) based on community composition at genus level showed the distribution pattern of the nrfA gene sequences. Nine samples formed three distinct clusters, corresponding to their geographical locations, which suggested that salinity was likely to affect the selection of the nrfA bacterial populations. This study provide a better understanding of DNRA in the Pearl River Estuary.

**KEYWORDS:** DNRA; Sediment; Rate; distribution pattern

**PAPER ID:** CEST2019_00020

# Air pollution

## *Saturday 7 September 2019*

# Validation of a multistep derivatization method for the determination of polar species in organic aerosol.

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## ABSTRACT

Secondary organic aerosol (SOA) is a significant constituent of airborne fine particles. A multistep derivatization method was developed, optimized, and validated for the determination of organic compounds in the atmospheric aerosol with mono- and multi-functional species, with GC/MS. The first step includes the alkylation of the carbonyl (C=O) moieties using o-methylhydroxylamine hydrochloride as the derivatization reagent. The second step refers to the conversion of carboxylic acids to methyl ester derivatives using TMSD/methanol or $BF_3$/methanol. Finally, alcohols are converted to trimethylsilyl ethers with BSTFA+ 1% TMCS. The use of TMSD/methanol as the derivatization reagent in step 2 is preferred for the procedure, achieving higher sensitivity. Additionally, $BF_3$/MeOH was ineffective at converting some mono/dicarboxylic acids and species with more than 2-OH moieties. The derivatization procedure in stage 3 was optimized yielding the appropriate reaction temperature and time, while in stage 2 yielding the appropriate amounts of the derivatization reagents. The method was validated for twenty-two compounds which are possible SOA tracers. Detection limits ranged from 0.31 to 0.98 ng $m^{-3}$ and recoveries from 73.5% to 108%. The method was applied to field samples from rural and industrial areas with concentration levels ranging from below limits of detection to 42 ng $m^{-3}$

**KEYWORDS:** Secondary Organic Aerosol, Multistep derivatization, GC-MS, Oxygenated compounds

**PAPER ID:** CEST2019_00215

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# Necessity of Full Implementation of Type Approval for Non-Road Mobile Machinery in the Republic of Croatia

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## ABSTRACT

Along with continuous progress in the reduction of emissions from road vehicles, the Non-Road Mobile Machinery (NRMM) becomes a more and more important source of emissions.

Namely, although the EU Regulation 2016/1628 for NRMM introduces the latest limit emission values known as Stage V, their values are still considerably higher than those of road vehicles. Also, the average age of the NRMMs is always significantly higher than the average age of road vehicles. Additionally, a significant share of NRMM is used in highly urbanised areas.

To enable the emission inventories of higher quality, it is necessary to enable a better data collection on usage and working conditions of NRMM required for the development of emission inventories.

With that goal in mind, an organisational scheme for implementation of rules on type approval for Non-Road Mobile Machinery in the Republic of Croatia is proposed. Besides, an organisational scheme for market surveillance is proposed. An additional benefit of proposed market surveillance is the collection of data and development of corresponding emission factors for NRMMs.

**KEYWORDS:** Emissions, Type Approval, EU Regulation 2016/1628, Emission Inventories, Market Surveillance

**PAPER ID:** CEST2019_00960

# Risk assessment and apportionment studies of particulate pollution at Ankamaly,South India

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## ABSTRACT

In the present world which is engulfed by the ill-effects of air pollution, stringent permissible emission standards to curb pollution are mandatory. Source and risk apportionment studies help to understand the sources and their contributions. Four parameters, lifetime average daily dose, hazard quotient, hazard index, excess cancer risk helped in assessing the risk at sampling site selected at Ankamaly, Kerala. Lifetime average daily dose was found be in the descending order as Fe> K> Na> Ca. Hazard quotient values were found to be greater than one for Mn and Cr, which conveys the non-carcinogenic effects due to pollution. Cu, Ni, and Zn were within safe limits. Chromium was found to be the main risk causing pollutant. Excess cancer risk (ECR) values shoot up to $6.67\times10^{-3}$ for child and $2.86\times10^{-3}$ for adults, which shows it is alarming. Risk apportionment was done and the highest contributors to risk were found to be smelting activities (92.4%) followed by wood residue burning (4.2%) and paved road dust (3.2%).

**KEYWORDS:** Human health risk; Excess cancer risk; Inhalation; Chromium; India

**PAPER ID:** CEST2019_00749

# Biowaste

## *Saturday 7 September 2019*

# Biopolymer extraction assay from fungal biomass

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## ABSTRACT

The cultivation of Penicillium strain, isolated from rotten vegetables, on potatoe dextrose broth (PDB) medium enriched in arginine and mineral elements, allowed to obtain a yield of 31.7 mg/g of dry biomass and 9 mg/g of dry biomass into chitin and natural chitosan, respectively. The infrared spectroscopy analysis showed a great similarity between the infrared spectra of chitin and natural chitosan obtained and the commercial chitin and chitosan, respectively.

**KEYWORDS:** Fungal biomass, chitin, natural chitosan, Penicillium, composition of the medium

**PAPER ID:** CEST2019_00861

# Water and wastewater reuse

## *Saturday 7 September 2019*

# Adsorptive Removal of Marbofloxacin from Milk using Activated Carbons

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## ABSTRACT

The present study aims to remove the residual marbofloxacin (MBX) from milk with activated carbons (ACs) in batch and flow systems to meet the maximum residue limits (MRLs, 0.075 μg $mL^{-1}$). Different types (granular and powder) and amounts of ACs were studied. In batch mode, 50 mg of commercial granular AC (CGAC) with 1083 $m^2$ $g^{-1}$ of BET specific surface area exhibited the superior adsorption performance for 20 mL of 1 μg $mL^{-1}$ MBX-spiked milk. 93.7% of removal efficiency (RE) and 0.063 μg $mL^{-1}$ of MBX residue were achieved. In flow mode, 325 mL of 1 μg $mL^{-1}$ MBX-spiked milk was efficiently purified through 500 mg CGAC in a glass column (1 cm ID) and 93.4% of RE and 0.066 μg mL-1 of MBX residue were attained at the end. The flow process can handle 1.6 times higher in volume than that in batch mode. In conclusion, antibiotics can be efficiently, economically and conveniently removed using ACs adsorption from milk, despite the presence of competition adsorption of impurities. The adsorption with flow mode paves the way for the removal of antibiotics in milk.

**KEYWORDS:** antibiotic; marbofloxacin; activated carbon, adsorption, milk

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# Design optimization of a polymeric nanofiltration membrane for olive mill wastewater valorization plus purification

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## ABSTRACT

The core of this work was to model and optimize an environmentally friendly nanofiltration (NF) treatment process for two-phase olive mill wastewater (OMW) valorization throughout concentration and recovery of its phenolic fraction and the obtention of a purified permeate stream. A statistical multifactorial analysis was performed to quantify the potential complex conjugated effects of the input parameters. Quality standards to reuse the purified stream in irrigation or in-site discharge were checked. To the author's knowledge, no previous work on the optimization and statistical modelling of membrane processes for OMW purification and valorization can be found up to the present. The optimized data are very relevant for the feasible scale-up of the proposed process, since the NF membrane was highly efficient at ambient temperature conditions and raw effluent pH. A permeate stream that could be reused for irrigation and a retantate stream concentrated in phenols (1315.7 mg/L) was provided.

**KEYWORDS:** Wastewater reclamation; Membranes; Nanofiltration; Modelling; Olive mill wastewater

**PAPER ID:** CEST2019_00969