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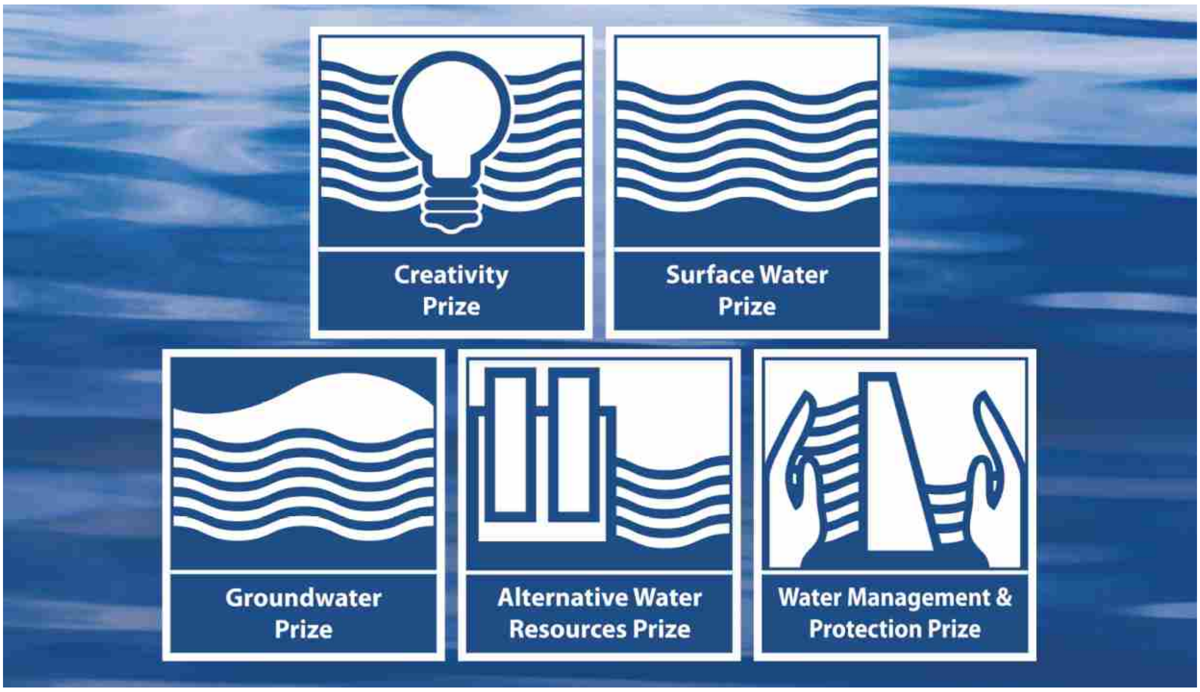

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PART A – ORAL PRESENTATIONS

SESSION 2 – HYDROLOGY AND WATER RESOURCES

Thursday 2 September - morning

'Water underground': real-time, continuous monitoring of the underground water's quantity and quality

Mavroforakis M.[1], Georgiou H.[1,*], Malisiovas V.[1], Psychias C.[1], Papadimitriou D.[1], Sarioglou K.[2]

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ABSTRACT

Water resource management is one the most urgent aspects of environmental protection and sustainability policies world-wide. Accurate, real-time remote sensing of the status of underground reservoirs is required for proper regional planning, prevention of droughts, optimized farming etc. 'Water Underground' is a low-cost solution, based on a combination of Internet of Things (IoT) local sensing, Edge computing, Cloud storage, web services and Machine Learning (ML) and predictive analytics, continuously monitoring the level of underground water and its quality. Specifically, water level is monitored via an IoT apparatus providing the Static (SWL) and Pumping Water Level (PWL). Moreover, the quality of water is tracked via measuring the Total Dissolved Solids (TDS), Oxidation-Reduction Potential (ORP), temperature, pH, electrical-conductivity, etc. Local processing in the IoT device includes measurements' transformations and robust adaptive control for the device's actuators. The reservoir dynamics is tracked and modeled using Cloud-based predictive analytics. The corresponding Cloud services include long- and short-term detection of periodic trends, Drawdown (DD) patterns, prediction of SWL, predictive maintenance via PWL tracking, etc. The overall solution has received international recognition in IBM Challenge 2020 as top-7 finalist for Europe. The platform is currently under prototype deployment in several sites in the Attica region of Greece.

KEYWORDS: hydrology, water management, remote sensing, predictive analytics, sustainability

PAPER ID: CEST2021_00305

Evaluation of urban flood characteristics through the spatial analysis of flood-related factors and flood incidents recorded in the western side of Athens basin on October 24, 2014

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ABSTRACT

On October 24, 2014, a severe flood event took place in the entire Athens basin, in Attica, Greece, causing extensive damages due to a short-duration rainfall event of high intensity. This work focuses on the analysis of the characteristics of this specific flood event by investigating the influence of various factors on the spatial distribution of urban flooding. These factors that are linked to flood occurrence are either static, mainly related to the surface and structure characteristics, or dynamic, such as the rainfall depth and intensities for various durations. All factors' values are determined with GIS techniques and, finally, logistic regression is used to evaluate their statistical correlation with flood occurrence. Results illustrate that several factors appear to have an impact on the distribution of flood incidents in an urban environment to a certain degree.

KEYWORDS: GIS; correlation; Urban floods; Athens basin; spatial analysis

PAPER ID: CEST2021_00611

Potential location of early Neolithic sites in Crete and Cyprus: A GIS-based regional potamological approach

Depraetere Ch.[1], Moutsiou Th.[2]

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ABSTRACT

This study aims to identify key locations for the potential unearthing of Early Holocene archaeological sites in the interior of Cyprus and Crete, two large islands in the Eastern Mediterranean. We apply geographic information system (GIS) methods, based on assumptions of environmental suitability and geographical accessibility. The core assumption is that the first farmers colonizing almost pristine islands had a fair empirical knowledge of morphopedological conditions suitable for their Mediterranean farming practices. Here we use the SRTM digital elevation model (DEM) to establish the primary factor of access to water resources calibrated on the hydrogeomorphological context of known archaeological sites on the two islands. Test zones on the central part of Crete (pre-ceramic Knossos, 9000-6500 BP) and the foothills of the Troodos mountains in Cyprus (Khirokitia culture) suggest potential suitable localities situated on specific terraces, ledges or footslopes perched above the flood plains of major rivers or smaller streams. The final aim is to establish a methodology for the discovery of new archaeological sites that is expected to contribute new data to the fragmented archaeological record of both islands. Although this study focuses on bridging existing gaps in the early Neolithization processes in the Eastern Mediterranean, our "potamological" (Pardé, 1949) approach is of value for any mountainous region where hydrological resources are a key factor at the early stage of neolithization.

KEYWORDS: Aceramic Neolithic, Cyprus, Crete, GIS, hydrogeomorphology

PAPER ID: CEST2021_00483

Penetration of tritium into ground water in the Czech Republic

Eva Juranová*, Barbora Sedlářová, Diana Marešová, Irena Pohlová

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ABSTRACT

Tritium (^3H), the radioactive hydrogen, can form naturally by interaction of the cosmic radiation with the atmosphere, or it can be produced by human activities. In recent, tritium occurs distributed in environment in low concentrations, which means no significant health risk, but it can be used for tracing purposes. In the Czech Republic, tritium was monitored in ground water samples together with the samples of precipitation, using the method of liquid scintillation analysis with electrolytic enrichment. The average value of the tritium concentration in ground water was 0.57 Bq/l, which is lower than the average value evaluated for precipitation (0.97 Bq/l). This is caused by the radioactive decay of tritium in ground water, where the connection with the surface is limited. The results of this tritium monitoring can be used for estimation of the surface influence onto the ground water and for the assessment of ground water vulnerability.

KEYWORDS: Tritium, Radioactivity, Ground Water, Precipitation, Infiltration

PAPER ID: CEST2021_00429

SESSION 3 – SOLID WASTE MANAGEMENT

Thursday 2 September – morning

Accumulation of microplastic in road dust and in soil alongside roads – a case study from the Eastern Region, Abu Dhabi

Habib R.Z.[1], Al Kindi R.[1], Ghebremedhin, F.[2], Elkashlan, M.,[2] Ajejevbe A.I.[2], Thiemann T.[2,*]

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ABSTRACT

Roadsides and soil have been sampled for microplastic content in 7 locations in the Al Ain area, Eastern Region, Abu Dhabi, UAE. The collection sites constituted residential areas and fall-out roads, but also one Wadi and the shoreline of a man-make lake. The concentration of micro-tire particles was found to be high on the roadsides of the residential areas. While a significant amount of tire macroparticles could be found on the roadsides of fall-out roads, these exhibited less micro-tire particles. Here, significant amounts of micro-tires could be found off-road, along the fallout roads, indicating, in absence of run-off water, Aeolic transport of the particles. The Wadi and the lakeshore sites were essentially free of micro-tires, but in all sites, microfibers were found. Collection of run-off water from roads during a rare rainstorm event showed transport of plastic microparticles both into the storm drains as well as to the adjacent soil. High surface temperatures and extreme aridity in the summer leads to the evaporation of small organic additives from the plastic materials leaving them dry and brittle. This leads to easy further mechanical fragmentation of the particles.

KEYWORDS: microplastic, micro-tires, microfibers, soil

PAPER ID: CEST2021_00464

Optimized use of biogenic waste streams through the combined production of bio-based products and bio-hydrogen

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ABSTRACT

Since 2015, there has been a legal obligation in Germany for the districts and cities to collect biowastes separately, which are then treated in a composting plant or fermentation plant. However, in both aerobic and anaerobic biowaste treatment, a large part of the carbon contained in the waste is released in the form of carbon dioxide (CO_2) without using the raw material potential it contains. Against the background of efforts to save climate-relevant gases and the scarcity of natural resources, the aim of biological waste treatment should be to make better use of the potential of bio-waste through innovations in the known treatment processes. These innovative processes should make better use of the carbon contained in the biomass and obtain higher-quality and economically profitable bio-based products from it, to substitute primary raw materials.

In a first step, the anaerobic process of dark fermentation initially produced short-chain carboxylic acids from organic waste streams. This process also produces a hydrogen-containing biogas that can be used for energy. In a secondary fermentation, the carboxylic acids are then to be lengthened and separated using a non-polar extractant. The extended carboxylic acids then serve as platform chemicals for the manufacture of various bio-based products.

KEYWORDS: Bio-waste, anaerobic, dark-fermentation, carboxylic acids, bio-based products

PAPER ID: CEST2021_00769

Effective separation of waste printed circuit boards using microwave-assisted organic swelling

Bruno Monteiro[1], Liliana M. Martelo[1], Paulo M.S. Sousa[1], Margarida M.S.M. Bastos[2], Helena M.V.M. Soares[1,*]

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ABSTRACT

Nowadays, our lifestyle demands more electronics products, and this rapid development generated an increase in the amount of electronic waste (e-waste). Waste printed circuit boards (WPCBs) are components in all electronic devices and responsible for a high percentage of the total weight of the generated e-waste worldwide. WPCBs are composed of fiberglass reinforced epoxy composites and additives. The critical step in recycling WPCBs is to separate the non-metallic and metallic components by removing the epoxy resins.

In this work, a new method is proposed to separate the several layers of the WPCBs using organic solvents under microwave conditions. Firstly, various solvents capable of dissolving the brominated epoxy resin from WPCBs were selected based on the calculation of Hansen solubility parameters. All chosen solvents were tested by microwave and then compared with methods previously described (thermostatic and ultrasonic baths). Microwave showed to be the most efficient and rapid approach. The best conditions were WPCBs dimensions of 225 mm^2 using N-methylpyrrolidone (S/L ratio of 300g/L) at 200 ºC with 2 cycles of 10 min.

This method showed to be an efficient, fast and eco-friendly choice over the technologies available for delaminating totally WPCBs into metallic and non-metallic components.

KEYWORDS: Waste printed circuit boards recycling; Microwave-assisted organic swelling; Hansen solubility parameters; Brominated epoxy resin dissolution.

PAPER ID: CEST2021_00127

Nothing to Waste: A Green Venture Business Model supporting local communities to Circular Economy pathways

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ABSTRACT

Nothing-to-Waste is a green venture about the promotion and implementation of circular economy in the area of Western Thessaloniki, Greece, where 24 businesses are attempting to self-manage their waste in sustainable way. The project is being planned, implemented, coordinated and monitored by NoWaste21, a non-profit enterprise running projects in circular economy, sustainable waste management and recycling. The project uses an integrated approach that includes the implementation of a pilot separate collection program by setting up 29 green points with bins for the separate collection of 6 different waste streams: paper, PET bottles, other plastics & metals and Tetrapak packaging, electrical & electronic equipment, household batteries, and cooking oils. Concurrently, the project includes an educational and training program of businesses and their employees to raise awareness on circular economy principles and ensure their active participation. Preliminary findings of 2 months showed inefficiencies and malpractices regarding the sorting of waste which over continuous communication and education decreased significantly collecting over 6.5 tonnes of recyclable material. Best results were reported for paper in terms of purity with most of the quantities being stocked material. As the project progresses there is a gradual improvement in the collected quantities and the purity of the materials.

KEYWORDS: circular economy, business model, recycling

PAPER ID: CEST2021_00643

Towards decentralizing the energy system: production of bioenergy and bioproducts via anaerobic digestion

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ABSTRACT

The model of circular economy has gained worldwide interest. Within its concept, biodegradable waste is viewed as a beneficial resource that needs to be re-introduced in the supply chains. The use of raw materials, energy, and water is also to be minimized. Undeniably, a strong link exists between the bioeconomy, circular economy, bioproducts and bioenergy. In this light, a range of alternative options and technologies for biowaste exploitation are currently available towards promoting bioeconomy. In this paper, a generic methodological scheme is proposed for the development of small, medium, or large-scale units of alternative biowaste treatment, with an emphasis on the production of bioenergy and other bioproducts. With the use of multi-criteria decision analysis, the model simultaneously considers environmental, economic, and social criteria to support robust decision-making. Towards validating the methodology, the latter was demonstrated in a real-world case study for the development of a facility in the region of Serres, Greece. Based on the proposed methodological scheme, the optimal location of the facility was selected, based on its excellent assessment in criteria related to environmental performance, financial considerations, and local acceptance. Moreover, anaerobic digestion of agricultural residues, together with farming and livestock wastes, are recommended to produce bioenergy and bioproducts.

KEYWORDS: sustainable management; bioenergy; decision support system; multi-criteria analysis; bioeconomy.

PAPER ID: CEST2021_00665

Analytical Developments for PVC Radiooxidation Study, in Simulated Disposal Conditions

Chantreux Mathilde[1,2], Rossignol Stéphanie[1], Ricard Denise[2], Bussière Pierre-Olivier[3], Thérias Sandrine[3], Gardette Jean-Luc[3], Wong-Wah-Chung Pascal[1,*]

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ABSTRACT

Radioactive waste is generated by the use of radioactive materials in industry, research and medicine, as well as in nuclear power plant. The management and disposal of such waste is, therefore, a very important issue. In France, the estimated volume for the low intermediate-level long-lived radioactive waste is around 43,000 m^3 according to the inventory at end 2018 (Andra, 2020). This category includes, among others, organic materials such as chlorinated and fluorinated polymers, polyolefins, polyurethanes and polyacrylates. Chlorinated polymers, like polyvinyl chloride (PVC), are one of the most used.

Under disposal conditions, PVC can be exposed to different processes of degradation and in particular to radiooxidation process that implies the concomitant action of gamma radiation and oxygen (Colombani et al., 2007; Decker, 1976; Miller, 1959). PVC radiooxidation leads to structural changes in the polymer such as chain scission or cross-linking (Miller, 1959) and the main identified reaction byproducts are HCl and H_2 gases and some carbonyl compounds and carboxylic acids (Colombani et al., 2007; Decker, 1976).

Most of the authors describe the radiooxidation mechanisms of the PVC matrix and less attention has been paid to the identification of organic degradation products. Indeed, the radiooxidation of PVC induces the formation of water-soluble molecules likely to migrate in groundwater and thus interact with disposal surrounding materials as well as with the radionuclides. These anionic compounds can form complexes with the radionuclides present in the waste packages (Barthelemy and Choppin, 1989; Keith-Roach, 2008; Reiller et al., 2017) and thus modify their properties by increasing their mobility and ultimately the risk of dissemination in the environment.

This work proposes an extensive study of the organic degradation products resulting from the radiooxidation of formulated PVC using powerful analytical techniques: thermal desorption coupled with GC-MS (TD-GC-MS) and liquid extraction with solvents or solubilization-precipitation approach coupled with GC-MS. This was combined with a diffusion study of these byproducts in interstitial cementitious water. The objectives are (*i*) to identify the byproducts and set their kinetics, (*ii*) to

discriminate their source (PVC polymer or additives) and (*iii*) to identify leaked compounds in the solution.

Thus, pure resin (powder) and three PVC formulations (films) containing a plasticizer, diisononyl phthalate (formulation 1), the same plasticizer and a heat stabilizer, metals organic derivatives (Ca/Zn) (formulation 2) and an industrial PVC, containing the same type of additives and others used as lubricant (stearic acid, calcium stearate, talc). They were exposed at different doses of γ radiation from a ^{60}Co source, to study the formation/degradation kinetics of byproducts. Then, these PVC samples were put in alkaline water (pH=13.3) to simulate the storage conditions of nuclear waste.

The exhaustive analysis of PVC radiooxidation by-products was carried out in two steps. A first study on the polymer to obtain a general insight into degradation products formed inside the matrix; then, a study on the leaching solutions. This second study aims to determine the different families of molecules contributing to the Total Organic Carbon (TOC) contained in the water.

The results allowed, thanks to TD-GC-MS, to highlight the increase of the concentration of total Volatile Organic Compounds (VOC) according to the irradiation dose and PVC formulation. In addition, many compounds such as ketones, alcohols and carboxylic acids were also identified by GC-MS. The latter, well-known as radionuclides complexing agents, were identified and quantified in PVC leachates, by Ion Chromatography coupled to Mass Spectrometry (IC-MS). The impact of the PVC formulation on the type of by-products formed and identified in the leachates was established. Pure PVC leads to byproducts resulting from the polymer chain radiooxidation such as carboxylic acids (carbon atoms > 4) while phthalic acid was mostly produced for industrial and formulated PVC. This formation was attributed to the alkaline hydrolysis and radiooxidation of DINP plasticizer.

KEYWORDS: PVC, radiolysis, degradation products, TD-GC-MS, GC-MS

PAPER ID: CEST2021_0000374

Declassification of drilling waste from oil & gas exploitation through end-of-waste criteria to be used as construction materials

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ABSTRACT

All activities related to Oil & Gas Exploration, Production, Storage and Transportation involve waste generation associated to potential risk to environment. Waste types are related to Exploration and Producing (E&P) activities. These activities are: Drilling operations, Production operations, Completion operations, Work-over operations, Gas plant operations. Many of the materials and wastes associated with drilling activities have the potential to impact on the environment negatively. The potential impact depends primarily on the material, its concentration after release of the biotic community that is exposed. Some environmental risks may be significant whiles others are very low. The major impacts of great concerns are pollution of water bodies, pollution of land, as well as air pollution. In oil-based drilling activity, the waste thar is produced is mainly treated through thermochemical cutting cleaner to recover oil and solid fraction. Oil is be used again back to drilling activities as lubricated while solid fraction remains unused. The article 6 of the amendment Waste Framework Directive (WFD) 2018/851, set out a condition whereby a waste product would cease to be classed as waste if a market or demand existed for such a substance as well that has ceased to be waste and that has not been placed on the market; or places a material on the market for the first time after it has ceased to be waste, to ensure that the material meets relevant requirements under the applicable chemical and product related legislation, a Waste produced from drilling activities needs further attention. EWC are all the requirements that have to be satisfied by a material resulting from waste to confirm that the quality of the material is such that its use is not harmful for human health or the environment The paper focuses on the declassification of the solid fraction from the thermochemical cuttings cleaner, to be used as construction material.

KEYWORDS: end-of-waste criteria, drilling waste, Oil & Gas Exploration, construction materials

PAPER ID: CEST2021_00487

Performance evaluation of flue gas cured calcium rich fly ash-based building blocks

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ABSTRACT

This work focuses on the local alkaline wastes of Estonia where different waste streams were studied for the performance testing of the fly ash based building blocks. Fly ash from oil shale direct combustion and wood fly ash from district heating plant were considered in the applications for utilizing both CO_2 and combustion residues. These types of ashes contain Ca/Mg-oxides, silicates, or other metal oxides as candidate precursor materials for CO_2 mineralization. Based on the results obtained from the performance testing of all compacted and carbonated (both with model flue gas and 100%CO_2) samples, it can be concluded that flue gas curing can be an effective method for direct mineral carbonation of compacted fly ash blocks. The formation of carbonate phases in compact bodies lead to an increase in compressive strength. The rate limiting impact due to the low CO_2 concentration in flue gas curing was negligible on the CO_2 uptake level when elevated curing pressures were applied to the fly ash based compacts.

KEYWORDS: Fly ash**,** accelerated carbonation, CO_2 mineralization.

PAPER ID: CEST2021_00333

Material flow analysis applied to a waste treatment plant in Lombardy (Italy)

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ABSTRACT

Material flow analysis (MFA) allows to quantify inputs, outputs and stocks of a system and to communicate results visually. It can be used for calculating process effectiveness, losses and for identifying critical points within a system, being useful for strategically intervening in a corporative environment. When linked with environmental indicators, actions to promote sustainable development and circular economy can be defined. In this study, a waste treatment plant located in Lombardy (Italy) was selected for a case study. An inventory analysis for three consecutive years was conducted and the MFA of the whole plant was developed. In addition, 11 environmental indicators were calculated. During the period in study, the company processed $720x10^3 \pm 4x10^3$ t of materials, including metals, inorganic materials and others (e.g., plastic, cardboard, glass). The highest recovery rates were achieved for metals (98.40 ± 6.26%). The overall percentage of materials recovered in the plant equals 78.50 ± 1.81 %. The company showed high eco-efficiency (0.78 ± 0.01), low energy intensity (0.20 ± 0.01 GJ/t/y) and relatively low water input ($4.65x10^4 \pm 8.14x10^3$ t/y). Indirect emissions due to energy consumption accounted for $5.79x10^3 \pm 2.35x10^2$ t-$CO_{2eq,}$ which can be reduced by adopting cleaner transportation services.

KEYWORDS: Circular economy, Eco-efficiency, Solid waste management, Recycling, Environmental indicators

PAPER ID: CEST2021_00277

Preparation of carbon nanotubes from plastic solid wastes over magnetic nickel ferrite catalysts

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ABSTRACT

This work presents the development of magnetic carbon nanotubes (MCNTs) from plastic solid waste (PSW). For this purpose, diverse catalytic nanoparticles based on Fe, Ni and Al were prepared by impregnation of alumina or co-precipitation of Ni, Fe and Al nitrate salts with NH_4OH, followed by calcination at 800 ºC. These magnetic nanoparticles were then used as catalysts in the growth of carbon nanotubes by chemical vapour deposition in a tubular furnace using low-density polyethylene as carbon precursor and as representative polymer composing PSW. MCNTs were characterized by transmission electron microscopy (TEM) and X-ray diffraction. The morphology and dimensions of the MCNTs were observed by TEM, concluding that large multiwalled MCNTs were prepared with magnetic nanoparticles inside (spacing of ~0.2 nm) and with a carbon interlayer spacing of ~0.34 nm. In conclusion, the synthesis of MCNTs from polyolefins is evidenced and can lead to technological alternatives in the treatment of PSWs.

KEYWORDS: plastic solid waste, chemical vapour deposition, nanostructured carbons, magnetic nanoparticles, valorization.

PAPER ID: CEST2021_00097

Optimum technical operating conditions and treatments for the production of high-purity struvite fertilizer from livestock wastewater.

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ABSTRACT

Inadequate treatment of nutrient-rich waste streams originating from human activities such as agriculture, animal breeding, urbanization, and industrialization causes an array of environmental problems. Among them are eutrophication of surface water, nutrients and pathogens leaching into groundwater, soil acidification, and destruction of fragile ecosystems. Moreover, food security will be jeopardized, since industrial P-fertilizers are manufactured using phosphate rocks which is non-renewable resource that is constantly depleting. Nutrient recovery (N and P) from wastewater matrices could be a sustainable solution to mitigate this problem. Struvite is a crystalline mineral, which constitutes a slow-release high-value organic fertilizer, containing equal molar concentrations (1:1:1) of magnesium, ammonium, and phosphate (struvite $MgNH_4PO_4 \cdot 6H_2O$), that can be recovered from nutrient-rich wastewater streams. This presentation will focus on the optimum operating conditions that should be applied, in order to produce high-quality struvite fertilizer from livestock wastewater. The tested experimental conditions for struvite crystallization included: solution pH, molar ratio Mg^{2+}: N-NH_4^+: P-PO_4^{3-}, temperature, added Mg-sources, retention time, and seeding-material addition. Moreover, the effect of matrix composition is discussed. The produced struvite from each process was analyzed for its quality and purity, which was higher than 90%, and in most of the cases the precipitate was complying with the legislative requirements for fertilizers.

KEYWORDS: recovery, wastewater, fertilizer, struvite, nutrient.

PAPER ID: CEST2021_00309

Modelling the Hydrothermal Carbonization of Cheese Whey Wastewater in Lesvos Island: an Application of the 3-Step Evolution Model

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ABSTRACT

Lesvos island has an extensive dairy production sector, and -at present- eighteen dairy processing facilities are operating. Efficient management of the liquid biowaste effluents has been an issue of interest since the scope is the minimization of the environmental impact. Hydrothermal carbonization of cheese whey wastewater can be a viable option for reducing the organic load and at the same time produce hydrochar, which is a material that can be utilized in several downstream processes. Locally sampled cheese whey wastewater was treated in a hydrothermal autoclave reactor under subcritical conditions, i.e., 200 °C and 20 bar. The novel 3-step evolution model is being used and validated for the specific case of cheese whey wastewater in Lesvos and different operating conditions. The model performs a series of "char-gas" reactions for the final calculation of the produced gases based on the hydrochar yield. The model reports ratios of hydrochar-to-gases that are very close to the experimentally measured values. The biggest fraction of the produced gaseous products was simulated to be carbon dioxide.

KEYWORDS: Thermodynamic modeling, Hydrochar, Biowaste, Experimental validation, Carbon dioxide

PAPER ID: CEST2021_00551

SESSION 4 - ADVANCED OXIDATION PROCESSES

Thursday 2 September – morning

Mitigation of *Microcystis sp.* with metallic peroxide granules: matrix effect on hydrogen peroxide release kinetics and toxicity study on invertebrates

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ABSTRACT

An array of mitigation strategies has been applied over the years for toxic blue-green algae with the most recent one to be hydrogen peroxide (H_2O_2). Hydrogen peroxide has been widely used as an alternative to copper algaecides, and it is perceived as a more environmentally friendly option for treating surface waters. However, dense blooms demand high oxidant causing undesirable effects to the non-targeted organisms in the aquatic ecosystem. Slow releasing H_2O_2 metallic granules have been used in this study as an alternative approach to direct application of high-doses liquid H_2O_2 application. In this study, calcium peroxide (CaO_2) granules were applied in surface water matrix (Kouris Dam, Cyprus) to examine: (a) their H_2O_2 releasing properties with varying pH values, (b) their mitigation efficiency on *Microcystis* sp. bloom in comparison with liquid H_2O_2, and (c) their toxicity on *Gammarus* sp. in a range of concentrations. Results showed that in acidified environments granules have higher H_2O_2 releasing capacity. Moreover, treatment of *Microcystis* sp. with 0.5 – 2.0 g/L CaO_2 were efficient to eliminate the blooms and safe on zooplankton species. All of the above, are indicative towards the potential of CaO_2 treatment, however its application necessitates further investigation prior taking it to the field.

KEYWORDS: cyanobacteria, hydrogen peroxide, metallic granules, mitigation, surface water

PAPER ID: CEST2021_00037

Catalytic Enhancement of Ozone-Based Processes for Removal of Selected Antibiotics from Wastewaters

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ABSTRACT

The aim of our work was to use advanced oxidation processes based on formation of reactive hydroxyl radicals (OH·) due to ozonation and its combination with H_2O_2, Fe^{2+} as catalyst and UV light for removal of Amoxicillin and Levofloxacin from model wastewaters at different pHs. Removal efficiencies were monitored by TOC (Total Organic Carbon) and COD (Chemical Oxygen Demand) measurements. Kinetics of oxidation was determined based on two-stage consecutive reaction presuming pseudo first order kinetics. Amoxicillin degraded during ozontion up to 33%. The most efficient was combination of $O_3/Fe^{2+}/H_2O_2$/UV (76%). In the case of Levofloxacin removal efficiencies for were up to 83% 8. Addition of H_2O_2 did not improve treatment efficiency, Kinetics of degradation confirmed rapid first degradation stages of both antibiotics, while the by-products degradation was slower. Investigated procedures exhibited potential for efficient removal of antibiotics from wastewaters.

KEYWORDS: antibiotics, biotreatability, kinetics, ozonation

PAPER ID: CEST2021_00057

Investigation of variables affecting UV-LED photocatalytic degradation of antibiotics ciprofloxacin and sulfamethoxazole

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ABSTRACT

In this study, photolytic and photocatalytic degradation of two antibiotics in ultra-pure water were analyzed. A lab-scale cylindrical reactor had its inner walls impregnated with TiO_2 nanofilm for the photocatalytic experiments. In the first step, an optimized photoreactor design was chosen based on the degradation of ciprofloxacin (CIP) under UV-A. The impact of controlled periodic illumination (CPI) on kinetic rates and energy expenses was also studied. In the second step, degradation of both ciprofloxacin and sulfamethoxazole (SMX) were analyzed at different wavelengths (UV-A and UV-C) using the photoreactor design selected in the first step. Results show the optimization benefits of an appropriate photoreactor and CPI for photocatalysis. Each compound's reactivity to different degradation pathways plays a major role in the process, so a careful study of the particularities of each system is paramount for lowering energy expenses.

KEYWORDS: Ciprofloxacin; Light-emitting diodes; Photocatalysis; Photoreactor design; Sulfamethoxazole; Ultra-violet

PAPER ID: CEST2021_00065

New pillared clays for the removal of pollutants from wastewater by treatment with oxidation processes

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ABSTRACT

The constant development of technological processes aggravates the problem of pollution, due to a significant change in the composition of effluents that makes necessary the development of new (and/or improvement of the existing) treatment methods and catalytic materials. In this sense, the use of natural claysin the synthesis of low cost pillared clays for application as catalysts in oxidation technologies for the treatment of wastewaters are relevant from an environmental and sustainable point of view. In this work, inexpensive natural clays from different regions of Kazakhstan(Akzhar, Karatau and Kokshetau) were used in the preparation of pillared clays for the catalytic oxidation of organic pollutants with H_2O_2. Since nitrophenols are commonly found in many types of industrial wastewaters (e.g. plastic, pharmaceutical, paper or pesticides industries), 4-nitrophenol (4-NP) was used asrepresentative model compound in the catalyst screening studies. The pillaring process of the targeted natural claysinvolved the incorporation of active metals such as Zr, Znand Fe, responsible by increasing the catalytic activity of the materials relatively to the natural clays. High conversions of TOC (85%) and of 4-NP (100%) were obtained with the Zr-pillared clay from the Akzhar region.

KEYWORDS: Wastewater treatment, pillared clays, oxidation, catalyst, organic pollutants

PAPER ID: CEST2021_00072

Performance of metal-free carbonaceous catalysts in the removal of paracetamol by catalytic wet peroxide oxidation

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ABSTRACT

The performance of metal-free carbonaceous catalysts was evaluated in the removal of paracetamol, chosen as model pharmaceutical micropollutant, by catalytic wet peroxide oxidation (CWPO). The carbon materials were prepared from pentaerythritol tetraacrylate and divinylbenzene copolymer with bis(2-ethylhexyl) phthalate as porogen followed by subsequent carbonization at 900 ºC under N_2 atmosphere. The synthesized material was grinded to powder and separated into different samples, according to its granulometry. The sample with particle sizes between 53 and 106 µm (catalyst Mon11) was further functionalized with nitric acid 5 M at 120 °C for 3 h (catalyst Mon11F) to increase the hydrophilicity of the original material. Both catalysts revealed high activity in CWPO, completely removing the pharmaceutical compound within 6 and 24 h of reaction at 80 ºC, when Mon11 and Mon11F were used, respectively. Total organic carbon (TOC) conversion achieved values of 86.8 and 75.8% with Mon11 and Mon11F, respectively. Adsorption tests at the same operating conditions resulted in removals of paracetamol after 24 h around 29% for Mon11 and 11% for Mon11F, confirming the predominance of catalytic removal of the pollutant in the CWPO runs.

KEYWORDS: CWPO, metal-free catalysts, functionalization, paracetamol

PAPER ID: CEST2021_00107

Selective denitrification of lipophilic pollutants from oily wastewater by peroxidation using Janus-structured amphiphilic carbon nanotubes as catalysts

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ABSTRACT

Carbon nanotubes (CNTs) were tested as catalysts in the selective denitrification of 4-nitrophenol (4-NP) from oily wastewater by catalytic wet peroxide oxidation (CWPO). The CNTs were prepared by chemical vapor deposition, feeding sequentially ethylene (E) and/or acetonitrile (A) during different times until 20 min, resulting in samples E20, A20 and E10A10, the number denoting the time feeding of each precursor and the order of appearance of the letter indicating the order of each precursor. The synthesized CNTs were tested in the CWPO of 4-NP in aqueous solutions and in simulated oily wastewater (2,2,4-trimethylpentane and water) at 80 ºC, initial pH 3.5, $C_{4\text{-}NP}$ = 1 g L^{-1}, $C_{H_2O_2}$ = 3.56 g/L and $C_{catalyst}$ =2.5 gL^{-1}. The catalyst A20 promoted a faster decomposition of H_2O_2 and a lower degradation of 4-NP in the aqueous system, whereas the catalyst E20 displayed the opposite trend, since E20 was able to remove 99% of the pollutant and A20 only 69% after 8 h of reaction. E10A10 in biphasic L-L media presented the highest conversion of 4-NP after 24 h in the oily phase (51%), followed by A20 (38%) and then E20 (25%). This tendency may be ascribed to the formation of Pickering emulsions by E10A10. The amphiphilic carachteristic of this material ensures a closer contact between the liquid phases, allowing higher mass transfer.

KEYWORDS: Catalytic wet peroxide oxidation, 4-nitrophenol, Carbon nanotubes, Janus-structure, Pickering emulsion.

PAPER ID: CEST2021_00125

Can mixed oxides act as efficient photocatalysts for the elimination of organic water pollutants?

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ABSTRACT

New mixed-metal oxides containing zinc and lanthanum were synthesized by co-precipitation. The as-prepared nanocomposites were then calcined, and characterized by scanning electron microscopy (SEM), X-ray diffraction, FT-IR, BET and DR analysis. The calcined sample showed a higher crystallinity, confirmed by sharper and more intensive diffraction lines. On the other hand, a slight decrease of the band gap was found for the calcined material. The photocatalytic effectiveness of the synthesized nanocomposite to degrade a refractory water micropollutant, named clofibric acid (CA) was investigated in this work under ultraviolet (UV-A) irradiation. Elimination and mineralization of the target molecule were evaluated by HPLC and TOC measurements. The influence of CA initial concentrations (3-50 ppm), irradiation time (60-240 min), catalyst loading (20-500 mg/L), water matrix and radiation intensity were evaluated in detail. The CA was completely eliminated just after 110 min. of reaction (10 mg/L CA concentration and 500 mg/L catalyst). Moreover, TOC measurements showed a good mineralization (70%) under these conditions. Process efficiency was found to decrease with increasing the initial concentration (10-50 mg/L). Obtained results demonstrated the merit of the synthesized materials to be considered as promising photocatalysts for water purification applications.

KEYWORDS: mixed oxide; lanthanum; water pollutant; degradation; photocatalysis

PAPER ID: CEST2021_00615

Sonolytic and hybrid-sonolytic degradation of 6-hydroxy-methyl uracil, a model compound for the study of cyanotoxin cylindrospermopsin

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ABSTRACT

The occurence of cyanotoxins, produced from cyanobacterial blooms, in the aquatic environment, has been a topic of great importance for scientists and authorities, over the last years. Cyanotoxins can greatly affect humans and fauna [1], therefore, their inclusion in monitoring programmes and in regulatory measures is considered of great significance. The target toxin of this study is cylindrospermopsin (CYN), which is an alkaloid compound, responsible for causing multiple organs' disorders, while being hepatotoxic and neurotoxic [2].

Several Advanced Oxidation Processes (AOPs), using mainly photocatalytic treatment, have been applied for the degradation of CYN [3]. The use of sonolysis for the oxidative degradation of organic compounds, has shown interesting results and satisfactory efficiency in selected applications [4]. Moreover, coupling sonolysis to catalytic AOP systems, has shown to promote degradation efficiency and lead to improved performance facilitating a broader range of applications [5].

The study of CYN's degradation presents great scientific and regulatory interest. However, CYN is a highly toxic compound and its analytical standards are rare and expensive, thus their use in extensive degradation research is problematic. The use of a more abundant and low-cost model compound could be a suitable alternative. 6-hydroxy-methyl-uracil (6-HMU) could be used as a model compound for CYN, since it contains a part of CYN's structure, partly responsible for its toxicity [6]. Furthermore, 6-HMU is a stable, non-toxic and reasonably priced substance.

In the present study, 6-HMU was used as model compound for CYN sonolytic and hybrid-sonolytic degradation. The research objectives were (1) to investigate and optimise the parameters affecting sonolysis' kinetics and efficiency, (2) to evaluate the efficacy of the coupled sono-Fenton process on the degradation of 6-HMU and, finally, (3) to detect and identify the transformation products (TPs) arising from the sonolytic degradation of 6-HMU and to compare them with the TPs of CYN's degradation.

The sonolytic and hybrid-sonolytic experiments were conducted in an ultrasound generator K 80 equipped with Transducer E/805/T and ultrasound bath 5/1575, at different intensities, initial concentrations of 6-HMU, pH values, and water matrices. The degradation of 6-HMU was monitored using HPLC-PDA, while the concentrations of Fenton reagents were measured spectrophotometrically. 6-HMU's TPs were identified and detected by LC-MS/MS.

The degradation kinetics of 6-HMU sonolysis in water were mainly affected by the intensity of sonication, initial pH and initial concentration of target compound. Initial degradation rate (r_o) varied from 4,69E-05 to 1,70E-04 mmol $L^{-1}s^{-1}$ under different intial concentrations of 6-HMU, while at pH 10, the highest r_o was observed, equal to 8,17E-05 mmol $L^{-1}s^{-1}$.

Hybrid sono-Fenton system was extensively studied in terms of Fe(II), Fe(III) and H_2O_2 initial concentrations individually and in combination. The addition of Fe(II) during water sonolysis of 6-HMU, resulted in faster and more effective degradation. Using only 10mg/L Fe(II) increased r_o (2,18E-04 mmol $L^{-1}s^{-1}$) was achieved.

Sono/Fe(II)/H_2O_2 system gave very promising results, showing improved degradation rate and efficiency, with limited consumption of reagents. The ratio Fe(II)/H_2O_2 that gave the most effective degradation, was 1mg/L Fe(II) / 100mg/L H_2O_2 (r_o = 3,07E-04 mmol $L^{-1}s^{-1}$).

Determination of 6-HMU's TPs displayed great similarities to CYN's TPs, confirming the initial research hypothesis that 6-HMU could be used as a model compound for the investigation of CYN's degradation with different treatment techniques.

KEYWORDS: Sonolysis, sono-Fenton degradation, cylindrospermopsin, 6-hydroxy-methyl-uracil

PAPER ID: CEST2021_00824

Silver decorated TiO2/g-C_3N_4 nanocomposites for photocatalytic elimination of water pollutants under UV and artificial solar light

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ABSTRACT

TiO_2/g-C_3N_4/Ag nanocomposites were prepared and used as highly efficient photocatalysts. TiO2 nanoparticles were first prepared using a sol-gel process, and titania herostructures with varying amounts of graphitic carbon nitride (g-C_3N_4) were created using a hydrothermal technique. Following impregnation in a silver nitrate aqueous solution employing sodium citrate, the TiO_2/gC_3N_4 heterostructures were decorated with Ag nanoparticles. The prepared materials exhibit strong photocatalytic activity in both oxidation and reduction reactions. Under UV and artificial solar illumination, the degradation of four model contaminants, methylene blue (MB), rhodamine B (RhB), 4-nitrophenol (4-NP), and chromium(VI) (Cr^{+6}), was examined. With degradation percentages of up to 95% for MB and 89% for RhB, an optimal condition was determined, resulting in the effective removal of dye contaminants under UV light. Fast degradation rates for these dyes were also observed under artificial solar light. In addition, the TiO2/gC3N4/Ag nanocomposites were successful during photocatalytic reduction of 4-NP and Cr^{+6} contaminants in water, converting these hazardous compounds to a useful industrial precursor (aminophenol) and a less toxic substance (Cr^{+3}), respectively.

KEYWORDS: TiO_2/g-C_3N_4/Ag nanocomposites; UV and artificial solar light; Organic-inorganic pollutants degradation.

PAPER ID: CEST2021_00151

SESSION 5 - CLIMATE CHANGE MITIGATION AND ADAPTATION

Thursday 2 September - morning

Studies on the CO_2 Adsorption onto Coal Fly Ash Zeolites at Elevated Pressures

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ABSTRACT

Coal fly ash zeolites (CFAZs) of Na-X type were prepared by ultrasonic-assisted double stage fusion-hydrothermal synthesis from lignite coal fly ash at two different fusion temperatures 550 and 800 °C. The detailed surface analyses were performed experimentally using N_2 physisorption technique and by applying standardized mathematical models. CFAZs were studied for their carbon capture potential at 5.5 MPa regarding their application in a pressure-swing CO_2 adsorption process. CO_2 loaded CFAZs were investigated by weight analyses, Fourier-Transform Infrared (FTIR) and Thermal Gravimetric Analyses (TGA). FTIR reveals vibration modes typical for the zeolite Na-X framework, physically attached CO_2 molecules and small amounts of carbonates. The adsorption capacity toward CO_2 measured by weight analyses and TGA reaches 385 $mgCO_2/gCFAZ$. Higher carbon capture ability was found at CFAZ prepared with a pre-fusion stage at 800 °C, despite its the lowest specific surface area. A favourable effect of the increased content of mesopores in the CFAZ framework on the CO_2 adsorption at elevated pressures has been established.

KEYWORDS: Pressure-swing carbon capture, Low-carbon energy, Coal fly ash utilization

PAPER ID: CEST2021_00298

Mitigation potentials of tree-crops: An economic evaluation of trading-off carbon sequestration with actual market goods.

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ABSTRACT

As climate objectives are far from being reached under the prevailing policies, more concrete actions should be undertaken, and all possibilities should be exploited. Land-based mitigation potentials are emerging as a cost-effective mitigation prospect. CO_2 sequestration is an essential ecosystem service offered by tree cultivations once properly managed. Tree-based mitigation potentials should be identified, evaluated and enriched. The present study aims at developing a framework for assigning an economic value to the climate change mitigation potentials arising from tree cultivation. Such values could enrich the design of coupled agriculture climate policies by offering farmers appropriate incentives to adopt climate objectives.

KEYWORDS: Carbon farming; Climate change mitigation; Common Agricultural Policy, Ecosystem Valuation; Voluntary markets.

PAPER ID: CEST2021_00635

Microalgae bio-fixation efficiency of carbon dioxide through innovative planar photobioreactor

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ABSTRACT

The high anthropogenic activity of recent centuries has led to an urgent need to improve CO_2 capture and sequestration technologies. In this context, microalgae systems have gained importance, thanks to their high photosynthetic efficiency and the many applications to which they can be destined. For this reason, a new photobioreactor prototype was developed, consisting of two interconnected units: a photostage loop, composed by fluorescent lamps and two parallel alveolar flat-panel, and an obscured tank in which culture mixing is achieved. The photobioreactor is also equipped with a system of sensors that allows to control all the growth parameters of the culture and a system to control the CO_2 flow rate introduced. In this study a series of parameters were monitored to characterize the photobioreactor both as regards the hydraulic and the luminous parts. Furthermore, a series of biological tests were carried out using the alga *Acutodesmus obliquus* to verify the growth system under different hydraulic conditions (4÷18 L min^{-1}) and the CO_2 removal efficiency of this microalgal species.

The next phase will be to try to optimize the photobioreactor from an energy point of view in order to maximize the efficiency of the entire system.

KEYWORDS: Acutodesmus obliquus, photobioreactor, CO_2 biofixation, artificial light.

PAPER ID: CEST2021_00404

Environmental Monitoring from Space & Geoinformation through the Excelsior H2020 Teaming Project

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ABSTRACT.

The "EXCELSIOR" H2020 Widespread Teaming Phase 2 Project titled ERATOSTHENES: EXcellence Research Centre for Earth SurveiLlance and Space-Based MonItoring Of the EnviRonment is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 857510 for a 7-year project period to establish a Centre of Excellence in Cyprus. The Government of the Republic of Cyprus is providing additional resources to support the establishment of the ERATOSTHENES Centre of Excellence (ECoE). The ECoE seeks to fill the gap by carrying out spaceborne Earth Observation (EO) activities in the Eastern Mediterranean and becoming a regional key player in the Earth Observation sector. The ECoE as a Digital Innovation Hub adopts a two-axis model, where the horizontal axis consists of three Thematic Clusters for sustained excellence in research of the ECoE in the domains of Atmosphere and Climate, Resilient Society and Big Earth Data Analytics, while the vertical axis consists of four functional areas: Infrastructure, Research, Education, and Entrepreneurship. This paper presents existing state of the art research examples within the Centre that deals with the integration of earth observation and geoinformation for monitoring systematically the environment in the areas of Agriculture monitoring, Atmospheric monitoring and Disaster risk reduction in terms of earthquakes and landslides, fires and floods.

KEYWORDS: EXCELSIOR, ERATOSTHENES Centre of Excellence, Environmental Monitoring, Earth Observation, Geoinformatics

PAPER ID: CEST2021_00262

Climate Change and Local Governance: Politics, Policies and Prioritization of Adaptation in Adansi North District

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ABSTRACT

Climate adaptation remains low on political agendas at the local level in most developing countries despite the reality of impacts being experienced already and a projection of the worsening of same. While the factors that account for the lack of climate action by local governments are countless, politics is the heavy hand behind it all, mediating both policy and the allocation of funds. This study sought to evaluate the awareness of relevant actors in AND on climate change and assess the extent to which they participate in planning. The study also sought to assess the extent to which adaptation policies are captured and budgeted for in the AND District Medium-Term Development Plan (DMTDP) and Composite Budget (CB) (2018-2021). The study took on a concurrent nested mixed methods approach as quantitative data on adaptation policies budgeted for in the DMTDP supplemented the vast qualitative data collected through interviews and semi-structured questionnaires. It emerged that while climate change awareness is appreciable among actors, there is lack of consensus on who should initiate climate action at the local level. 41% of the broad policies in the DMTDP also directly align with strategies adopted in Ghana's Nationally Determined Contributions.

KEYWORDS: climate adaptation, local government, politics, policies, nationally determined contributions

PAPER ID: CEST2021_00361

Energy Transition in West Macedonia. What is the Public attitude of the local society?

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ABSTRACT

In view of the EU decarbonization policy implementation, the Greek government has recently decided the permanent retirement of lignite based thermal power stations (TPS) of West Macedonia, being in operation since the 70's. For the last fifty years, the Public Power Corporation has undertaken the responsibility to run the quarries and the thermal power stations offering almost 15000 direct and indirect job positions. In this context and despite the significant environmental impacts in the wider area, the lignite extraction and the operation of the TPS of Ptolemaida, Amintaio, Kardia and Agios Dimitrios have been the major economic activity of the entire prefecture for the last five decades. Although the Greek government has prepared quite ambitious plans to financially support the local communities and to encourage public and private investments, local societies are quite anxious about their future. To this end, the present work not only investigates the energy transition of the West Macedonia but also analyzes the attitude of the local people towards the radical changes anticipated in the near future. Emphasis is put on examining the answers of young scientists, most of them expecting to work in the energy supply chain of the under retirement TPS. The results of this analysis are quite interesting and underline the danger of significant immigration and brain drain for the area, while the involvement in planned energy installations may also be a serious alternative solution.

KEYWORDS: Lignite, Natural Gas, Job Creation, Air pollution, Energy supply security.

PAPER ID: CEST2021_00800

Development of an urban resilience indicator for Athens in the context of climate change

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ABSTRACT

Urbanization interacts with climate change through the way cities are organized and built (land cover/ land use, urban morphology). Increased energy consumption and consequently CO_2 emissions, combined with emissions from city functions (urban metabolism, anthropogenic heat sources) intensify urban climate change. The effects from more frequent extreme weather events and natural disasters etc. are already observed in cities in multiple spatial and temporal scales. Especially for the Athens basin, there has been an urban expansion of 28% from 1987 to 2010, a burden on human thermal comfort and a deterioration of the thermal environment in the suburban areas leading to social and economic inequalities within the urban complex of Athens.

The above highlight the necessity to develop an Urban Resilience Indicator (URI) as well as its spatial and temporal mapping over the Athens Basin. The indicator is based on the use of Earth Observation and census data and it allows the identification of urban units that exhibit limited resilience to climate change and the related factors. Moreover, the URI mapping will allow the identification of specific interventions that enhance resilience to climate change and the drafting of comprehensive plans for adapting and mitigating urban climate change.

KEYWORDS: climate change, urban resilience, GIS, remote sensing

PAPER ID: CEST2021_00271

Studies on the CO_2 Adsorption Mechanism of Na-X and Na-Ca-X Coal Fly Ash Zeolites

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ABSTRACT

Coal fly ash zeolites (CFAZ) of Na-X and Na-Ca-X types were synthesized using as raw materials fly ashes generated by the combustion of lignite from various deposits with low and medium limestone content. It has been found that CFAZs with higher calcium content superior those containing less calcium with respect to their ability to capture CO_2. This provoked our interest to elucidate the role of Ca in the CO_2 adsorption process. CFAZs of Na-X and Na-Ca-X types were investigated in dynamic CO_2 adsorption cycles, as the thermal regeneration of the adsorbents is carried out at low temperatures at which only the physically adsorbed molecules can be released. Desorption was investigated by thermogravimetric TG-DTG analyses over a wide temperature range.

KEYWORDS: Carbon capture, Circular economy, Coal fly ash utilization, Coal fly ash zeolites

PAPER ID: CEST2021_00296

Assessing small & medium-sized enterprises' resilience capacity to flooding: Evidence from a structural equation model

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ABSTRACT

In this study a model that comprises of factors linked to the resilience capacity of small and medium-sized enterprises (SMEs) to flooding is tested. A sample of 343 enterprises from flood-prone areas was administered a structured questionnaire on cognitive, managerial and contextual factors that influence the ability to shape effective responses to flood challenges. Structural Equation Modeling is employed to identify associations between the various observed items forming the individual latent sub-constructs, as well as the associations between these latent sub-constructs with the flood resilience capacity construct (FRCI). Findings reveal that the major contributor to the FRCI is the sub-construct of 'behavioral/managerial' factors (beta = 0.893; p-value<0.001). Moderate associations are observed with the 'cognitive' factors (beta = 0.157; p-value<0.1), whereas no associations are found with the 'contextual' parameters linked to FRCI. Through the proposed approach, an analytical framework is set forth that will help standardize such assessments with an overarching aim of reducing the vulnerability of SMEs to flooding. This is achieved by identifying major internal and external attributes explaining the resilience capacity which is particularly important given the limited resources these enterprises have at their disposal and that they tend to be primary sources of vulnerabilities in supply chain networks.

KEYWORDS: Floods; SMEs; organizational resilience capacity; structural equation modeling.

PAPER ID: CEST2021_00579

Monitoring of soil Greenhouse Gases emissions from a controlled burnt area combined with guided herbivory

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ABSTRACT

Rural depopulation as well as the intensification of farming systems in southern Europe have led to important changes in landscape and the ecosystem services they provide. Indoors livestock production is translated into a reduction or absence of grazing which ends up with a rapid expansion of bushes and extensive processes of natural forestation. This causes loss of biodiversity and accumulation of biomass fuel increasing the risk of big fires and therefore negatively affecting these lands.

Within the Open2Preserve project, different regional pilot experiences (France, Spain, and Portugal) were established. These pilots aimed at combining an initial prescribed burning to enhance forage quality followed by a grazing to both reduce fire risk and increasing the economic return of farmers, while reducing mechanical costly clearances to be developed there. We aim at evaluating the effect of horse grazed and un-grazed areas on greenhouse gases (GHGs) emissions in a mountain area of the Galicia region (NW Spain) after prescribed burning implementation A monitoring of GHG (CH_4, N_2O and CO_2) soil emissions during 16 weeks along the year 2020 was carried out.

KEYWORDS: Understory, fire control, grazing, shrubland.

PAPER ID: CEST2021_00782

Climate Adaptation and Local Institutions: An assessment of the adaptive capacities of key sectors in Adansi North District

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ABSTRACT

The over-domineering of political policies aimed at perpetuating power means issues of social interest such as climate adaptation capabilities are often relegated to the background. Thus, the success of adaptation efforts often hinges ultimately on the nature of institutional robustness and willingness to commit to the provision of adaptive capacity building at the local level. The objectives of this study were to assess the impacts of climate variability and change on the agricultural and health sectors in AND and assess the adaptive capacities of the same sectors. The study approach was mixed methods. Qualitative data was collected through interviews while quantitative data was consulted from weather data, DMTDP, CB, AAPs, crop yield data and OPD cases data. The magnitude of identified climate change impacts was analyzed using the formular, Magnitude= MEco+Menv+MSoc /15 x 100. The adaptive capacities of the key sectors were assessed using the Adaptive Capacity Wheel framework. The study revealed that rainfall, temperature and wind speed have increased in AND. This has led to a number of negative impacts with floods being the most devastating. Also, while the adaptive capacities of both the agricultural and health sectors need improving, the health sector has the better robustness.

KEYWORDS: adaptive capacity, local government, local institutions, climate change, impacts, agriculture, health

PAPER ID: CEST2021_00362

SESSION 6 - HEAVY METALS IN THE ENVIRONMENT

Thursday 2 September - morning

On the geochemistry of Gialova lagoon, SW Peloponnesus, Greece

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ABSTRACT

The spatial distribution of lithological characteristics, organic carbon and major / trace elements was studied in the surface sediments of the Gialova lagoon, a shallow water lagoon (<1.0 m) which is located at southwestern Peloponnesus (Greece). The sediment samples were collected on the basis of a detailed bathymetric map and the backscatter properties of the lagoon floor acquired using high resolution side scan sonar on board of an Unmanned Surface Vehicle (U.S.V.). Four main geochemical phases were identified based on the elements – grain size – organic carbon associations. Geoaccumulation index (Igeo) was estimated for heavy metal concentrations showed low to moderate contamination for Mo, Pb, Ni, and Cr.

KEYWORDS: Lagoon, sediments, heavy metals, Igeo

PAPER ID: CEST2021_0057

Selenate uptake by *Chlamydomonas reinhardtii* Algal Cells, its Transformation and its Effect on Membrane Lipid Profiles

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ABSTRACT

While selenium (Se) has been demonstrated to be essential for the optimal growth of freshwater microalgae Chlamydomonas reinhardtii [1], exposure to elevated concentrations of selenite (Se[IV]) or selenate (Se[VI]), the two major aqueous forms of Se, induce cell toxicity[2]. In this study, Chlamydomonas reinhardtii (cc.1690) cells have been grown in the presence of Se[VI] at increasing concentrations of 20, 50, 100 and 150 μM. Se determination obtained using ICP-MS upon cell digestion revealed that the uptake of Se follows a linear pattern with Se amounts determined at 10.7 and 103.6 fg per cell for the 20 and 150 μM incubation, respectively. In order to gain further information on the protein-bound cell internalized Se, size-exclusion chromatography coupled to ICP-MS (SEC-ICP-MS) was employed. Results demonstrated that an average 41% $\pm$ 6% of the uptaken Se, for all incubation concentrations, is protein-bound, while the existence of a low intensity chromatographic peak adjacent to the elution time of inorganic Se suggests the incorporation of Se into smaller biomolecules such as Se-cysteine and/or Se-methionine. Mass spectra from the direct lipidomic analysis of cells, obtained using desorption ambient mass spectrometry (EASI-MS), demonstrated a higher degree of saturation for 2 classes of membrane lipids, i.e., phosphatidylglycerol (PG) and sulfoquinovosyl diacylglycerol (SQDG), suggesting that reorganization of cell membrane lipids is taking place upon cell interaction with increasing amounts of Se[VI].

PAPER ID: CEST2021_00831

CO_2-Uptake Enhances Chromate Release from Fresh Chromium Ore Processing Residues (COPR)

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ABSTRACT

Chromium ore processing residue (COPR) still contains considerable chromate which can lead to groundwater contamination at uncontrolled dumpsites. The alkaline pH and presence of portlandite introduced in the high-lime roasting render COPR a potential CO_2-trap. To assess whether this feeds back on chromate mobility, fresh COPR samples from two Indian production sites for leather tanning salts were examined. Carbonation was performed at near atmospheric pressure and 100 vol.-% CO_2 for 48 h. The pH, electric conductivity, chromate and bulk anions were determined in aqueous batch leachates of the carbonated and native samples. In addition, the latter were spiked with Na_2CO_3 and titrated with HNO_3 to the pH observed in the carbonated material to distinguish mere pH effects on chromate release from carbonation. The samples sequestered up to 5.0 wt.-% CO_2, decreasing the pH and increasing chromate release by up to 270 %. The mobility enhancement was stronger in the carbonated than the pH-adjusted samples. Weathering of COPR and the concomitant uptake of CO_2 may thus increase the risk of groundwater contamination at COPR dumpsites.

KEYWORDS: COPR, Carbonation, Chromate, Leaching

PAPER ID: CEST2021_00294

Effect of pH on Release of Metals from Conventional and Cool Cement Blocks

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ABSTRACT

Pavements constructed from conventional cement blocks absorb solar radiation during the day and release it into the atmosphere at night. In contrast, cool cement blocks reflect sun's radiation back to the sky, reducing their surface temperature and, thus, mitigating the heat island effect. Cement block pavements in contact with rain water or snow will produce leachates during their service life, which may affect soil, surface water and groundwater quality. Therefore, the objective of this work was to determine and compare the leaching behaviour of heavy metals from conventional and cool cement blocks using the tank leaching test as a function of pH, according to method CEN/TS 14429. The results showed that leaching was higher at low pH and decreased with increasing pH for all metals. The extent of leaching varied from metal to metal as a function of pH. Since some limits for inert waste landfill are exceeded, disposal of both the cool and conventional cement blocks to non-hazardous waste landfills should be permitted. Leaching of cool materials is similar with that of the conventional ones as a function of pH.

KEYWORDS: cool materials, leaching, cement pavements

PAPER ID: CEST2021_00675

Coupling Pb and Zn bioaccessibility with sequential and HNO_3 extraction in soil from the industrial area of Volos, Greece

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ABSTRACT

The urban environment is a complicated system where various anthropogenic sources contribute to the accumulation of metals in soil, leading to potential negative environmental effects. Within this context, we performed single and sequential extractions in contaminated soil from the industrial area of Volos. The objective was to understand how Pb and Zn oral bioaccessibility was related to different pools in soil based on sequential and 0.43 M HNO_3 extractions. Pb was principally found in the reducible fraction (F2;15-76%), followed by the residual (F4; 9-54%) and the oxidizable (F3; 6-54%), whereas the acid soluble fraction was of minor importance (F1; 2-15%). Zn fractionation was dominated by the residual fraction (20-73%), followed by the oxidizable (10-49%) and the reducible (5-38%). Significant correlations were found between Pb and Zn bioaccessibility and the sum of fractions F1, F2 and F3 (0.50 for Pb and 0.86 for Zn, $p<0.01$), indicating that the applied bioaccessibility solution preferentially targeted the mobile fraction of Pb and Zn in soil. HNO_3-extractable Pb and Zn were highly correlated to bioaccessible Pb and Zn (0.80 and 0.93 respectively, $p<0.01$), suggesting that the HNO_3 can determine the oral bioaccessibility of Pb and Zn in urban soil influenced by industrial activities.

KEYWORDS: soil contamination, toxic elements, geochemical fractionation, bioavailability

PAPER ID: CEST2021_00039

Mercury in the coastal waters of Greece under the implementation of the Water Framework Directive (WFD)

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ABSTRACT

Mercury (Hg) is an environmentally hazardous metal and a priority element in Mediterranean environmental monitoring. Hg is a priority pollutant in the main pieces of European legislation pertaining to the marine environment (the Marine Strategy Framework Directive - MSFD and the Water Framework Directive WFD).

Despite the environmental importance of Hg there is limited knowledge on levels in Greek waters. The Laboratory of Environmental Chemistry (LEC) analyses very low Hg concentrations (above 0.5ng/L) using state of the art equipment in clean room facilities and participates in the national WFD coastal zone monitoring since 2012 in collaboration with the Hellenic Centre for Marine Research (HCMR).

This paper presents the first attempt to evaluate Hg levels in the coastal waters of Greece in the last 8 years (2012-2020) and identify trends and spatial patterns. The Hg levels measured in all areas were well below the European Legislation threshold of 70ng/L (EC 2013/39). Increased levels of Hg were found, as expected, near the major cities of Greece (Athens, Thessaloniki) and the major rivers of Northern Greece as well as in some of smaller ports.

KEYWORDS: Hg, Greece, coastal waters, WFD, Cold vapour atomic fluorescence spectroscopy

PAPER ID: CEST2021_00079

Changes of Photosynthetic Performance of *Brassica napus* Affecting Cadmium Phytoextraction Performance under Elevated Temperature, CO_2 and Drought

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ABSTRACT

This study aimed to investigate the Cd-removal efficiency from the soil by rapes (*Brassica napus* L.) under changing climate conditions, i.e. elevated temperature and CO_2 with or without additional drought stress. As photosynthesis is the most important primary metabolic process, determining plant growth, Cd-phytoextraction performance was evaluated through the changes in chlorophyll *a* fluorescence (ChlF) parameters that are widely used to quantify abiotic stress responses. The results showed that, with the less affected photochemical quantum yields and better general physiological state of PSII, well-watered rapes grown under elevated temperature and CO_2 conditions produced significantly higher harvestable biomass and extracted significantly higher Cd content from the soil than those grown under ambient temperature and CO_2 conditions. Drought fully negated this gain; however, Cd-phytoextraction performance by rapes under the combined impact of elevated temperature, CO_2 and drought was not related to the changes of selected ChlF parameters, suggesting other restrictions to photosynthesis under additional drought stress than the reduced photochemical activity due to the decrease in electron transport flow.

KEYWORDS: phytoextraction, *Brassica napus*, cadmium, photosynthetic performance, climate change

PAPER ID: CEST2021_00295

Heavy metals in soil, sediments, and water from Lake Ohrid catchment (Albania)

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ABSTRACT

Lake Ohrid is located in the Balkan Peninsula in South East Europe and it is shared between Albania and Macedonia. Formed in the tertiary period between 3.5 and 4 million years ago, Lake Ohrid is considered as one of the oldest lakes in the world, with numerous freshwater native and endemic organisms. Heavy metals enter in the lake through several pathways, mainly due to the pedo-geological processes of ultramafic soils and mining activities around the lake.

This study aims to quantify the origin, the spatial distribution and the level of pollution caused by heavy metals in the soil, sediments and water of Lake Ohrid catchment. The soil, water and sediments samples were collected in November 2020. They were taken in six selected sites around lake.

The results showed that the concentration of Fe, Cr, Ni, Co and Mn in soils samples that have ultramafic origin or are near dump sites was high, typical for ultramafic soil. The lake surface water was found to have low levels of heavy metals, except for nickel concentrations being higher in Memelisht, Hudenisht and Pojske, that are ultramafic areas. Sediments contained very high levels, mostly near ultramafic sites, and mineral dump areas with concentrations ranging 414-1333 mg/kg for Ni, 175-416 mg/kg for Cr, 101-163 mg/kg for Co, 233-600 mg/kg for Mn. and 13-40 g/kg for Fe. Sequential extraction of metals demonstrates that Nickel concentration in the sediments varies from 10 to 15 mg/kg in sampling stations near ultramafic areas and mineral dump areas. Thus, the ultramafic substrate and mining activities presented a potential toxic risk in Lake Ohrid catchment.

KEYWORDS: Heavy metals, ultramafic area, Ni availability, water quality, Ohrid region

PAPER ID: CEST2021_00168

SESSION 7 - ENERGY TECHNOLOGIES AND SUSTAINABILITY

Thursday 2 September - morning

Application of cutting-edge environmental technologies for the development of resilient and sustainable cities

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ABSTRACT

The development of resilient and sustainable cities emerged as a solution to tackle the several challenges arising from the exponential growth of urban areas population worldwide. The implementation of environmental technologies represents a solution to minimize negative impacts of crowded cities on the environment and human health. The research presents and discusses the applications of advanced and innovative cutting edge technologies to develop sustainable, green and resilient cities. The study is carried out by distinguishing environmental technologies (ETs) on four principal sectors: water and greywater, air pollution, municipal solid waste and mobility. For each technology the strengths and weaknesses are analysed and pointed out. The application of the principal technologies evaluated with reference to real cases study of metropolitan area were highlighted. The work contributes to the development of sustainable cities, providing useful information to support urban planners and policymakers in order to minimize environmental pressures and improve the way they operate.

KEYWORDS: sustainable development goals, climate change, urban agriculture, renewable energy, natural resource conservation.

PAPER ID: CEST2021_00592

Technological solutions for giving a new life to power plants of alternative energy: social, economic, and environmental assessment of end-of-life scenarios.

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ABSTRACT

The resources on the planet are not unlimited and special attention has been paid to alternative energies in recent years. Alternative (or renewable) energy are all those energy sources that do not come from fossil fuels (coal, oil and natural gas). To date, wind and solar energy are the main sources of renewable energy on which huge investments has been made in recent years. However, many of these plants are no longer functional and need to be disused or upgraded. The aim of the following study is to show a technical and economic analysis carried out on some alternative energy plants, focusing on the social, economic and environmental aspects.

In particular, the different possible scenarios were analyzed, in which the principles of reuse and recycling were applied, where the different plants from renewable sources were given a new life.

KEYWORDS: renewable energy, natural resource conservation, solar energy, wind energy, life cycle economy

PAPER ID: CEST2021_00288

Evidence of Cyprus Energy Strategy, Realities and Options

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ABSTRACT

Cyprus is an insular European Union member state. It is energy isolated and mostly depended on imported fossil fuel. Moreover, its energy planning is affected and guided by relevant European strategies as well as sustainability targets of the United Nations. Although a significant renewables potential, especially solar energy, is available, the country barely fulfills relevant share targets. Furthermore, offshore indigenous natural gas reserves, have been recently detected, but it is not clear, when their exploitation will be possible. Additionally, cable and pipeline interconnection projects are discussed and planned for the island, but major investments are needed in order these to be implemented. In this framework, this work investigates and evaluates the Cyprus energy strategic planning, the realities and options. According to the available data, government energy planning and the present energy system status, three different energy planning scenarios for the country are formulated. These are evaluated, by implementing two separate sustainability evaluation methods. One combining Political, Economic, Social, Technical, Environmental and Legal (PESTEL) and Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis with Multicriteria Evaluation. And one which implements a Life Cycle Analysis based analysis. Further to the results, conclusions for the most sustainable scenario and recommendations are formulated and discussed.

KEYWORDS: Cyprus, Energy Resources, Energy Strategic Planning, Sustainability Evaluation

PAPER ID: CEST2021_00178

A review on the potential use of flammable gases from sewage systems as a source of energy

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ABSTRACT

The demand for natural resources has increased exponentially due to the consistent growth of the global population and urbanization. This has resulted to considerable environmental challenges that are potentially affecting the global sustainable development goals. Therefore, it is important to develop sustainable strategies to manage urban wastes as well as produce and utilize energy. Flammable gases being generated from the sewage systems can be a prospective renewable resource of energy. However, existing studies suggest that the potential of sewage gas utilization for energy production has not been explored effectively. This paper focuses on identifying key design elements of sewage systems in an Anaerobic Digester (AD) to optimize the process of conversion of human waste into energy source. The paper uses a kinetic model to describe the fermentation process and thus evaluating the effect of key parameters on biogas (specifically methane) gases production in an anaerobic digester environment.

KEYWORDS: Flammable Gases, Methane, Renewable Energy, Biogas, Sewage System**.**

PAPER ID: CEST2021_00656

Increasing the recovery of automobile shredder residue (ASR) through assimilation to a solid recovered fuel (SRF): the results of a feasibility study

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ABSTRACT

This study analyzes the possibility of assimilating some fractions extracted from the shredder light fraction (SLF) to a solid recovered fuel (SRF). Italian Ministerial Decree D.M. 22/2013 fixes the criteria for the assimilation in the compliance of three parameters (heating value and chlorine and mercury content) and a number of heavy metals with threshold values. A sample of SLF underwent a product composition analysis. The results demonstrated that polyurethane foam (PUR) and heavy textile were the most abundant fractions, with 46.0% and 23.5% by weight (b.w.) respectively. Because of their size, amounts equal to 50% b.w. of PUR and to 75% of heavy textile could be separated by using a 150 mm sieve. The mixture of the separated products had a net heating value of 25.7 kJ/g, that made it suitable to be classified as a first class SRF. The content of heavy metals was well below the threshold values fixed by D.M. 22/2013, with the only exception of nickel, the concentration of which in the mixture of the two products was 40 mg/kg, 33.3% higher than the threshold value. The results of the analyses and tests demonstrated that PUR and heavy textile were good candidates to be assimilated to a SRF and, furthermore, they could integrate the conventional fuel in cement factories, foundries or other thermal plants.

KEYWORDS: shredder light fraction (SLF), sieving, heavy metal, net heating value, thermal valorization

PAPER ID: CEST2021_00452

Gas mixture candidates for SF_6 replacement in medium voltage switchgear: Analysis and modeling of the filling episodes

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ABSTRACT

A more environmentally friendly replacement for SF_6 must be found for medium voltage switchgear, as a change in European regulations will come into force soon. The mixing process of alternative binary and ternary gas mixtures is studied, which are made up of the hydrofluoroolefin HFO-1336mzz(E) ($C_4F_6H_2$) and the heptafluoroisopropil trifluoromethyl ketone ($C_5F_{10}O$), using dry air or N_2 as carrier gases. The mixture's monitoring, meaning the evolution of the concentration concerning time and position, is carried out by UV-VIS spectroscopy technology in a gas chamber that has been designed to be analogous to a medium voltage cell. The mixing process is described using a mathematical model that considers molecular diffusion, Fick's Law, and natural convection, the effect of gravity. This work aims to configure a tool for predicting the dynamics of gas mixtures of different components, estimating the diffusivities of the mixture's components, and analyzing the behaviors derived from the use of different concentrations.

KEYWORDS: Global warming potential; Dielectric strength; Gas mixing modeling; Gas diffusivity; Multicomponent mixing.

PAPER ID: CEST2021_00237

Decomposition products of 1,3,3,3-tetrafluoropropene and perfluoro-(3-methylbutan-2-one) gas mixtures in medium voltage electrical switchgear. Alternatives to SF6

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ABSTRACT

In this work, binary and ternary gas mixtures of 1,3,3,3-tetrafluoropropene, HFO-1234ze(E), and perfluoro-3-methylbutan-2-one, $CF_3C(O)CF(CF_3)_2$, with CO_2 and synthetic air, are presented as alternatives to SF6 in medium voltage electrical equipment. They were used in four medium voltage switchgear cubicles replacing SF6 gas. After a period of time under permanent 30 kV AC voltage, gas mixtures samples were extracted and analyzed at the same day by a validated methodology based on gas chromatography coupled to mass spectrometry (MS) and thermal conductivity (TCD). CF_4 (tetrafluoromethane), C_2F_6 (hexafluoroethane), C_3F_6 (hexafluoropropylene), C_3HF_7 (1,1,1,2,2,3,3-heptafluoropropane), CH_2F_2 (difluoromethane) and cis and trans-$C_3H_2F_4$ (1,3,3,3-tetrafluoropropene) have been identified as decomposition products in these gas mixtures. The most abundant decomposition products identified in mixtures (C_3HF_7 and C_3F_6), water and CO content have been quantified using commercial gas mixture reference standards. The toxicity and global warming of the analyzed compounds are evaluated to determine the best mixture of those exposed in this study.

KEYWORDS: Hydrofluoroolefins; Perfluoroketone; SF6; Barrier discharge processing; Degradation products

PAPER ID: CEST2021_00741

SESSION 8 - WATER AND WASTEWATER TREATMENT AND REUSE

Thursday 2 September – afternoon

Catalytic reduction of Cr(VI) using recovered Silicon from end-of-life photovoltaic panels as a catalyst

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ABSTRACT

As installed photovoltaic panels (PVP) approach their end of life, the need for a sustainable recovery plan becomes imperative. This work aims to reuse Silicon from End-of-Life PVP as a potential catalyst/photocatalyst for wastewater treatment. PVPs were pretreated thermally (550°C for 30 min). The resulting mixture of glass, silicon, electrodes, and ash was separated into different fractions in a trommel. Recovered Silicon flakes were washed with water, acetone, HNO3, and HF in order to obtain pure Si. Then Si was etched through a single stage Ag-assisted Chemical etching process and doped with copper. Doping was performed in aqueous HF solutions containing CuSO4. Photocatalytic reduction of Cr(VI) in the presence of 5mM citric acid was carried out in a 600 mL batch reactor irradiated by a Xenon 150W arc lamp as well as under dark conditions. It was found that in the presence of 1.2 g/L of the Si catalyst, Cr(VI) at an initial concentration of 15 mg/L can be reduced below detection limit (>99%),under dark conditions in 90-240 min, depending on the pH of the solution. Irradiation, however, was shown to inhibit the process, contrary to previous reports that had not examined catalysis in the dark.

KEYWORDS: Hexavalent Chromium reduction; Photocatalyst; Photovoltaic panel; Silicon Recovery; Wastewater treatment

PAPER ID: CEST2021_00199

Assessment of yields and properties of bioplastics production from acidified sugary wastewaters via mixed microbial cultures

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ABSTRACT

A mixed microbial culture (MMC) of poly-hydroxy-alkanoates (PHAs) producers was developed in a draw- fill reactor (DFR) subjected to sequential nitrogen/carbon limitation stress using short chain fatty acids (SCFAs) as carbon source. The distribution of microorganisms was analyzed in the beginning of the process and after six weeks of limitation, in order to verify the domination of PHA producers in the consortium. The potential of the enhanced MMC for production of co-polymers was then evaluated in batch mode using synthetic media. The parameters tested were the C to N ratio (C/N), the propionate to butyric ratio (prop/but) and the initial pH (pH_{in}). It was shown that the type, yields and productivity of PHAs was highly affected and the optimal yield, 40 % PHAs/dry cell weigh (DCW) (w/w), was achieved for a C/N of 200 (w/w), prop/but 10/90 (mol/mol) and pH_{in}, 7.5. The MMC was further assessed for the production of PHAs from acidified sugary wastewater (ASW) containing SCFAs, sugars and lactate at different ratios. PHAs were solvent-extracted from the microbial biomass; they were further analyzed in terms of their chemical composition, via ^{1}H-NMR and ^{13}C-NMR, their structure at molecular level via Attenuated total reflectance – Fourier transform infrared spectroscopy (ATR-FTIR), and their thermal properties, *via* differential scanning calorimetry (DSC). It was shown that in all cases, P(3HB-co-3HV) was produced with T_m ranging from 170,0 to 164,1 ^{o}C.

KEYWORDS: poly-hydroxyalkanoates, co-polymers, mixed cultures, nutrients limitation, DSC, ATR-FTIR, NMR.

PAPER ID: CEST2021_00378

Nutrients recovery from anaerobic digestion effluent for the production of microalgae biomass

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ABSTRACT

The efficient management of anaerobic digestion effluents (ADEs) from biogas plants has raised increasing environmental concerns, as a result of their high content in nutrients, mostly in the form of NH4- and PO4-. Their discharge to farmlands is restricted due to irrigation guidelines, while nutrients represent valuable sources for microalgae cultures. In this study, the green microalgae Chlorella sorokiniana, isolated from anaerobic digestate, was cultivated in diluted ADE and BG-11 as reference medium, both in flasks and in a 20 L tubular airlift photobioreactor (PBR). Biomass productivity and pollutants removal rate were examined under different CO_2 atmospheres and sample dilution in lab-scale experiments, in order to identify the impact of the culture conditions on nitrogen assimilation by microalgae and to determine the critical variables for process scale-up. The culture growth was further studied in the PBR system, in batch and continuous operation mode, using an ultrafiltration membrane for efficient biomass harvesting. As expected, a higher growth rate was achieved in BG-11 than ADE due to the chemical nature of the effluent. However, efficient ammonia nitrogen removal was observed in the wastewater sample, reaching up to 90%, proving that microalgae cultivation represents a challenging method, combining the simultaneous nutrients recovery and excess biomass production.

KEYWORDS : Microalgae; anaerobic digestion eggluents; nitrogen recovery

PAPER ID: CEST2021_00346

Use of ornamental plants in floating treatment wetlands for greywater treatment in buildings: preliminary results

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ABSTRACT

Floating treatment wetlands (FTWs), have been recognized by many researchers for their efficiency in removing pollutants and thus improving wastewater quality. Despite their wide use for treating various types of wastewater, little is known about their efficiency in greywater treatment. In this study, ten FTWs planted with climbing and ornamental plants were examined for the performance of greywater treatment in the island of Lesvos, Greece. More specifically, Canna indica an ornamental flower plant and Hedera helix an ornamental climbing plant, were established in a pilot scale FTWs experiment, under natural weather conditions. The main operational variables in the experimental set-up design of the FTWs were (a) the presence /absence of plants, (b) the use of two different floating mats (polypropylene, geotextile), and (c) the use of two different water depths (30 cm and 40 cm). The determination of the optimal pollutant removal and plant growth regarding the different variables was investigated. In parallel, plant growth traits as well as water quality parameters were measured on a biweekly basis.

KEYWORDS: floating treatment wetlands, ornamental plants, greywater treatment, *Canna indica*, *Hedera helix*, constructed wetland

PAPER ID: CEST2021_00608

A comparison of electrooxidation of phenol on boron doped diamond and mixed metal oxide anodes

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ABSTRACT

Phenolic compounds are widespread in wastewater from various industries. Since the phenols are potentially carcinogenic for humans and hazardous for the environment, their presence in wastewater raises concerns. In this paper electrooxidation process was used for treatment of synthetical prepared wastewater containing phenol. Initial phenol concentration in wastewater was 50 mg/L with addition of different supporting electrolytes (NaCl, Na_2SO_4, H_2SO_4). The treatment was performed in a batch electrochemical reactor at constant current density of 20 mA/cm^2. Boron doped diamond (BDD) and mixed metal oxide (MMO) anode materials were examined, and stainless steel was used as cathode. Phenol concentration before and after treatment was determined by standard spectrophotometric method with 4-aminoantipyrine, while transformation products were identified by different chromatographic methods. Experiments have shown that the treatment is very efficient and with low energy consumption, wherein the phenol removal efficiency mostly depends on the duration of treatment and the type of supporting electrolyte.

KEYWORDS: BDD, MMO, removal efficiency, 4-aminoantipyrine

PAPER ID: CEST2021_00492

Anaerobic Digestion of Municipal Wastewater (MWW) in a Periodic Anaerobic Baffled Reactor (PABR)

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ABSTRACT

The scope of this work is to study the treatment of municipal wastewater in a Periodic Anaerobic Baffled Reactor (PABR). PABR is an innovative, high-rate bioreactor, designed to operate under high organic loadings. Apart from the Hydraulic Retention Time (HRT) an important operational parameter is the Switching Period (T). The current research work aims to study the impact of the operational parameters' variation (HRT and T) in the biogas and biomethane productivity.

Six distinct experimental phases were conducted, during which the operational parameters of the PABR were consecutively modified: HRT varied from 10 to 1 day, T between 2.5 and 0.25 days while the OLR remained constant at values near 1 $g_{sCOD}/L_{bioreactor}$*d. The maximum CH_4 productivity was 26.5 LCH_4/d corresponding to the operation under HRT=1d, OLR=0.89 $g_{sCOD}/L_{bioreactor}$*d and T=0.25 days. Conclusively, the PABR is a high-rate AD system, capable of treating MWW under extreme operational conditions.

KEYWORDS: Anaerobic Digestion; Bioreactor; High rate; Methane; Municipal Wastewater; PABR

PAPER ID: CEST2021_00314

Comparison of the continuous fermentative hydrogen production efficiency from cheese whey in suspended and attached-biomass growth systems

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ABSTRACT

In the present study, comparison of dark fermentation (DF) efficiency from cheese whey (CW) in an anaerobic UpFlow Column Reactor (AUFCR), filled with a support material for biomass attachment and a Continuous Stirred Tank reactor (CSTR), was assessed. The process efficiency and stability as well as the effect of the operational parameters, such as the initial carbohydrates concentration (dilution factor) and the hydraulic retention time (HRT) were assessed. The experiments showed that DF of CW in a CSTR led to higher hydrogen production yields compared to the AUFCR, which was 0.36 mol of H_2 per mol of consumed carbohydrates at the HRT of 12 h with initial carbohydrates concentration of 30 g/L, respectively.

KEYWORDS: Cheese whey, Continuous stirred tank reactor, Upflow Column bioreactor, hydraulic retention time

PAPER ID: CEST2021_00405

Suspected-target screening for the assessment of pollutants in sewage sludge and assessment of their environmental risk

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ABSTRACT

Wastewater generated by human activities contains different organic pollutants from anthropogenic origin. During its depuration in the wastewater treatment plants (WWTPs) sewage sludge is generated, which also contains these pollutants. While water influents and effluents of WWTPs are widely studied, the studies focused in the analysis of sewage sludge are more limited. This is probably due to the complexity that involves the analysis of samples with a high percentage of organic matter. However, since sewage sludge is sometimes employed as fertilizer, its analysis is crucial to assess its possible impact in the environment and human health. Sludge samples analysed in this study were from 8 WWTPs with different treatments. They were extracted using ultrasound assisted extraction (UAE). Then, solid phase extraction (SPE) using StrataTMX cartridges was employed as clean-up. The suspected analytes were identified by liquid chromatography-quadrupole time-of-flight mass spectrometry (LC-QqTOF-MS). As overall results, 50 different compounds were identified with high degree of confidence belonging 31 of them to the group of the pharmaceuticals. Human metabolites were the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-phenylalanine). Several human metabolites (nucleotides, amino acids, etc.) were also detected. A significant number of compound were tentative identified but more in depth study is needed to increase the degree of confidence in their identification. Further research is also needed to provide a complete profile of the organic pollutants present in sewage sludge and to obtain a full picture of their potential risk for humans and the environment.

KEYWORDS: non-target, suspected screening, pharmaceuticals, metabolites

PAPER ID: CEST2021_00417

SESSION 9 - MICROPLASTICS IN WATER TREATMENT: FATE, TOXICITY ASSESSMENT AND REMOVAL TECHNOLOGIES

Thursday 2 September – afternoon

How does presence of microplastics impact on biogas production?

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ABSTRACT

The aim of this study was to evaluate the inhibition on the biogas production caused by microplastics (MPs). Wastewater treatment plants (WWTPs) are receptors of MP. After wastewater treating, more than 90% of MP could be retained in the sludge. Anaerobic digestion of the excess sludge can help reduce its volume and operating costs of WWTPs, due to CH_4 production. Analysis with OxiTop control system could help to follow anaerobic degradation process to evaluate impact of MP on biogas production with slightly modified standard procedure by adding MP. Comparison of pressures gain of samples with added MP to control sample could determine the impact of added MP on biogas production and give the ratio of methane and carbon dioxide in biogas. Presence of MP mainly negatively affected biogas and CH_4 production. Polyamide (PA) had shown the most negative affect and reached even up to 19% less of total biogas produced, while its presence decreased CH_4 yield for up to 10% at 2.38 g L^{-1}. Polyacryl inhibited CH_4 yield up to 15% at even the lowest added concentration 0.05 g L^{-1}.

KEYWORDS: anaerobic digestion, biogas, microplastics, wastewater

PAPER ID: CEST2021_00114

Role of microplastics as vector for pharmaceuticals in aquatic environment

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ABSTRACT

The presence of contaminants of emerging concern (CECs) in aquatic environment represents the risk due to potential adverse effects on both human health and the environment. The term CECs does not only apply to chemical contaminants but to the microplastics (MPs) as well. As MP may interact with the co-pollutants present in water through sorption, it may serve as a vector for accumulated chemicals, altering their environmental behavior and overall toxicity. We investigated adsorption behaviour of pharmaceutical by pristine and aged MPs. The study is aimed at establishing correlation between structural characteristics of MPs and adsorption capacity at varied conditions. For that purpose, polyethhylene teraphthalate (PET) MPs were used as the most abundant type in aquatic environment in the combination with diclofenac as the representative of widely used pharmaceuticals. The adsorption experiments were performed according to the statistical planning, whereas the level of MPs aging, as well as pH and temperature were used as influential factors. The results were modelled using the principles of response surface methodology and the corresponding adsorption isotherms were established. The toxicity of MPs/diclofenac was assessed using freshwater green algae Selenastrum capricornutum according to the standard method ISO 8692:1989.

KEYWORDS: microplastics, polyethylene, atrazine, adsorption isotherms, toxicity

PAPER ID: CEST2021_00229

The abundance, characteristics and risk of microplastics in surface water in urban artificial steams of Saudi Arabia

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ABSTRACT

The presence of microplastics (MPs) in water is an indicator of the increase of human impacts on the Earth. In this study, water of the channels and ponds that conduct a mix of surface water and treated wastewater in two cities of Saudi Arabia were assessed to ascertain the influence of the population on abundance and characteristics of MPs (>20 µm in size). The selected cities were Riyadh with a population of 5,188 million inhabitants and al-Jubail with a population of only 0.77. MPs. The MPs were isolated using showed an average of 3.2 items/L in Riyadh and 0.2 items/L in Al-Jubail showing a clear relationship between presence of microplastics and density of population. Fibers were dominant in all sites (60 %); their size was mainly distributed between 80 and 250 µm (60 %), and white (40 %) red (25 %) and blue (20 %) were the dominant colors. Infrared spectral analysis revealed that most of the selected particles were identified as MPs of polypropylene and polyethylene (48.3%). The risk assessment performed using two approaches showed higher risk for Riyadh whether the MPs could be acutely hazard for aquatic biota. Our study provides new insides for establishing the impact of MPs in channels and surface water increasingly affected by the re-use of wastewater treatment plants.
Acknowledgement - The authors thank the financial support from the project number (RSP-2020/11) King Saud University, Riyadh, Saudi Arabia.

KEYWORDS: Microplastics, Al-Jubail; Riyadh, Surface water, Distribution, Abundance

PAPER ID: CEST2021_00440

Interactions between microplastics and organic pollutants: Effects on transport and bioaccumulation: from the lab to the environment

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ABSTRACT

Microplastics (MPs) have the ability to extract/preconcentrate other contaminants from water samples and could also act as vectors to other environmental compartments. The occurrence and distribution of MPs in different points of Al-Jubail, the most important industrial city, and the second biggest after Riyadh have been studied. The sampling points included those of the runoff channel system that transports treated water from different industries, and that cross longitudinally the city up to the sea. MPs were visually identified after filtration and digestion of the organic matter and the chemical composition was identified by FTIR. Furthermore, polycyclic aromatic hydrocarbons (PAHs) and perfluoroalkyl substances (PFASs) were selected as a model toxic hydrophobic organic contaminants to study the MPs capacity to sorb them. The relative bioavailability of dissolved and MP-sorbed phenanthrene, fluoranthene, prefluoroctane sulfonic acid (PFOS) and perfluoroctanoic acid (PFOA) under co-exposure conditions was assessed. To this, high density polyethylene (PE) microspheres were purchased from “Gran Velada” in dry powder form, in 180–221 µm (’PE-200′) range. These spheres were put in contact with PAHs and PFASs dissolved in water according to their solubility capacity. Results pointed out the presence of MPs of different sizes, colours and forms in the water samples taken. The most common plastics were whit fibers >0.5 mm. However, there were many different types of plastics mostly <200 µm. Regarding the type of polymer, only 4 polymer types, PE, PP, PET and PS were determined based on a comparison with infrared spectrogram databases. The sorption experiments demonstrated that both PAHs and PFASs are absorbed in the surface of the MPs. Then, the effects of this adsorption in the aquatic biota needs further research. This study can be used as a reference to better understand the impacts of MPs in artificial surface channels and ponds affected by the discharges of wastewater treatment plant. Furthermore, results confirmed the importance of polymer type, particle size and temperature as determining factors for the degree and mechanism of hydrophobic organic contaminant sorption from water to MP. Acknowledgement - The authors thank the financial support from the project number (RSP-2021/11) King Saud University, Riyadh, Saudi Arabia.\

KEYWORDS: Microplastics, Saudi Arabia, Organic Pollutants, Sorption, Water

PAPER ID: CEST2021_00441

Detection of Microplastics using Laser-Induced Breakdown Spectroscopy – A first approach

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ABSTRACT

The worldwide inability to enforce effective plastic guidelines results in an increasing accumulation of microplastics in natural habitats. Since this problem is in need of human intervention, we propose Laser-Induced Breakdown Spectroscopy (LIBS) as a new tool to identify microplastics. Our results illustrate that LIBS could be a method to identify microplastics from the environment. Based on the spectral fingerprint of different plastic types, microplastics seem to be distinguishable from non-plastic materials and from their base polymer.

KEYWORDS: Laser-Induced Breakdown Spectroscopy (LIBS), Microplastic, Identification, Sediment Sample, Plastic Pollution

PAPER ID: CEST2021_00150

The fate of microplastics during the anaerobic digestion of thermally pretreated sludge

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ABSTRACT

The presence of microplastics (MPs) in the water environment has raised as an issue of great concern, mainly due to their persistence and potential adverse effects on biota. Municipal wastewater treatment plants have been claimed among the most important point source of MPs. Nevertheless, they act as a barrier for the spread of MPs in water, since a significant amount of these pollutants concentrates in the sludge originating from wastewater treatment. This study focuses on the presence of MPs in sewage sludge, with the main aim of assessing their fate during the mesophilic anaerobic digestion of thermally pretreated sludge. MP abundance in the digestate as well as the anaerobic biodegradability of the pretreated substrates were assessed. Experimental results addressed preliminary considerations on the effects of high temperature on the MPs as well as on their influence on anaerobic degradation processes.

KEYWORDS: biological process, plastics, pollution, polymers, thermal pretreatment

PAPER ID: CEST2021_00221

Nanoplastics mineralization by the intensified photo-Fenton process

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ABSTRACT

The widespread presence of microplastics (MPs) and nanoplastics (NPs) in aquatic systems has become one of the most challenging environmental issues nowadays. Although advanced oxidation processes (AOPs) have been widely studied for the treatment of persistent contaminants in water, their application for MPs and NPs removal have been scarcely addressed. In this study, the degradation of polystyrene NPs of different sizes (909 nm and 140 nm) by intensified photo-Fenton oxidation has been evaluated. The degradation experiments (6 hours) were carried out at 80ºC and pH_0=3 in a pyrex glass reactor, using an initial NPs concentration of 20 mg/L. The initial concentrations of H_2O_2 and Fe^{3+} were set at 130 mg/L and 10 mg/L, respectively, introducing additional doses of H_2O_2 to enhance the oxidation yield. Firstly, photolysis was evaluated, demonstrating that NPs are poorly degraded only by irradiation (8% mineralization). The addition of H_2O_2 (UV/H_2O_2 treatment) significantly improved the mineralization of NPs (53% mineralization regardless NP size). Finally, by the intensified photo-Fenton reaction, using Fe salts as catalyst, almost complete mineralization was achieved with both NPs (82% and 94% with NP size of 909 nm and 140 nm, respectively). These results are very promising for the elimination of plastic waste in water.

KEYWORDS: Water treatment; photo-Fenton oxidation; microplastic; nanoplastic; polystyrene.

PAPER ID: CEST2021_00766

SESSION 10 - ADVANCED OXIDATION PROCESSES

Thursday 2 September - afternoon

Hexavalent chromium reduction in a photocatalytic membrane reactor in the presence of organic acids

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ABSTRACT

This study deals with the photocatalytic reduction of carcinogenic hexavalent chromium, encountered in industrial effluents and surface waters, to much less toxic and harmful trivalent form. Experiments were performed in a pilot scale Photocatalytic Membrane Reactor employing titanium dioxide suspension as a catalyst, UVC lamps as irradiation source and hollow fiber UF membranes as separation media. It is observed that the reduction of Cr(VI) is enhanced in the presence of carboxylic acids, which are used as sacrificial agents and act as electron donors, mainly due to formation of Cr(VI)/organic-acid complexes. The effect of all key operating parameters, including pH, catalyst loading, hydraulic retention time, UV dose, organic acid type and molar ratio over Cr(VI) ions, water matrix, on system performance is also examined. Encouraging results are obtained since complete reduction can be achieved in the presence of 300 mg/L citric acid or 180 mg/L oxalic acid under acidic conditions (pH 3), meeting the standards for safe disposal to natural water bodies. Complete reduction can be also obtained at higher pH values (~5.5) with simultaneous 'on-line' dosing of approx. 8 mg/L/min H_2O_2. Moreover, up to 62% photocatalytic oxidation of organics is attained, under the most favorable conditions.

KEYWORDS: advanced oxidation processes, heterogeneous photocatalysis, ultrafiltration, titanium dioxide nanoparticles, wastewater treatment

PAPER ID: CEST2021_00419

Degradation of refractory compounds in industrial wastewaters by advanced technologies based on electrochemical and photochemical oxidation

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ABSTRACT

Results are presented of a systematic experimental investigation aiming to eliminate refractory organics from industrial effluents, of high and non-biodegradable organic load, by two Advanced Oxidation Processes (AOPs). Bench scale experiments were performed with real wastewater samples collected from a pesticides manufacturing plant, of varying TOC content (800-1820 mg/L), to investigate the effectiveness of boron-doped diamond (BDD) anodic oxidation (AO), of H_2O_2 photolysis with UV-C irradiation (H_2O_2/UV-C), and their combination (i.e. AO/H_2O_2/UV-C) on the total organic carbon (TOC) removal. The effect of main operating conditions was investigated for both processes, separately and in combination. In the case of AO, TOC and COD were removed at a rate of 36.4 mgC/h and 89.5 mgO_2/L, by applying a current density of 100 mA/cm^2 and a recirculation flow rate of 1400 mL/min. The H_2O_2/UV-C process achieved a TOC removal rate of 369 mgC/h and over 98% color removal after 4 h of treatment, when a single dose of 6 g/L H_2O_2 and 11.8 W/L of UVC irradiation dose were applied. Finally, the combined process (AO/H_2O_2/UV-C) led to a faster TOC abatement (534 mgC/h) and a higher color removal, after treating the wastewater with 77 mA/cm^2 current density, 5.9 W/L UVC irradiation dose and 'on-line' dosing 15.7 g/L H_2O_2.

KEYWORDS: wastewater, refractory organics, electrochemical advanced oxidation processes, anodic oxidation, photochemical oxidation, pesticides industry

PAPER ID: CEST2021_00355

Preliminary Research on Removal of Organic Substances Contained in Wastewater from Plastic Lenses Production

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ABSTRACT

More than 80 percent of all eyeglasses worn today have plastic lenses. Plastic lenses made of polycarbonate discs are created through the process of machining which requires the use of a coolant. During the production process, the rotating disc and blade are poured with a mixture of water and synthetic coolant to remove the resulting chips and cool the blade and discs. The ensuing wastewater contains chips, water and coolant. The chips are separated by filtration and the water and coolant are returned to the machine tool. Due to the low particle weight some of the plastic dust flotates easily and creates foam. If there is too much foamed dust, a skimmer is added. In order to avoid machine damage and product quality deterioration, the mixture in circulation is changed every 24 hours. This mixture is wastewater with a high COD value of 11 200 - 20800 mg/L, a turbidity of 260-870 NTU, and a colour of about 200 mg/L. For their treatment, a coagulation process using mainly aluminum coagulants and advanced oxidation processes (AOPs) used of Fenton reagents were applied.

KEYWORDS: organic substances, wastewater treatment, advanced oxidation process, Fenton reagent

PAPER ID: CEST2021_00359

Selected Applications Of Cavitation Based Advanced Oxidation Processes (Aops) For Treatment Of Water And Industrial Effuents

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ABSTRACT

Cavitation phenomenon was effectively applied for enhancement of Advanced Oxidation Processes (AOPs) effectiveness. Main applications are focused on treatment of water as well as industrial effluents [1-2]. Cavitation phenomenon can be generated in the liquid by intentionally formed differences in local pressure. It can be obtained by local increase of the liquid flowrate (hydrodynamic cavitation) or by ultrasounds (sonocavitation/acoustic cavitation). The paper presents selected achievements in the field of cavitation based AOPs with presentation of most important results of applicational studies on these group of processes. During the presentation recent developments of our research group will be presented in respect to effective degradation of several pollutants present in industrial effluents, including volatile organic compounds (VOCs) and BTEXs. Special attention will be made on possibility of application of cavitation phenomenon for activation of persulfates using direct as well as catalytic route. Details on optimization of process parameters will be discussed and related to mechanisms responsible for transformation or organic pollutants during cavitational treatment [3-7]. Developed technologies will be discussed in terms of specific instrumentation used to perform the process, details of process control, economical evaluation, scale-up aspects, hybrid – cavitation-catalytic processes as well as overall advantages and limitations of cavitation based AOPs. Acknowledgements The authors gratefully acknowledge financial support from the National Science Centre for project UMO-2017/25/B/ST8/01364. Literature 1. G. Boczkaj, A. Fernandes, 2017, Wastewater treatment by means of Advanced Oxidation Processes at basic pH conditions: A review, Chem. Eng. J. 320, 608-633. 2. M. Gągol , A. Przyjazny , G. Boczkaj, 2018, Wastewater treatment by means of advanced oxidation processes based on cavitation – A review, Chem. Eng. J. 338, 599-627. 3. K. Fedorov, M. Plata-Gryl, J. Khan, G. Boczkaj 2020, Ultrasound-assisted heterogeneous activation of persulfate and peroxymonosulfate by asphaltenes for the degradation of BTEX in water, J. Hazard. Mater. 397 (2020) 122804 4. K. Fedorov, X. Sun, G. Boczkaj, Combination of hydrodynamic cavitation and SR-AOPs for simultaneous degradation of BTEX in water, Chem. Eng. J. 2021 in press, 5. E. Cako, K. Dinesh, R. Soltani, G. Boczkaj Ultrafast degradation of brilliant cresyl blue under hydrodynamic cavitation based advanced oxidation processes (AOPs), Water Res. Ind. 24 (2020) 100134, 6. M. Gągol, R. D. C. Soltani, A. Przyjazny, G. Boczkaj 2019, Effective degradation of sulfide ions and organic sulfides in cavitation-based Advanced Oxidation Processes (AOPs), Ultrason. Sonochem. 58, 104610. 7. M. Gągol, E. Cako, K. Fedorov, R. Soltani, A. Przyjazny, G. Boczkaj, Hydrodynamic cavitation based advanced oxidation processes: Studies on specific effects of inorganic acids on the degradation effectiveness of organic pollutants, J. Mol. Liq. 307 (2020) 113002.

KEYWORDS : cavitation, AOP, radicals, wastewater treatment, oxidation, persulfates

PAPER ID: CEST2021_00364

Destruction of anthracene and phenanthrene using PDS/UV, one of advanced oxidation processes in terms of degree of destruction and by-products

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ABSTRACT

Anthracene and phenanthrene belong to a group of persistent environmental contaminants called PAHs. Evaluation of the structural of two selected PAHs i.e. anthracene and phenanthrene on its resistance to destruction by UV-activated PDS was the aim of this study. Authors focused on two aspects of this problem:

- role of so called ‘bay-region’, in the structure of phenanthrene, during PDS/UV oxidation

- formation of substituted forms of these PAHs in absence and presence of three nitrogen containing compounds i.e. ammonia and nitrite or nitrate ions.

Even though phenanthrene and anthracene have the same molecular formula, the difference in their ring assessment influence their degradability. Considering all the results, in all the cases anthracene was degraded faster and/or had higher degradation rate. That proves phenanthrene to be more stable and resistant for degradation however comparison of PDS/UV systems vs. UV– irradiation alone confirms that addition of PDS accelerate the degradation of anthracene and phenanthrene.

Comparison of PDS/UV with the addition of three different nitrogen-containing compounds showed significant difference between anthracene and phenanthrene. In the experiments with phenanthrene were observed additional peaks with the absorption maximum between 230-240 cm^{-1} which is characteristic for nitro-group. Based on their absorption maximum and the addition of nitrogen-containing compounds, emerging by-products are assumed to be nitro-derivatives of phenanthrene.

KEYWORDS: Anthracene, Phenanthrene, AOPs, substituted PAHs

PAPER ID: CEST2021_00468

Carbon nanotubes synthesized from LDPE for application in wet peroxide oxidation of paracetamol

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ABSTRACT

Carbon nanotubes (CNTs) were produced by chemical vapor deposition (CVD) considering low-density polyethylene (LDPE) as a carbon source and as an alternative to upcycle plastic solid waste. The CNTs were synthesized over bimetallic catalysts (Ni and Fe) supported on Al_2O_3 and purified with H_2SO_4 to dissolve the metal particles from the material. Both original (CNT-O) and purified materials (CNT-P) were tested as catalysts in catalytic wet peroxide oxidation (CWPO) of paracetamol (PCM). Both catalysts promoted the complete conversion of PCM within 8 h of reaction and were able to mineralize 60% of the organic content of the effluent (measured as TOC) in 24 h. Catalyst CNT-O was able to completely decompose hydrogen peroxide (H_2O_2) within 24 h, whereas CNT-P was only able to decompose ~80%. Therefore, the efficiency of H_2O_2 consumption, measured as $X_{TOC}/X_{H_2O_2}$, was higher for catalyst CNT-P (0.75) than for CNT-O (0.61). Metal leaching, especially Ni, was observed during the CWPO run with CNT-O, while it is avoided when using CNT-P. Thus, purified CNTs have proved to be active in CWPO of PCM, allowing a more controlled decomposition of H_2O_2 and avoiding leaching of metal species.

KEYWORDS: catalytic wet peroxide oxidation, paracetamol, plastic solid waste, carbon nanotubes.

PAPER ID: CEST2021_00113

Magnetic $CoFe_2O_4$@carbon yolk-shell nanoparticles as catalysts for the catalytic wet peroxide of paracetamol

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ABSTRACT

This work focuses the use of carbon-coated magnetic cobalt ferrite nanoparticles as catalysts for catalytic wet peroxide oxidation (CWPO) of the emerging pollutant paracetamol. A magnetic core composed of $CoFe_2O_4$ is developed by a sol-gel method. The core is subsequently coated with a formaldehyde-resorcinol resin and TEOS, further carbonized at 600 ºC, and etched with NaOH to create a yolk-shell structure denoted as $CoFe_2O_4$@void@C. XRD, TEM, and FTIR analysis revealed that the uncoated core is composed by a $CoFe_2O_4$ cubic spinel structure with a crystallite size of 53 nm calculated using the W-H method, matching very well the average size observed by TEM (53.51 ± 4.2 nm). Comparing the performances of $CoFe_2O_4$@void@C and of the bare $CoFe_2O_4$ in the CWPO of paracetamol, TOC removals of 46 and 58% are obtained respectively after 24 h of reaction. An empirical kinetic model based on second-order and autocatalytic expressions was developed to suitably describe the decomposition of H_2O_2 and the removal of paracetamol using $CoFe_2O_4$@void@C as catalyst.

KEYWORDS: $CoFe_2O_4$ nanoparticles, CWPO, emerging pollutant, paracetamol, carbon-coated

PAPER ID: CEST2021_00126

Application of carbon-based catalysts derived from compost on catalytic wet peroxide oxidation of leachate waters from mechanical and biological treatment plant units for municipal solid waste

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ABSTRACT

This work aims at the valorization of compost from mechanical and biological treatment (MBT) units of municipal solid waste by their transformation into carbon-based catalysts for further application in the treatment of MBT leachate waters (chemical oxygen demand (COD) = 60.0 g L^{-1}, total organic carbon (TOC) = 26.7 g L^{-1}, five-day biochemical oxygen demand (BOD_5) = 23.3 g L^{-1} and aromaticity = 10.2 g L^{-1}). The catalyst was prepared in this work by hydrothermal carbonization at 230 ºC from compost obtained in a MBT unit. The treatment of the leachate waters was conducted by combining a pre-treatment with a cationic ion exchange resin followed by catalytic wet peroxide oxidation (CWPO). The CWPO step was operated for 24 h using 7.2 g L^{-1} of catalyst, 85.7 g L^{-1} of H_2O_2 poured inside the reactor in 5 stepwise additions, at 80 ºC and pH = 3. The combined treatment by cationic resin and CWPO led to obtain removals of 68.2, 65.4, 96.8 and 93.1 % for COD, TOC, BOD_5 and aromaticity, respectively, after 24 h of reaction. In conclusion, it was found that compost is a suitable precursor to produce active catalysts for the CWPO of leachate waters.

KEYWORDS: valorization; carbon-based catalysts; leachate wastewaters; advanced oxidation processes; wastewater treatment**.**

PAPER ID: CEST2021_00152

Heterogeneous activation of persulfate by LaSrNiGaO3

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ABSTRACT

In recent years, scientists in the field of environmental management and protection, have not only detected but also quantified a large number of pharmaceuticals in treated wastewater, surface and groundwater. In order to address this problem, intensive research is carried out to develop effective water treatment technologies, including advanced oxidation processes (AOPs).

In the present study, $LaSrNiGaO_3$, a perovskite oxide, is used as heterogeneous catalyst to activate sodium persulfate (SPS) for sulfamethoxazole (SMX), an antibiotic agent, degradation. It was found that simultaneous use of SPS and $LaSrNiGaO_3$ led to complete degradation of 0.5 mg/L SMX in 60 min. The effect of different experimental parameters as well as water matrix effect on SMX degradation are studied in detail.

PAPER ID: CEST2021_00520

SESSION 11 - DESALINATION

Thursday 2 September - afternoon

Novel super-hydrophobic carbon nanotube-based nanomaterial for membrane distillation

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ABSTRACT

Membrane distillation (MD) is a low-grade heat-based emerging technology found viable for seawater desalination. Membrane properties such as high hydrophobicity, mechanical strength, and thermal stability are crucial in assessing the compatibility of a membrane for use in this application. In this work, multiwall carbon nanotubes (MWCNTs) were modified with oleylamine (Ol), which is an 18-carbon chain hydrocarbon. The attachment of oleylamine was confirmed via thermal gravimetric analysis (TGA). The modification resulted in an increase in the contact angle (CA) of MWCNTs from 104.0±2.1 to 140.5 ± 6.5°. Non-solvent Induced Phase Separation (NIPS) was then used to fabricate five polyvinylidene fluoride (PVDF) based composite membranes by varying nanomaterial concentration from 0 up to 15 wt% of the polymer. The incorporation of the nanomaterial in the membrane was confirmed via SEM, and fourier-transform infrared radiation. CA, porosity, liquid entry pressure (LEP), and tensile strength were utilized to investigate the membrane properties. A 5% and 15% increase in the CA and LEP, respectively, was observed. An increase in the tensile properties was also achieved, where the membrane consisting of 5.0 wt% nanomaterial exhibited maximum tensile stress of 34.0 MPa, compared to 23.6 MPa in the pristine PVDF. The developed nanomaterials were found to enhance the membrane properties and result in a stable overall flux of the MD system.

KEYWORDS: Super-hydrophobic; carbon nanotubes; membrane distillation; chemical synthesis; desalination.

PAPER ID: CEST2021_00207

Superhydrophobic Nanoparticle-Coated PVDF-HFP Membranes for Increased Flux and Fouling Resistance Membrane Distillation

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ABSTRACT

Water is one of the most precious natural resources of the planet. Global water demand is expected to increase by 20-30% in near future, mainly due to the increase of industrial activities and domestic use. In this context, up to now, many water treatment technologies have been proposed to address water scarcity. Among them, processes based on membrane technology such as membrane distillation (MD) have received significant scientific and technological attention. In the present work, innovative nanocomposite polymeric membranes were developed, aiming to enhance the performance in relation to the state of the art membranes for direct contact membrane distillation (DCMD) desalination. To this aim, the development of porous poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) membranes and their modification by introducing a top layer of superhydrophobic fluorinated silicon nanoparticles on their surface was thoroughly studied. The developed membranes were characterized by a variety of techniques such as SEM, AFM, contact angle, liquid entry pressure (LEP) and bubble point (BuP). DCMD experiments shown enhanced performance compared to neat PVDF-HFP membranes, having improved fouling resistance properties, increased permeability and wetting resistance against various low surface tension organic compounds. The results indicate that the nanocomposite membranes exhibit improved overall performance aiming to tackle critical issues of membrane distillation process.

KEYWORDS: Membrane distillation, desalination, fouling, porous materials, silica nanoparticles

PAPER ID: CEST2021_00208

The thermodynamic model of improved desalination using hydrophobic polyelectrolyte gels

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ABSTRACT

We modeled the desalination process as a four-step reversible thermodynamic cycle transferring ions from a low salinity solution to a high salinity one. The cycle implies reversibility at any stage, therefore the method achieves the maximum thermodynamic efficiency, thus may compete with reverse osmosis (RO). As a driving force for ions movement, we use the fact that compression of the gel leads to a decrease in the gel ionization degree, and therefore to release of ions entrapped in the gel. We considered the gel composed of the ionogenic units modified by hydrophobic pendants and showed that this modification may significantly increase the number of transferred ions. This increase is caused by a first-order phase transition originated from an interplay between repulsive electrostatic and attractive steric interactions. The transition happens during hydrogel compression. At a certain pressure, the gel collapses abruptly changing its volume almost to that of a dry state and releasing almost all ions collected inside. Employing the phase transition allows to model the desalination cycle which transfers a much larger number of ions and works at rather low pressures < 10 bar.

KEYWORDS: desalination, polyelectrolytes, hydrogels, hydrophobic gel, phase separation

PAPER ID: CEST2021_00471

Gravity-driven oil/water separation using PVDF-HFP electrospun nanofiber membranes

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ABSTRACT

With increasing industrialization and lenient waste disposal practices, oil-contaminated wastewater has become a significant environmental concern. Oil spills associated with oil exploration and transportation will continue to pose an ecological threat as long as we depend on oil for energy needs. Electrospun nanofiber membranes have a high surface area, porosity, mechanical strength, and tunable nanofiber structure and have been increasingly employed in membrane filtration and desalination systems. A well-designed superhydrophilic and underwater superoleophobic membrane could overcome several challenges associated with the traditional membrane processes for oil/water separation. In the present work, electrospun poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) nanofiber membranes blended with tungsten oxide (WO_3) nanoparticles and surface-coated with polydopamine nanostructures (PDA) were fabricated and tested for gravity-driven oil/water separation. PDA hybrid coating resulted in superhydrophilic membranes, which facilitated the preferential penetration of water while rejecting the oil when filtered as an oil-in-water emulsion. When filtered (under gravity) with 1000 mg/L mineral oil, the WO_3-blended/PDA-coated PVDF-HFP membrane achieved the highest water flux of ~145 L m^{-2} h^{-1} (LMH), followed by the PDA coated pristine PVDF-HFP membrane reporting ~80 LMH. As being hydrophobic, the pristine PVDF-HFP membrane showed no flux during the gravity filtration of 1000 mg/L of mineral oil. Similarly, the WO_3-blended/PDA coated PVDF-HFP membrane demonstrated the highest oil removal efficiency of approximately 97%, whereas the PDA coated pristine PVDF-HFP membrane reported ~92% oil rejection. Thus, the fabricated novel nanofiber membrane results in low energy consumption and a low propensity for membrane fouling.

KEYWORDS: poly(vinylidene fluoride-co-hexafluoropropylene; tungsten oxide; superhydrophilic; superoleophilic; electrospun nanofiber membranes; produced water

PAPER ID: CEST2021_00110

Preparation and Characterization of f-MWCNT-GO Self-assembled Polymeric Nanocomposite Membrane for Wastewater Treatment

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ABSTRACT

Increased population and urbanization have resulted in the generation of significant amounts of wastewater. The integration of membrane technology with nanotechnology has prompted revolutionary advances in the treatment of wastewaters. In this study, functionalized multi-walled carbon nanotubes (f-MWCNT)- (GO) nanocomposite was prepared by self-assembly, then incorporated into polylactic acid (PLA) membranes. Different concentrations of f-MWCNT-GO ranging from 0% to 8 wt.% were used. Fourier-transform infrared (FTIR) was performed to confirm the existence of f-MWCNT-GO in the fabricated membranes. In addition, the effect of f-MWCNT-GO incorporation on the performance of the membranes were investigated by carrying out analyses that include, but are not limited to, deionized (DI) water contact angle (CA), porosity, water flux, heavy metals removal, etc. The addition of f-MWCNT-GO resulted in a decrease in the DI water CA from 79.0±3.8° in the pristine PLA membrane to 51.8±2.4° in the 8 wt.% f-MWCNT-GO-PLA membrane. Furthermore, the water flux increased from 1062.8 $L/m^2 \cdot h$ to 2543.4 $L/m^2 \cdot h$ in the pristine PLA and 8 wt.% f-MWCNT-GO-PLA membrane, respectively. Such membranes have the potential to be utilized in real wastewater treatment applications.

KEYWORDS: Wastewater; functionalized multi-walled carbon nanotubes; graphene oxide; Self-assembly; nanocomposite.

PAPER ID: CEST2021_00157

Synthesis of self-assembled graphene oxide (GO)/manganese oxide (MnO_2) sulfonated-polyethersulfone (SPES) membranes for heavy metals removal from wastewater

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ABSTRACT

As the 21st century continues, water scarcity remains a significant burden to overcome in many regions. The treatment of industrial wastewater has great potential in providing adequate quantities of freshwater. To ensure safe usage of this water, heavy metal ions must be removed to avoid their toxic impacts on the various water users. For this, graphene oxide (GO)/manganese oxide (MnO_2) nanocomposite was prepared and incorporated with sulfonated-polyethersulfone (SPES) membranes. The nanocomposite and membranes were characterized using SEM, EDS, FT-IR, among others and their potential in metal ion removal/adsorption was evaluated using dead-end ultrafiltration (UF) setup. The results showed an increase in the water flux from 59.5 $L/m^2 h$ in the pristine SPES membrane to 129.7 $L/m^2 h$ in the SPGM4 (i.e., 4 wt.% GO/MnO_2) membrane. In addition, the highest Cu^{2+}, Ni^{2+}, and Zn^{2+} removal of 81.13, 67.41, and 64.00% (pH≈6), respectively, was achieved using the SPGM4 membrane. These composite membranes have the potential to be utilized in practical wastewater treatment applications.

KEYWORDS: Polyethersulfone (PES); graphene oxide (GO); wastewater treatment; membranes.

PAPER ID: CEST2021_00181

Effect of current density value and current application period on the wastewater treatment performance of Electrochemically Enhanced Self-Forming Dynamic Membrane Bioreactors (e-SFDMBRs)

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ABSTRACT

The use of membrane reactor in wastewater treatment gained interest for the past years due to its high-quality effluent. However, expensive membranes and high operational costs due to membrane fouling limit the wide application of this process. Research on fouling control by combining membrane use with different techniques have been studied to address this challenge. This study particularly uses electrochemically-enhanced self-forming dynamic membrane bioreactor (e-SFDMBR). The main feature of the SFDMBR technology is that the biological filtering layer self-forms on a support of cheaper, inert coarse-pore membrane. This work focuses on describing the treatment performance of the bioreactor and the effect of lowering the current density and application period of electric current on the effluent quality and membrane fouling. Two systems of e-SFDMBR were operated and compared in terms of ammonium-nitrogen and orthophosphate removal and concentration of fouling precursors. The lower application period system (0.5 mA/cm^2, 3 min ON/27 min OFF) posted 99.71% ammonium-nitrogen removal while the lower current density system (0.3 mA/cm^2, 5 min ON/20 min OFF) achieved 99.68% removal. Both systems were able to completely remove phosphate and produce low concentration values of known fouling precursors.

KEYWORDS: electrochemical process, membrane fouling, membrane bioreactor, dynamic membrane

PAPER ID: CEST2021_00234

Integration of negatively charged MWCNT-fGO self-assembled nanomaterials into PLA polymeric membranes for wastewater treatment

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ABSTRACT

The integration of nanomaterials in membrane's matrix aims to improve the membrane's hydrophilicity, mechanical strength, thermal stability and water flux, which are vital membrane properties needed to active efficient removal of contaminants. Multi-walled carbon nanotubes (MWCNT) and functionalized Graphene oxide (fGO) have recently attracted attention, as they have proved to have potential in various applications. The main objective of this work was to fabricate polylactic acid (PLA) membranes incorporated with negatively charged, self-assembled MWCNT-fGO using phase inversion method. Different concentrations of MWCNT-fGO 2,4,6 and 8 wt% of the polymer were fabricated.

KEYWORDS: Membrane filtration; wastewater treatment; carbon nanotubes; graphene oxide; self-assembly.

PAPER ID: CEST2021_00161

SESSION 12 - SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION

Thursday 2 September - afternoon

Trifluralin-polluted soil treatment using nanosecond pulsed DBD plasma

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ABSTRACT

Cold atmospheric plasma (CAP) was examined as an advanced oxidation process (AOP) for the remediation of trifluralin in soil. Trifluralin is a commonly used herbicide, which is toxic and persistent in soil. CAP experiments were conducted using a cylinder-to-cylindrical-grid reactor layout, driven by a high voltage nanosecond pulse generator. This layout permits plasma discharges to be produced inside the pores of the soil. The initial concentration of the pollutant in a model sandy soil was set 200 mg/kg. The effect of CAP treatment was studied at different operational conditions (e.g. applied voltage and soil type). It was observed that increase of pulse voltage resulted in the increase of degradation efficiency of trifluralin. On the other hand, the use of a field loam soil seemed to decrease the degradation efficiency. In optimum operational conditions, CAP treatment seemed to have excellent performance; a complete removal of the pollutant was observed within a few minutes (3 min < t < 5min). At the same time, the system examined in the current study was proven to be highly-energy efficient.

KEYWORDS: Soil remediation, DBD plasma, Trifluralin, Herbicides

PAPER ID: CEST2021_00047

Implementation of hydroseeding methods as bioengineering techniques for soil stabilization and reclamation projects

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ABSTRACT

The protection of soil from erosion is an essential element for projects where we have to deal with steep slopes terrains. Those could be construction of roads, quarry and open-pit mines. The soil stabilization occurs with the implementation of technical works such as the installation of synthetic and metallic textiles or with bioengineering methods. The mine closure and the rehabilitation of mine sites and waste dumps are popular projects under sustainable policies. A bioengineering stabilization method is hydroseeding which can be used for mine rehabilitation. Hydroseeding is considered one of the most appropriate methods for fast installation of vegetation. It is used for planting seeds of grass species, even shrubs and trees. This paper aims to highlight the advantages of hydroseeding as a sustainable bioengineering method for soil stabilization. The contributing factors for successful installation of hydroseeding were examined and analyzed. Those are time the: time and climatic conditions, different methods, selection and quality of the materials and the selection of the proper mix of species which are used. A review of applied projects in Greece is taking place with focusing in the growth of the plants and the results of this method compared with others.

KEYWORDS: hydroseeding, erosion, soil stabilization, reclamation, bioengineering, steep terrain

PAPER ID: CEST2021_00104

IN-SITU BIOREMEDIATION OF GROUNDWATER POLLUTED WITH CR(VI) UNDER ANAEROBIC CONDITIONS

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ABSTRACT

The natural capacity of several microbes to reduce Cr(VI) to Cr(III) has been considered of much interest in order to remediate soil and groundwater polluted with Cr(VI). The objective of this work is to evaluate the enhancement of the activity of indigenous Cr(VI) reducing bacteria by the addition of carbon source and to investigate the synergistic effect of abiotic and biotic Cr(VI) reduction in the presence of iron reducing bacteria. In order to simulate in-situ bioremediation field conditions, microcosm experiments were conducted under anaerobic conditions and at hexavalent chromium (Cr(VI)) groundwater concentrations in the 0–2000 μg/L range. The groundwater and the soil used in the experiments were collected from the deep aquifer in the Oinofyta region. Two carbon (molasses and EVO) and an iron source ($FeSO_4$) were used as ways to stimulate the metabolism and proliferation of bacterial Cr(VI) reducers in-situ. To quantitatively describe the degradation kinetics of Cr(VI), pseudo first-order kinetics were adopted. The results indicate that an anaerobic system dosed with simple (molasses) or complex (emulsified vegetable oil) external organic carbon sources can lead to practically complete Cr(VI) reduction to Cr(III) and the addition of Fe^{+2} can increase Cr(VI) removal rate significantly.

KEYWORDS: Hexavalent chromium, groundwater pollution, bioremediation, microcosm experiments, anaerobic conditions

PAPER ID: CEST2021_00281

PFAS removal performance of novel technologies for treatment of firefighting water and groundwater

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) are a group of widely used man-made organic chemical substances. PFAS have been used because of their particular physicochemical properties: most are stable at high temperatures, recalcitrant to chemical oxidation and biological degradation, and act as a surfactant. Many PFAS may also be bio-accumulative and toxic and there are concerns around their environmental effect.

In this study several treatment technologies for PFAS removal were tested in the laboratory on both groundwater containing PFAS, and firefighting wastewater obtained from a firefighting training site where firefighting foam was applied. The treatment technologies assessed were performance of sorbents, coagulation/flocculation, nanofiltration, foam- and ozo fractionation technologies. In all cases the PFAS removal effectiveness was evaluated.

Experiments showed that all sorbents were able to remove PFAS from both groundwater containing PFAS as well as firefighting wastewater, but the latter required sorbent dosages in g/L range. It was therefore concluded that groundwater containing PFAS can be treated with one of the tested sorbents directly, while for firefighting wastewater, typically has higher PFAS concentrations as well as other contaminants, a treatment train approach is likely to be more efficient.

KEYWORDS: PFAS (per- and polyfluoroalkyl substances), treatment technologies, PFAS impacted groundwater, firefighting wastewater, comparative evaluation.

PAPER ID: CEST2021_00761

Groundwater Flow Dynamics in Shallow Coastal Plain Sands Aquifer, Abesan Area, Eastern Dahomey Basin, Southwestern Nigeria.

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ABSTRACT

Thirty hand-dug wells were identified and evaluated to study the groundwater flow dynamics and anionic species distribution in the study area. Topography and water table levels method with the aid of Surfer were adopted in the delineation of six recharge and discharge zones correspondingly. Dissolved anionic species of Cl-, HCO_3-, SO_{42}- and NO_3- were determined using titrimetric and spectrophotometric method. The prominent anions in order Cl- > HCO_3- > SO_{42}- > NO_3- at discharge and recharge area are Cl- and HCO_3- ranging from 0.22ppm to 3.67ppm and 2.59ppm to 0.72ppm respectively. Analysis of groundwater head distribution and flow vector in Abesan area confirmed that Cl- concentration is higher than HCO_3-concentration in recharge zones and conversely in discharge zones. A large percentage of the samples showed that the anions falls within the permissible limit of the W.H.O standard. Water Quality assessment revealed saltwater intrusion imprints in the groundwater of the study area. Potential salinity and SO_{42}-/ Cl- ratios signifies that most of the groundwater in Abesan falls in a water class found to be insuitable for irrigation and not saline. Continuous dissolution of these anionic species may pose a significant threat to the inhabitants of Abesan area in the nearest future.

KEYWORDS: groundwater flow, recharge, discharge, anionic species, Abessan.

PAPER ID: CEST2021_00623

Modelling the Evaporation Flux from Shallow Sandy Aquifers

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ABSTRACT

A mathematical model based on Richard's equation and the soil hydraulic properties was developed in order to understand the influence of the soil depth to the water table on the maximum potential evaporative flux through the unsaturated zone. The model was applied on shallow aquifers using different types of sandy soils with hydraulic properties available from literature. Simple equations are presented to estimate the maximum evaporation from shallow sandy water table aquifers.

KEYWORDS: Evaporation, vadoze zone, shallow water table

PAPER ID: CEST2021_00736

Biodegradation of anthracene by an Antarctic fungal strain a member of genus Alternaria

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ABSTRACT

By the aim to characterize the ability of an isolated from Antarctic soils fungal strain termed *Alternaria maritima* AL10 to degrade anthracene as sole carbon sources at different temperature conditions (23°C and 10°C), research has performed. The results from GC-MS analysis have shown that the strain *A. maritima* AL10 degraded and utilized anthracene only in mesophilic conditions. Phenol hydroxylase activity measured in cleared cells' lysate of strain *A. maritima* AL10 was significantly high - 1,123 U / mg P.

KEYWORDS: Alternaria maritima, biodegradation, anthracene, GC-MS

PAPER ID: CEST2021_00649

Study of the potential of Rhodococcus strains for degradation of the pesticide Glyphosate (Roundup)

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ABSTRACT

The experiments were aimed at studying the tolerance of the studied strains of *Rhodococcus* sp. M1 and *Rhodococcus* sp. D1 to the presence of Glyphosate (N- (phosphonomethyl) glycine) in the culture medium. A rich organic medium (YEPD), a mineral medium (VD) with 1% glucose and a mineral medium without a carbon source were used for cultivation. Each of the media was supplemented with Glyphosate, up to 0.3 g/l. The obtained data showed that the tested strains grew well and were tolerant to the presence of Glyphosate in the media used.
The purpose of the following experiments was to determine the ability of both strains to degrade glyphosate. By GC-MS analyses, it was found that a strain of *Rhodococcus* sp. M1 utilized glyphosate as the only carbon source, degrading 36% of it within 120 hours. The other strain, over the same time period, degraded 40% of the pesticide tested.
Glyphosate is one of the most widely used organophosphate herbicides in modern agriculture. The presented studies on the potential of new strains of *Rhodococcus* for its biodegradation contribute to the complementarity of the known techniques for bioremediation of polluted environment.

KEYWORDS: Biodegradation, Bacteria, Glyphosate, GC-MS

PAPER ID: CEST2021_00133

SESSION 13 - SOLID WASTE MANAGEMENT

Thursday 2 September – afternoon

Transferring the Carbonation of Biomass Bottom Ash from Batch to Continuous Operation

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ABSTRACT

Biomass incineration residues may be used for CO_2 capture and storage by carbonation of waste-borne metal hydroxides. Moist carbonation of these ashes can be performed under mild conditions (ambient pressure and temperature) and accelerated by using a CO_2-rich gas. The process requires the wetting of the typically dry-discharged ashes and highly depends on the moisture content. Handling of the moist ashes in continuously operated reactors is challenging, especially due to build-up of incrustations. In this study, the carbonation of biomass bottom ash was performed in fixed-bed and rotating drum reactors. Wetting was performed either manually prior to fixed-bed carbonation or with spray-nozzles. The moisture dependent CO_2 uptake was evaluated by a gas balance. Results show that the CO_2 uptake in the fixed-bed and rotating drum was consistently between 20 and 35 g/kg, although the CO_2 concentration in the rotating drum was significantly lower (10 vol% vs. 100 vol%). In the fixed bed, the uptake strongly depended on the moisture content, while in the rotating drum the effect was less pronounced. Application of such rotating drums allows for a continuous solids feed while combining wetting and carbonation.

KEYWORDS: mineral carbonation, alkaline waste, carbon capture and storage, rotating drum

PAPER ID: CEST2021_00112

Citizens' perceptions towards urban solid waste management system: Case Study of the Municipality of Kozani

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ABSTRACT

The aim of this study is to investigate, through a survey the perceptions and attitudes of citizens about urban solid waste management system in the Municipality of Kozani. The objective of this survey is to obtain information related to: the actual behavior of citizens, the determining factors that influence and facilitate their intention to participate in recycling, their beliefs about the existing waste collection system and their perceptions of the rewarding incentives to those who actively participate in recycling processes. A structured questionnaire survey method is used as a research tool for data collection from respondents. The design of the questionnaire is based on the recent relevant. literature. The questions are mainly focused on the knowledge and attitudes of the citizens. The results of the present study may contribute to citizens' awareness in order to participate actively in recycling and reduce waste. Considering the research findings and final results, stakeholders could design appropriate recycling progresses and schemes, in order to improve the existing urban solid waste management system.

KEYWORDS: Urban solid waste management and recycling; Existing waste collection services; Rewarding recycling; Citizens' perceptions; Questionnaire survey

PAPER ID: CEST2021_00466

A comparative assessment of alkali-activated stabilisers including waste materials, for the treatment of swelling-shrinking soils.

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ABSTRACT

Swelling-shrinking soils (also known as expansive soils) experience very considerable volume changes upon changes in moisture content, thus causing major damages to lightweight structures, pavements, slopes and utilities. To counteract this problem chemical stabilisation of this type of soil with agents such as lime has been extensively used. However, the production of lime causes high CO_2 emissions. Thus, there are intensive efforts in finding alternative stabilisers of lower carbon footprint. In this context, alkali-activated cements (AAC) show potential in becoming more sustainable alternatives to conventional soil stabilisers. The aim of this study was to assess the performance of a number of AAC systems as stabilisers of a swelling-shrinking clay soil. Activators of ground-granulated blast-furnace slag also included a waste material (Paper Sludge Ash, PSA) used as a source of calcium oxide. All studied AAC mixes reduced considerably the propensity of the soil to swell in the presence of water. Potassium-based AAC binders were most effective in reducing the soil plasticity and also reduced other swelling indices reflecting an improved volumetric stability of the soil. PSA showed consistently good performance and is therefore a promising activator to study further.

KEYWORDS: chemical ground improvement; alkali-activated cements; ground granulated blast furnace slag; paper sludge ash; solid waste management

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Characterisation of Radioactive Contaminated Waste: Alpha-Induced Air-Fluorescence Detection Under Daylight Conditions

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ABSTRACT

Short travel of alpha particles in environments complicated the detection and characterisation of alpha-emitting contamination in mixed radiation fields in nuclear decommissioning sites. As a result, detection of alpha-induced radioluminescence became popular in nuclear decommissioning applications. The detection has to be done under dark conditions or special lighting conditions, in order to prevent interference of alpha-induced radioluminescence with background light. However, stand-off detection even under daylight condition, can be achieved by detecting alpha-induced radioluminescence in the ultraviolet C wavelength range (180-280 nm). We have demonstrated the use of an UVTRON flame sensor, which is solar-blind (developed by Hamamatsu), detecting photons in the ultraviolet C wavelength range. Ultraviolet C radioluminescence from a Po-210 sample was detected in normal lighting conditions using the UVTRON, with very low background counts found in all environments. As the Ultraviolet C radioluminescence signal is small, gas flows of Ar, Xe, Ne, N2, Kr and P-10 were directed over the Po-210 sample to enhance radioluminescence with positive effect. In one instance Xe doubled the count in relation to an air atmosphere.

KEYWORDS: alpha-induced radioluminescence, UVTRON flame sensor**,** ultraviolet C, nuclear decommissionig

PAPER ID: CEST2021_00230

Sustainable management of solid waste by advanced decision-making tool

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ABSTRACT

Waste management has always been a critical problem globally. In the solid urban waste sector, generally, waste production is related to the people's lifestyles. The spread of COVID-19 has led to a drastic and unusual change in people's lifestyles. The adoption of a prolonged lockdown phase, with the closure of various production activities, the establishment of safety protocols with the use of personal protective equipment and the forced sanitation of environments, has changed our life habits and resulting in the production of a new specific category of waste. The paper presents and propose analysis indicator as a tool to assist decision-makers in the management of solid waste treatment plants. The activities are carried out considering the Campania Region (Italy) as territory. The changes in the waste production and components due to the pandemic are used for the analysis and discussed in the research. The experimental activities are made by considering three different time periods and related regulatory constraints: pre-pandemic, first total lockdown and subsequent partial block. The correlation between the proposed analysis indicators and the people's lifestyles are investigated. The work contributes to the solid waste management sector by suggesting innovative analysis indicators for planning the construction and optimization of the treatments plants.

KEYWORDS: COVID-19, Pandemic, Waste production, Indicators, Regulations

PAPER ID: CEST2021_00326

Use of Biochemical Methane Potential (BMP) Assays for predicting biogas production from co-digestion of food waste and compostable bags

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ABSTRACT

Biodegradable plastics have been introduced to the market to substitute petro-based plastics to alleviate plastic pollution. Biochemical methane potential tests were carried out on food wastes (FW), with or without pre-treatment, compostable bag and a mixture of food waste and compostable bag (CB) to examine the anaerobic biodegradability of those materials. Anaerobic tests were carried out in mesophilic (35^{o}C) conditions. The aim of this work is to study the residuality of compostable bags in anaerobic digestion. At the end of the process, a dry mass of 26 % and 28 % was recorded for compostable bag and co-digestion of compostable bag and food waste respectively.

The CB added to the feed did not have a negative effect on reactor performance, but seemed to have higher biogas production. Moreover, co-digestion with CB improved biogas production by 0.8-1 times. The best VS removal efficiency of approximately 68% was achieved for FW & CB substrate. Therefore, when the compostable bag was used as a combination of substrate with food residues it produced larger amounts of biogas than samples containing only food residues. This result highlights the fact that the compostable bag does not adversely affect the process.

KEYWORDS: biogas, compostable bags, anaerobic digestion

PAPER ID: CEST2021_00366

Quality evaluation of composts in the Greek market

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ABSTRACT

In recent years, many composting products of various organic residues have been placed on the Greek market. Some of the benefits of composting, in addition to protecting the environment, are saving money, reducing wastes, improving soil quality and further complying with EU environmental rules.

The main purpose of this study is to present the results of a recent online market survey of compost products on the Greek market. Also, it was assessed the quality and the agronomic characteristics of compost products or products marketed as such.

Physical and chemical parameters (moisture, organic matter, electrical conductivity, pH and concentration of nitrogen, phosphorus and potassium), listed on the labels of the products, were statistical processed for the quality and agronomic evaluation of the compost products. The largest amount of commercial compost products comes from composting solid household waste residues (32%). 61.90% of the market survey compost samples have a sum of nitrogen (N), phosphorus (P) and potassium (K), greater than 3%. The pH value ranges from 7.0 to 7.5 at the 54.55% of the samples, the conductivity equal to 2,0 mS/cm at 41.67% of the samples and organic matter equal to 40% have the 27.78% of the samples.

Results revealed wide variations even within the same group of products. The high variability of such important parameters in composts available in the Greek market suggests an urgent need for establishing quality assurance procedures and mechanisms in the country.

KEYWORDS: compost, quality, agronomic, evaluation, organic matter

PAPER ID: CEST2021_00802

Development of efficient techniques for the removal of brominated flame retardants from polymer blends with composition that simulates WEEE

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ABSTRACT

Waste electric and electronic equipment (WEEE) has increased enormously because of the rapid expansion and consumption of electronic devices and their short lifespan. Recycling of WEEE is challenging, due to the presence of various materials including glass, metals and plastics (Buekens and Yang 2014). Brominated flame retardants (BFR), such as tetrabromobisphenol A (TBBPA) that are often added into plastics are toxic substances that must be removed before or during recycling (Ma et al. 2016). Pyrolysis is an environmentally friendly method, since secondary valuable materials or monomers can be recovered (Antonakou et al. 2014). In this work solvent extraction prior to pyrolysis is examined as a pretreatment method, in order to reduce the bromine content in specific brominated-polymeric blends. The blends consist of acrylonitrile-butadiene-styrene (ABS), high-impact polystyrene (HIPS), polycarbonate (PC) and polypropylene (PP), along with TBBPA, which is the tested BFR. Different solvents as well as different extraction times were investigated. Before and after pretreatment, blends were analysed by X-ray fluorescence (XRF) so as to estimate the bromine content; and were also pyrolysed in order to evaluate the derived products and examine if brominated compounds continue to form. XRF and pyrolysis experiments indicate that reduction of bromine can be effectively achieved.

KEYWORDS: WEEE, pyrolysis, soxhlet extraction, brominated flame retardants, XRF

PAPER ID: CEST2021_00356

Prior electro-mechanical separation to improve metal recovery from ceramic-rich electronic waste using bioleaching

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ABSTRACT

PCBs, as one of the most valuable streams of e-waste, are a considerable source of precious metals, but also contain considerable amounts of plastic and ceramic. These non-metallic fractions interfere with and can inhibit the efficiency of metal recovery, particularly for precious and rare earth metals, which are present in e-waste in very low concentrations. In this work, electro-mechanical pre-treatment was applied in order to remove ceramic and plastic fractions from e-waste prior to the application of the bioleaching process. Metal content with and without mechanical separation, as well as metal dissolution and behaviour in the bioleaching process were compared. The results obtained illustrate the beneficial effects of separating the metallic from the non-metallic fraction prior the bioleaching process for the recovery of precious, rare earth and base metals from e-waste.

KEYWORDS: Electronic Waste, Printed circuit board, Bioleaching, Mechanical Separation

PAPER ID: CEST2021_00236

Waste Printed Circuit Boards (WPCBs) as a potential source for the recovery of rare earth elements through bioleaching

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EXTENDED ABSTRACT

Rare earth elements (e.g., neodymium, dysprosium and praseodymium) have contributed to the miniaturization, energy efficiency, durability, and high speed of many technology gadgets. Due to their electric conductivity, magnetic, luminescence and optical properties, rare earth elements (REE) are crucial and potentially irreplaceable in current and future technologies, especially for the world's transition towards low-carbon economies. The recovery of REE from secondary sources, such as waste electrical and electronic equipment (WEEE or e-waste), is gaining more attention as these elements are at high supply risk, and the environmental impacts of mining primary sources are of increasing concern.

Waste printed circuit boards (WPCBs) represent a significant proportion of e-waste, they contain hazardous components but also valuable and critical materials (e.g., copper, gold, silver, rare earth elements), making this waste stream a suitable alternative for beneficiation purposes. The aim of this research is to investigate the recovery of REE from WPCBs using an environmentally friendly method, bioleaching, which exploits the ability of microorganisms to recover metal ions from the waste matrix. WPCBs were supplied by three local e-waste recycling companies following comminution process. First, physical characterization and elemental analysis of the material was performed, with emphasis on REE content. The distribution of REE and other metals in different size fractions of the WPCBs was determined. Furthermore, bioleaching was investigated for the extraction of REE from WPCBs.

The most abundant REE found in the WPCBs samples include Nd, La and Pr, with concentrations up to 4500 g/ton, 2500 g/ton and 670 g/ton respectively. Spearman's rank correlation analysis revealed strong correlations between REE and particle sizes (r_s up to -0.98). Concentrations of REE were found up to a thousand times higher in the smaller particle size range (<0.25mm) compared with coarser particles (>2mm). Most of base metals including Cu, Sn, Pb and Zn did not show this trend. These findings are particularly important as the REE content in WPCBs and their potential recovery have scarcely been addressed in the scientific literature [1, 2]. Unlike base and precious metals (e.g. Cu, Al, Au, and Ag), REE are not considered for metal recovery purposes in current commercial recycling processes. The low yield of REE in e-waste has been a major drawback for their recycling. However, this study has shown that a cost-effective size separation could enrich the REE content for further recovery steps, preventing potential losses and enhancing the valorisation of WPCBs as an untapped resource for REE recovery.

Particles below 0.5mm size, significantly rich in REE, were therefore used for bioleaching experiments. Following a two-step bioleaching process for 7 days at 28°C, with 1% (w/v) pulp density, two different fungal isolates were able to leach up to 40% of Nd, Gd and Pr, and 20% of Dy, almost doubled the leaching efficiency than the commercially available control strain. Although pyro- and hydro-metallurgical methods are the most common industrial practices for metal recovery, these processes still represent a risk to the environment due to their high chemical and energy requirements. While bioleaching of REE is still under development, many researchers have accomplished high leaching rates making use of different microbial strains; over 80% of REE have been recovered from WEEE shredding dust, and up to 100% from spent magnets [1, 3].

The present study evidenced the potential of WPCBs as a source of critical materials that have hardly been recovered from this waste stream, such as REE. Furthermore, the application of bioleaching enhances the green credentials of material extraction from WPCBs. The upcoming work in this research will aim to maximize the leaching efficiency and to provide a thorough understanding of the REE-microbial interactions in this complex e-waste matrix.

KEYWORDS: Bioleaching, Characterization, Rare earth elements (REE), Recovery, Waste printed circuit boards (WPCBs)

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Identification and Assessment of Food Waste Prevention Practices Throughout The Food Supply Chain

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ABSTRACT

Food waste generation is an issue that poses grave environmental, social and economic repercussions for the entire European Union (EU). According to the findings of the UNEP Food Waste Index Report (2020), approximately 931 million tonnes of food waste were generated in 2019. To tackle this issue, last decade, hundreds of different actions, practices, and innovations have been designed and employed, posing various levels of efficiency and transferability. This paper identifies and classifies a total of 170 food waste prevention actions.

KEYWORDS: food waste; prevention; best practices

PAPER ID: CEST2021_00838

Bioelectronics and Green Electronics for a clean Environment

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ABSTRACT

Some directions of environmental tasks for Romania in collaboration with foreign partners for next decade are: (i) electric and electronic wastes recycling using sustainable future networks suppliers-materials conversion-production, in a chain of countries; (ii) strategies at group of countries till European initiatives about reforestation, deforestation stopping, soils re-invigoration for agriculture including smart irrigation and bio-nano-technologies help, (iii) water depolluting and monitoring in see, rivers, potable water, treatment of the biological contaminated waters; (iv) air contamination with pollutants; (v) human education for the planet conservation. Starting from our achievements in the domain of bioelectronics and green electronics, we propose some directions of action.

KEYWORDS: Environmental biosensors; Green organic semiconductors; Planet care

PAPER ID: CEST2021_00345

Contribution to low-carbon building industry and improved durability through incorporation of waste into cement composites

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ABSTRACT

By using mineral waste in the production of cement composites, it is possible not only to reduce greenhouse gas emissions and carbon footprint, but by adding secondary waste such as fly ash, silica fume or slag, some properties of the resulting composites are also improved. The waste mentioned are recommended to increase the durability of cement composites against acidic corrosion. The paper presents an examination of the possible positive effects of the mineral waste to improvement of cement pastes resistance against acid rain attack. Exposition of cement pastes to experimental solutions included natural acid rain, laboratory acid rain and deionized water as reference medium during 150 days. Findings revealed that addition of fly ash, silica fume and zeoslag had improved the resistance of cement pastes to acid rain. A positive effect was seen for all additives, but the best results were found for fly ash pastes which achieved the permeability lower than the reference sample by 56 to 70%. Ion penetration testing proved to be a perspective method to estimate the actual behavior of the cement composites in real environment.

KEYWORDS: cement paste, acid rain, fly ash, silica fume

PAPER ID: CEST2021_00749

Municipal solid waste management in island communities: existing experience and implementation possibilities for South Aegean Islands

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ABSTRACT

Solid waste management in island communities is triggered by the limitation in the availability of resources, which in combination to the small amounts of wastes produced, renders the selection and sizing of the appropriate methods and infrastructures very challenging. Certain complexity to the decision-making adds also the lack of advanced infrastructures which in most islands are only limited to sanitary landfills and the time-varying MSW production load following the related touristic infusion. The current national policy foresees the creation of local facilities with emphasis in the recovery and recycling of materials, but still the technology selection and the model of MSW locally applied needs further exploration. In view of that, the aim of this paper is firstly to review the technologies and models used in MSW management in isolated island areas around the world and secondly to acknowledge any possible technology and know-how transfer that could be used in the case of Greek island regions. The paper concludes with a community-based solution suggestion: a set of MSW facilities for a group of islands, allowing to operate on a synergetic and economically viable basis, even during the winter period that the waste faction is very limited.

KEYWORDS: Municipal solid waste management; island communities; scale of capacities; synergetic model

PAPER ID: CEST2021_00056

Properties of dry hydraulic road binder mixture with additional component of cement bypass dust

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ABSTRACT

This paper is aimed at properties characterization of a designed binder mixture containing cement, fine natural limestone, cement bypass dust (BPD), and ground granulated blast furnace slag (GGBS) with an emphasis on a potential utilization of BPD into a normal hardening hydraulic road binder in accordance with the standard EN 13282-2. 10 wt.% addition of this potentially hazardous waste formed during the clinker production by burning alternative fuels was used into cement mixture. Physical and chemical properties of binder mixture of composition designed according to the recommended sheet of Slovak commercial product (DoroCem) were tested. Effect of additional component of BPD on behaviour of fresh mixture and properties of mortar specimen after 56 days of hardening was studied. The results prove that designed experimental mixture met the standard requirements for fineness and chemical composition of the powdered mixture, consistency of the fresh mixture and compressive strength of hardened mortar, and it could be used as hydraulic road binder. However, there is a need to investigate its durability as a potentially limiting factor of commercial use.

KEYWORDS: hydraulic road binder; cement; limestone; granulated blast furnace slag; bypass dust

PAPER ID: CEST2021_00740

SESSION 14 - WATER AND WASTEWATER TREATMENT AND REUSE

Thursday 2 September - afternoon

Hydrogen and organic acids production from mesophilic and thermophilic dark fermentation of vinasse without buffers

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ABSTRACT

The main objective of this study was to evaluate the valorization of vinasse dark fermentation (DF) through bioH_2 and value-added metabolites production without buffers in two similar Upflow Anaerobic Sludge Blanket (UASB) reactors under mesophilic (U30) and thermophilic (U55) conditions. An average organic acids yield of (376 ± 52 and 248 ± 122) mg-COD_{OA}.$g^{-1}$$CODt_{in}$, and productivity of (17396 ± 5220 and 14024 ± 1642) mg-COD_{OA}.L^{-1}.d^{-1} was obtained for U30 and U55 reactors, respectively, with only vinasse as substrate. BioH_2 production was feasible with sucrose and pH below 3.0, but it ceased with substrate replacement by vinasse along with natural pH increase. A change in the structure of the microbial community was also observed: *Ethanoligenens*, *Clostridium* sensu stricto 12, and *Liquorilactobacillus* using sucrose, under pH <3.0 were replaced by *Prevotella*, *Megasphaera*, *Pectinatus*, *Clostridium* sensu stricto 11 and *Lactobacillus* using vinasse, under pH>4.0.

KEYWORDS: dark fermentation, biohydrogen production, organic acids production, UASB reactor, vinasse.

PAPER ID: CEST2021_00771

Peracetic acid disinfection: An effective way to reduce antibiotics resistant bacteria from raw hospital wastewater

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ABSTRACT

Risk of infection from antibiotic resistant bacteria from wastewater to the workers in the plant can be reduced by disinfecting wastewater. Peracetic acid (PAA) was used to disinfect the raw wastewater from hospital in pilot scale experiment. Batch experiment was conducted in parallel to confirm the dose of PAA used in the pilot experiment. Degradation of PAA was fast that resulted to no residual effect to the process of wastewater treatment plant. Numbers of ciprofloxacin resistant bacteria was reduced from $5 \cdot 10^4$ cfu/ml to $<1 \cdot 10^1$ cfu/ml using 75 mg/L PAA with 10 min contact time. Similarity on removal of ciprofloxacin resistant bacteria from pilot experiment and batch experiments were observed. Removal of ciprofloxacin resistant bacteria increased by increasing contact time and PAA concentration. The method appears an ideal technology to minimize the risk of antibiotic resistant bacteria to the sewage workers when new centralized super hospital are constructed in Denmark utilizing the unbranched direct connection of wastewater from hospital to the WWTP.

KEYWORDS: Antibiotic resistant bacteria; Hospital wastewater; Peracetic acid; Disinfection

PAPER ID: CEST2021_00670

Continuous flow hydrodechlorination for micropollutants removal using an innovative Pd-based Catalytic Membrane Reactor

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ABSTRACT

The aim of this work is to develop a Pd-based Catalytic Membrane Reactor (Pd/CMR) for its application in organochlorinated micropollutants removal by hydrodechlorination (HDC). The external surface of a Al_2O_3 membrane was homogeneously decorated by Pd nanoparticles (0.2% wt.). The Pd/CMR developed system allowed the treatment of a continuous water flow by HDC and offered significant advantages in terms of cost, design and manufacture. In this work, the Pd/CMR system was employed for the HDC of the anti-inflammatory drug diclofenac (DCF) under ambient conditions. The Pd/CMR system showed a remarkable stability upon long-term reaction and 64% of DCF conversion. The initial DCF concentration did not modify the final conversion achieved, so the reaction can be accurately described by a pseudo-first order kinetic model. Furthermore, the versatility of the system was demonstrated in a real aqueous matrix (tap water). Finally, it was evidenced the notable feasibility of the Pd/CMR system for scaling-up the HDC process since the catalytic membrane reactor worked satisfactorily for up to 200 h.

KEYWORDS: Catalytic hydrodechlorination, Diclofenac, Catalytic membrane reactor, Pd-structured catalysts, Drinking water treatment

PAPER ID: CEST2021_00760

Risk Analysis of Pathogenic Organisms During Soil-Aquifer Treatment: Application to A Coastal Aquifer In Cyprus

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ABSTRACT

A quantitative microbial risk analysis of Ezousa (Cyprus) Managed Aquifer Recharge (MAR) site is presented herein to evaluate the health risks associated with the pathogenic fraction of three microorganisms: the bacterium *Escherichia Coli* (*E. Coli*), the *Rotavirus* and the protozoan *Giardia duodenalis*. At Ezousa, raw wastewater from the urban area is subject to wastewater treatment followed by soil-aquifer filtration prior reaching the end-users, who are mainly farmers. The removal efficiency standards of wastewater treatment processes are determined according to World Health Organization (WHO) reports, whereas two extreme end-user exposure scenarios are considered. The first scenario refers to a situation commonly encountered in industrialised countries, where farmers use tractors and associated farming equipment and are expected to wear protective gloves during their activities. The second scenario describes farming practices in developing countries, in which tractors and gloves are rarely used. The results suggest that all three pathogens are likely to infect individuals for both exposure scenarios. Regarding Scenario 1, around 25 % of the samples for *E. Coli* exceed the target values, whereas the highest health risks are found for *Rotavirus* and *Giardia*, in accordance with existing reports. As expected, the risk analysis for Scenario 2 provided much higher values for the health parameters compared to Scenario 1, suggesting that all pathogens possess a high risk for human health under the "worst-case" scenario. Finally, the Quantitative Microbial Risk Assessment (QMRA) was used to predict the required microbial removal after subsurface filtration of treated wastewater, in order to meet health-based targets. For *E. Coli*, the total performance requirement for Scenario 1 and Scenario 2 is found to be 5.5 log_{10} and 7 log_{10} units removal, respectively. These values are consistent with the findings of existing reports, suggesting that the removal efficiency of the soil-aquifer passage plays a crucial role under circumstances such as a heavy microbial load or technical failures.

KEYWORDS: risk analysis; farmers; pathogens; waster-water treatment; soil-aquifer treatment

PAPER ID: CEST2021_00461

Membrane Aerated Biofilm Reactor: A Correlation between Biofilm Thickness and Removal of Pharmaceuticals and Endocrinal Disruptor Compounds

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ABSTRACT

Removal of thirteen pharmaceuticals and endocrinal disruptor compounds via membrane aerated biofilm reactor was tested. MABR system demonstrated good management of nitrogenous nutrients. An increase in biofilm thickness enhanced the removal of analgesics, hormones, and disinfectants.

KEYWORDS: biodegradation, organic micropollutants, biofilm, nitrification

PAPER ID: CEST2021_00683

Practical impediments to the effective utilization of Ballast Water Management Plan from Port facilities and Shipping practice

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ABSTRACT

Since the new Ballast Water Management Convention entered into force in 2017, the ballast water should be cleansed of any harmful aquatic organisms, pathogens, wastes or even bacteria, before being released into a new aquatic environment. For this purpose, the ships are required to carry i) a ballast water management plan with detailed descriptions upon the implementation of the Convention's requirements, ii) a ballast water record book, clearly stating the release spots and stations of ballast water and iii) an International Water management certificate, stating if the ship should abide the D-1 or D-2 standards. The research questions of this paper are, i) should these standards apply when ballast water is released into more aggressive aquatic environments than the one that the outgoing ballast was collected? ii) how a port authority will be able to enforce the Convention's rules when the water release happens in open waters and how a vessel can be criminalized? iii) Are the Port Facilities prepared and equipped in a global spectrum with the necessary tools to handle the ships' demand on waste water unloading? iv) is the creation of an aquatic map stating the level of threat the local organisms pose to other aquatic environments viable and how this will help with the decrease of ballast water management processes.

KEYWORDS: BWM Convention, Ballast Water Management Plan, BWM Record Book, BWM aquatic(bio) map

PAPER ID: CEST2021_00536

AliCy as Extractant to Remove Iron from Copper-Free Extreme AMD for Further Extraction of Zinc

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ABSTRACT

A previous work showed that copper can be specifically extracted from acid mine drainage (AMD) classified as high-acid and extreme-metals (pH 1.19, ~63 g/L Fe, ~6.5 g/L Al, ~5.3 g/L Cu, ~1.9 g/L Zn and ~0.1 g/L Mn), using 30% (v/v) Acorga M5640 in Shell GTL (a kerosene like solvent) as extractant. Yet, to further extract zinc, another strategic metal in this water, using 0.9M D2EHPA or a mixture of 0.72 M D2EHPA plus 0.18M Cyanex 272 in kerosene as extractants, difficulties were observed due to iron co-extraction. Thus, an alternative solvent extraction strategy based on the use of the self-prepared ionic liquid AliCy 0.3M in kerosene was tested. The results revealed potential selectivity since 35% of iron was removed, while the removal of other metals was < 5%. Afterwards, higher concentrations of AliCy (0.6, and 1.2M) at different aqueous to organic ratios (A:O = 1:1, 1:2, 1:3 and 1:4) were tested on copper-free extreme AMD (after copper recovery with Acorga M5640), and the best compromise between iron extraction efficiency and selectivity was observed for 0.6M at A:O = 1:4 and also for 1.2M at A:O = 1:2 (75 to 80% removal or iron and 5 to 10% of zinc in both cases).

KEYWORDS: Acid mine drainage, metals recovery, solvent extraction, extractants, ionic liquids.

PAPER ID: CEST2021_00699

Analyzing the impact of Pharmaceuticals and personal care products in L'Albufera Natural Park (Valencia, Spain)

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ABSTRACT

The Anthropocene is the new geological epoch in which persistent changes produced by anthropogenic forces in the Earth are occurring. The global change and pollution constitute the prevalent binomial that must be studied jointly to alleviate Anthropocene effects on the most sensitive ecosystems [1, 2]. The most representative classes of emerging contaminants of human origin are pharmaceutical compounds and personal care products (PPCPs). Therefore, the purpose of this work was investigated these contaminants in a typical Mediterranean Coastal Wetland, the Albufera Natural Park (Valencia, Spain). The monitoring of occurrence and spatial distribution in different matrices, such as wastewater, water, sediment, and soil were performed. Moreover, statistical analysis of the different variables and environmental risk assessment were studied. This study was focused on 32 PPCPs of different therapeutic classes, including acid, basic and neutral compounds. The study area is a Park with 21120 ha consisting of a coast lagoon surrounded mainly by rice fields, citrus and vegetable orchard and separated from the Mediterranean Sea by a string of sand. A total of 104 samples (20 wastewaters, 19 sediment, 32 water and 33 soil) at 53 sampling points were collected. The extraction is based on solid-phase extraction (SPE) using two different stationary phases of cartridges Reversed and Polymeric Weak Cation Phase. The determination was carried out by liquid chromatography-tandem mass spectrometry (LC-MS/MS) with a triple-quad using two precursor → product ion transitions for each compound in the multiple selected reaction monitoring mode (MRM). The concentrations of the PPCPs at the different sampling points and the different matrices were integrated into the GIS (Geographic Information System) environment to include a point layer with the location and analytical values. The results highlight the presence of many PPCPs at levels of few ng L−1 in water and few ng g−1 in soil and sediment. The spatial distribution of these compounds showed significant differences between the northern and southern parts of the park, and between the types of water and land used. The PPCPs concentration was higher in the northern area of the park, whereas the ibuprofen was higher in the south. BPA, caffeine, diclofenac, ethyl paraben, methyl paraben, metformin, tramadol, and salicylic acid were the predominant PPCPs detected in the channels and the lake and are in good agreement with those detected in the effluent. Salicylic acid (858 ng L−1) and tramadol (1264 ng L−1) were at the highest concentration in water. Ibuprofen was present at highest concentration in sediment and soil (100 and 76 ng g−1). A risk assessment based on the hazardous quotient (HQ) indicated that caffeine is a compound of concern, and tramadol at the highest concentration showed a moderate risk for the organisms assessed. These data showed the importance of improving wastewater treatments and developing new barriers to reduce or eliminate the discharges of PPCPs to protect biodiversity. The study offers an accurate overview of the current basal state of the Albufera Natural Park. References 1.Sadutto, D., et al., Pharmaceuticals and personal care products in a Mediterranean coastal wetland: Impact of anthropogenic and spatial factors and environmental risk assessment. Environmental Pollution, 2021.

271: p. 116353. 2.Steffen, W., et al., The Anthropocene: conceptual and historical perspectives. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 2011. 369(1938): p. 842-867. Acknowlegment: This work has been supported by the Spanish Ministry of Economy and Competitiveness and the ERDF (European Regional Development Fund) through the project CICLIC subproject WETANPACK (RTI2018-097158-B-C31) and by the Generalitat Valenciana through the project ANTROPOCEN@ (PROMETEO/2018/155); D. Sadutto also knowledge the Generalitat Valenciana for his “Santiago Grisolía” grant “GRISOLIAP/2018/102, Ref CPI-18-118”.

KEYWORDS: Emerging contaminants, Mediterranean Wetlands, Spatial Distributio

PAPER ID: CEST2021_00442

Improving Innovation Capacities of Private and Public Actors for Sustainable and Profitable Recycling of Livestock Waste

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ABSTRACT

The Mediterranean region is known for its intensive livestock farming, especially for the breeding of pigs and cattle. These activities result in vast amounts of waste that necessitate proper treatment. Inadequate manure treatment can cause eutrophication of surface waters, enrichment of nitrates and pathogens into groundwater, detection of excess nutrients and heavy metals in soil, and increase GHGs emissions. RE-LIVE WASTE is an Interreg MED project (2/2018-4/2021) that focused on testing innovative solutions for livestock waste management in Cyprus, Italy, Spain, and the Federation of Bosnia and Herzegovina. The proposed route to address the environmental and financial problems associated with livestock waste was through nutrient recovery and the precipitation of an organo-metallic fertilizer known as struvite. Each participating region constructed and operated a struvite precipitation plant that transformed anaerobically treated and untreated livestock waste from cattle, pig, and mixed waste into struvite. Different treatment trains were followed in each demonstrative pilot to record the effects of treatment and source of waste on the final product. In Cyprus struvite was produced by a mixed effluent that was anaerobically digested and filtered with filter bags and UF ceramic membranes. The struvite produced had a purity between 90-99% based on the applied conditions.

KEYWORDS: struvite, livestock waste, anaerobic digestion, nutrients.

PAPER ID: CEST2021_00036

Aloe Vera waste for Methylene Blue (MB), Rhodamine B (RB) and Methyl Orange (MO) adsorption

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ABSTRACT

Aloe Vera (*Aloe barbadensis miller*) waste obtained from a local cosmetic production factory was used as bio-adsorbent for the removal of three different dyes: Methylene Blue (MB), Rhodamine B (RB) and Methyl Orange (MO). The material was preliminary washed with water at room temperature. Batch tests at 25°C were performed and the experimental data were fitted using the pseudo-second order kinetic model. It was found out that the rate of adsorption for the tested dyes follows the order MO>MB>RB. Results show that the Aloe Vera waste can be successfully used to remove cationic dyes in aqueous solution. More precisely, 94% removal of MB, 71% removal of RB and a 13% removal of MO was observed in separate tests in which the starting concentration of the correspondent dye was set to 210 mg/L and the bio-adsorbent dosage to 20g/L.

KEYWORDS: Adsorption; Aloe Vera; Data fitting; wastewater treatment.

PAPER ID: CEST2021_00154

Enhanced commercial and 3D-printed bio-carriers improve wastewater treatment performance: A critical mini-review

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ABSTRACT

An advanced wastewater treatment technology, simple, uniform, reliable and stable in its operation, which at the same time is highly competitive from the economic and environmental point of view, is Moving Bed Biofilm Reactors (MBBR) performed with the contribution of bio-carriers. This review provides an overview of the most innovative and recent applications of several kinds of bio-carriers to improve wastewater treatment efficiency. In particular, the use of commercial plastic bio-carriers is presented, such as K1, K3, RK 04Z098, or bio-carriers of natural origin after modification of their surface, such as Loofah sponge coated with $Bi_{24}O_{31}Br_{10}$ photocatalyst and Basalt fibers modified with ferric citrate. Research has shown that the most critical parameter that determines the performance of the MBBR technology is the appropriate design of the carrier in terms of its specific surface, material, texture, and orientation. 3D-printing technology provides the solution on optimization of the bio-carriers' construction, having flexibility in the design and the possibility of choosing the desirable construction material. The utilization of 3D-printed bio-carriers to improve wastewater treatment performance is still in the early research stages, and almost all the research conducted in this direction is presented in this review.

KEYWORDS: Enhanced bio-carriers; 3D-printed bio-carriers; Wastewater treatment; Moving Bed Biofilm Reactor

PAPER ID: CEST2021_00663

Monitoring and treatment of St. George lake to mitigate Cyanobacterial Harmful Algal Blooms (cyano-HABs)

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ABSTRACT

This study aimed to monitor St. George Lake, located in the Athalassa National Forest Park of Cyprus, in order to correlate its trophic condition with its water quality characteristics and identify the key environmental variables driving cyanobacteria blooming and their cyanotoxicity. The monitoring lasted for 12 continues months, between January and December 2019, and samples were analyzed for several physicochemical parameters, cyanobacterial and green algae content, and cyanotoxins concentration. The actual blooming period was between May to September 2019, and 99% of the phytoplankton biovolume was attributed to a single picocyanobacterial species, the *Merismopedia sp*. Besides monitoring the lake, cyanobacterial contaminated water was also used to test novel oxidants that release hydrogen peroxide as a mitigation process. During the blooming period, water was collected and used for bench-scale experiments in order to compare different oxidation processes in terms of efficiency and targeted treatment, while taking into consideration the environmental impact of the treatment. Liquid hydrogen peroxide, calcium peroxide and magnesium peroxide granules were applied as mitigation processes for treating toxic cyanobacteria. The oxidants exhibited different efficiencies as the release of active hydrogen peroxide varied, with calcium peroxide being the most promising one for this dense bloom.

KEYWORDS: cyanobacteria, granules, hydrogen peroxide, monitoring, treatment

PAPER ID: CEST2021_00040

Proceedings of the 17th International Conference on Environmental Science and Technology
Athens, Greece, 1 to 4 September 2021

Photocatalytic Removal of Pesticides Present in Agro-industrial Water Effluents

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ABSTRACT

Pesticide residues accumulated in agricultural wastewaters constitute a potential risk for the environment and the human health. Hence, focused actions for their elimination are of high priority for both the industry and national authorities. This work evaluates the effectiveness of the photocatalytic process to decompose four representative pesticides of different physicochemical properties; chlorpyrifos an organophosphate; thiamethoxam an neonicotinoid; flonicamid a pyridine and tebuconazole a triazole, frequently detected in the water effluents generated of the fruit-industry. Their photocatalytic degradation was examined using the commercial photocatalyst Evonik P25 TiO_2 in a lab-scale batch reactor. The optimum conditions of the photocatalytic reactions were defined and the apparent reaction rate constants for the pesticide decomposition was determined. It was confirmed that the reaction rate depends on the pesticides concentrations (varying from 1 to 10 mg/L), the pH values of the solution (from strong acidic, to neutral and strong alkaline medium) and the presence of scavenger reagents (acting as reactive radicals quenchers). The photocatalytic efficiencies were evaluated taking into thorough consideration the compounds solubility and their adsorption onto the catalyst's surface. Complete degradation of the selected pesticides was achieved after one hour illumination under UV-A light, without any formation of toxic by-products.

KEYWORDS: degradation, pesticide, scavengers, solution pH, titanium dioxide photocatalysis

PAPER ID: CEST2021_00432

Use of a two-stage MBBR system for medium-strength dairy wastewater treatment

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ABSTRACT

A two-stage Moving Bed Biofilm Reactor (MBBR) system consisting of a methanogenic and an aerobic reactor in series was used for medium strength dairy wastewater treatment. An energy analysis was conducted for the methanogenic MBBR to investigate its autonomy and its potential to act as a pretreatment step for dairy wastewater treatment under ambient conditions. According to the results, the operation of the methanogenic reactor under ambient conditions achieves partial removal of COD and important biogas production for having energy autonomy. A total energy production of 0.538 kWh m^{-3} was estimated in this reactor, whereas its energy consumption was equal to 0.025 kWh m^{-3}. Its coupling with the aerobic MBBR results to total removal of COD, NH_4-N TKN, and PO_4-P equal to 93, 97, 99 and 49%, respectively.

KEYWORDS: Dairy wastewater, biological treatment, moving bed biofilm reactors, energy efficiency

PAPER ID: CEST2021_00183

SESSION 15 - EMERGING POLLUTANS

Thursday 2 September - afternoon

Evidence of marine plastic particles transfer to the atmosphere through bubble bursting.

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ABSTRACT

Plastic debris in the marine environment are the subject of an extensive literature. According to studies dedicated to the determination of plastic litter abundance, models were used to estimate the global plastic debris abundance and to simulate their transfer and distribution. Despite these efforts, there is still missing plastic in the models used as areas exist where plastic abundance is less than that estimated. In parallel, microplastics presence in the atmosphere and in remote areas was confirmed suggesting long range atmospheric transport. Potentially addressing both these issues, the aim of this study is to evaluate plastic particles transfer from the marine environment to the atmosphere via the bursting of air bubbles at the sea surface.

KEYWORDS: Bubble bursting, Nano-plastic, water-air interface, transfer.

PAPER ID: CEST2021_00106

Determination of Watch List chemicals in Irish surface waters: Chemical occurrence and analytical method challenges

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ABSTRACT

Contaminants of emerging concern (CECs) which do not have adequate data on occurrence in the environment are being added to the Watch List under the Water Framework Directive. The WL contains multiple CECs or groups of CECs with differing chemistries which can make analysis of surface water samples increasingly complicated due to the multiple extraction and analysis methods needed 1,2. Because of the low levels (ng.L -1 range) at which WL chemicals may occur in surface waters, reaching the detection and quantification limits needed to monitor these micropollutants presents a challenge. In this work, an analytical approach involving solid phase extraction (SPE) and liquid chromatography tandem mass spectrometry (LC-MS) was developed for monitoring 2nd Watch List substances in Irish surface waters. This is the first time data for the full expanse of the Watch List has been generated in Ireland. Conditions from extraction to analysis were optimized for recovery of this broad range of compounds at the ng.L-1 concentration level. It was found that the pesticide metaflumizone was not compatible with the evaporation and solvent exchange step of SPE, and therefore analysis of the direct eluent was performed for this compound prior to blow down. Two LC-MS methods were used for detection of the full suite of 15 analytes, in which estrogens were determined separately to the other analytes due to inefficient ionization of these analytes when used in the main method. Matrix-matched calibrations were used resulting in good linearities (R2<0.99) for the majority of compounds excluding the estrogens. Detection limits were in the low ng.L-1 range. All studied analytes aside from estrogens are below the EU stated target LODs. The methods were applied to 21 field samples taken from surface waters across Ireland over a three-year period from 2018-2020. Frequently detected analytes from the second Watch List, occurring in approximately 50% or more Irish samples, were the three estrogens, three macrolide antibiotics and four out of five studied neonicotinoid pesticides. The majority of these detections were below quantifiable levels. This work represents the first data on monitoring of all Watch List chemicals in Ireland. 1. R. N. Carvalho, L. Ceriani, A. Ippolito, T. Lettieri, European Commission, Joint Research Centre and Institute for the Protection and the Security of the Citizen, Development of the first watch list under the environmental quality standards directive., Publications Office, Luxembourg, 2015. 2. J. C. G. Sousa, A. R. Ribeiro, M. O. Barbosa, C. Ribeiro, M. E. Tiritan, M. F. R. Pereira and A. M. T. Silva, Monitoring of the 17 EU Watch List contaminants of emerging concern in the Ave and the Sousa Rivers, Science of The Total Environment, 2019, 649, 1083–1095.

KEYWORDS: watchlist chemicals, emerging contaminants, LC-MS, sample matrix, oestrogen's

PAPER ID: CEST2021_00496

Non-targeted screening workflows for gas chromatography – high-resolution mass spectrometry analysis to find and identify biomagnifying contaminants in biota samples

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ABSTRACT

The health of key species in the Baltic region has been affected by exposure to anthropogenic hazardous substances (AHSs), which accumulate in organisms and are transferred through food chains. Therefore, there is a need for comprehensive characterization of the occurrence and accumulation of AHSs in the ecosystem. In this study, we use a non-target screening (NTS) approach for this purpose. A major challenge in NTS of biological samples is the removal of matrix components, like lipids that may interfere with the detection and identification of analytes. We combine size separation by gel permeation chromatography with polarity separation by adsorption chromatography to achieve sufficient lipid removal for gas chromatography – mass spectrometry analysis. In addition, we present new data processing workflows designed to systematically find and identify frequently occurring and biomagnifying AHSs. Using these workflows, we discovered a wide range of contaminants in marine biota samples and calculated their biomagnification factors (BMFs). Compounds with BMFs above one included legacy chlorinated pollutants (e.g., PCBs), polybrominated diphenyl ethers, and brominated biphenyls. There were also several halogenated natural products, the novel flame retardant Dechlorane 602, and other emerging contaminants. The legacy pollutants exhibited the expected biomagnification behavior, demonstrating the utility of the data processing workflow.

KEYWORDS: The Baltic Sea, Anthropogenic Hazardous Substances, Non-Target Screening, Lipid Removal, GC-QTOF/MS, Biomagnification Factor

PAPER ID: CEST2021_00600

Development and validation of a novel analytical protocol for the simultaneous determination of organic micropollutants in biota specimens by GC-APCI-QToF MS.

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ABSTRACT

During the last decades, overwhelming evidence has shown that various xenobiotic compounds have been released into the environment, due to anthropogenic activities. The term “Persistent Organic Pollutants (POPs)” has been established for organic chemicals that are resistant to degradation, persistent, bioaccumulative and toxic chemicals (PBTs). These chemicals are transported at low concentrations by movement of fresh and marine waters and, as they are semi-volatile, they are also transferred over long distances in the atmosphere. The result is their widespread distribution across the globe. They encompass a wide variety of compounds, including pesticides (such as insecticides, acaricides and fungicides), industrial chemicals (such as polychlorinated biphenyls, PCBs, polybrominated diphenyl ethers, PBDEs and polychlorinated naphthalenes, PCNs) and unintentional by-products of industrial processes (such as polycyclic aromatic hydrocarbons, PAHs, dioxins and furans) (M.S. El-Shahawi et al., 2010). The term “Chemicals of Emerging Concern (CECs)” refers to 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; Gavrilescuet al, 2015; Dulio et al, 2018).

In recent years, research efforts have been focused on the development of analytical methods for the determination of organic contaminants in environmental compartments, with a special interest in wildlife exposure to them, because of their bioaccumulative and biomagnificative properties (Roscales J.L. et al, 2017). Biota play a key role as integrated indicators in the environmental monitoring for a number of reasons, including their position at the food webs, the potential negative effects on human health through their consumption and the relative ease with which samples can be obtained, due to their prevalence (C. Cruzeiro et al., 2016, T. K. Parmar et al, 2016). In a few studies, xenobiotics have been determined by target analytical methodologies, which despite their high selectivity and sensitivity, using mainly selected reaction monitoring (SRM) mode of detection, are limited to cover only a relatively narrow range of chemical classes. 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, has enabled the simultaneous determination of hundreds of micropollutants and their transformation products, initiating a new trend in analytical data processing towards wide-scope target, suspect and non-target screening strategies (Picó et al, 2012; Du et al, 2017). To keep up with this evolution in analytical methodologies and in order to approach their multi-residue character, generic sample preparation protocols, offering rapid and reliable analysis are needed. However, the different classes

and physicochemical properties of the analytes make the development of comprehensive methodologies that allow their extraction, purification and separation from complex biological matrices, difficult (C. Baduel et al., 2015). According to the literature, several studies reported the occurrence of volatile, thermally stable and non-polar organic contaminants in biota matrices, however these methods were mainly focused on the determination of compounds from selected chemical classes, including a limited number of analytes (Fidalgo-Used et al, 2007; Wang et al, 2007; Zhang et al, 2015) There are only few research groups that applied a multi-residue protocol using ASE as the extraction technique of choice, due to its unique advantages, of automation, speed and use of small amounts of solvents, with a simultaneous clean-up of the produced extracts (Fidalgo-Used et al, 2007; E. Björklund et al, 2006).

Within this context, the aim of this study was the development, optimization and validation of a novel generic analytical protocol for the determination of organic micropollutants of a wide chemical domain in biota matrices by Gas Chromatography coupled with High Resolution Mass Spectrometry (GC-APCI-QToF MS). Furthermore, the performance and suitability of the developed method was demonstrated through its application in real biota samples.

In particular, in the frame of this study, the effect of various crucial parameters during the sample preparation, such as the extraction solvent and temperature as well as the use of sorbents for further extract purification, were investigated. These parameters were optimized by evaluating method performance criteria such as LODs, recoveries and matrix effect for selected GC amenable compounds. For the optimization and validation, a dataset of representative compounds of NKUA target list, based on their different physicochemical properties, was selected. The developed methodology was applied in marine biota of the lower trophic levels (fish and mollusks), demonstrating the suitability of the proposed analytical protocol for the simultaneous determination of GC-amenable xenobiotics in biota specimens.

KEYWORDS: Biota Specimens, Organic Micropollutants, ASE, Generic Analytical Protocol, GC-APCI-QToF MS

PAPER ID: CEST2021_00826

Investigation of the influence of environmentally relevant pH values in the toxicity of the b-blocker Metoprolol in zebrafish (*Danio Rerio*) embryos through toxicokinetic approaches (uptake, bioaccumulation, and biotransformation)

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ABSTRACT

Recently, the release of emerging contaminants into the aquatic ecosystems has become an issue of concern among scientists since some of them are frequently detected in the environment at levels that may cause harm. One of the main categories of emerging contaminants is the human and veterinary pharmaceuticals. Metoprolol (MET) is a cardioselective b-blocker widely used in the treatment of various cardiovascular disorders. It has been frequently reported in aquatic environments with mean concentrations ranging from ng L^{-1} to μg L^{-1} range, mainly due to its inefficient elimination by the conventional wastewater treatment plants (WWTPs). As a result, MET and its metabolites may bioaccumulate in aquatic organisms causing adverse effects. Thus, it is urgent to evaluate its potential toxic effects in the aquatic forms.

Furthermore, MET is an ionizable organic compound (IOC). IOCs are substances that can exist in an aqueous phase both in ionic and/or neutral form. The chemical speciation, neutral or ionized form, of the IOCs (such as MET) depends on the pH values of the ambient medium. Neutral species, which are less polar than their ionized counterparts, permeate more easily through membranes and thus may be more toxic for the organisms. Therefore, slight shifts in the ambient pH values can cause considerable changes in the uptake and thus in the toxicity of the IOCs. However, the influence of pH in the toxicity and the bioaccumulation of MET has not been extensively investigated so far.

For environmental toxicity tests many organisms, such as phytoplankton, zooplankton, invertebrates, and fish are used. Zebrafish (*Danio rerio*) is a powerful model organism, which is widely used in ecotoxicology research studies for assessing the potential effects of xenobiotics on aquatic organisms due to the numerous beneficial traits over other model organisms. Its main advantages are its rapid development, the short generation time and its similar biotransformation systems to mammals.

The objective of the current study was to evaluate the extent of the influence of different pH values on the uptake, bioaccumulation, biotransformation as well as the toxicity of the b-blocker MET in Zebrafish Embryos (ZFE).
Another goal was to determine the potential biotransformation products (bio-TPs) of MET and to assess whether the bio-TPs could contribute to the toxicity of the parent compound.

For this purpose, the fish embryo toxicity test (FET) with ZFE was conducted according to the OECD 236 Guidelines at different pH values. The LC_{50} values of MET at 3 different environmentally relevant pH values (6, 8, and 9) were determined. Subsequently, these LC_{50} values were used for the toxicokinetic experiments of MET.

The extraction of the MET in ZFE samples was performed with the Cryolis Evolution homogenizer (Bertin Technologies, France) operating at 8200 rpm at 4 ˚C (3 cycles of 15 s with a 60 s break between each cycle). Exposure water samples and ZFE extracts were analyzed by RPLC and HILIC in both positive and negative ionization mode using LC-ESI-QTOF-MS.

A target screening approach was followed for the identification of the parent compound (MET), whereas the detection and identification of tentative bio-TPs were performed through in-house developed suspect and non-target screening workflows. The internal concentrations (C_{int}) of MET in ZFE extracts were determined. The bioaccumulation of MET was evaluated and the bioconcentration factors (BCF) of MET were calculated. Finally, the biotransformation of MET in ZFE was studied and a potential biotransformation pathway was proposed.

KEYWORDS: Metoprolol, zebrafish embryo, pH dependent toxicity, internal concentration, biotransformation

PAPER ID: CEST2021_00828

Cluster Analysis and Principal Component Analysis using Micropollutant Measurements on the Most Polluted Tributary of Ergene River: Çorlu Stream

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ABSTRACT

This study focuses on investigation the spatial distribution of pollutants in Çorlu Stream is the highest industrialized tributary of Ergene River which is one of the most polluted rivers in Turkey. A total of 250 conventional, metal and micropollutants were scanned at eleven sampling locations for four seasons in Çorlu Stream of Ergene River. At these locations, total of 126, 124, 99 and 107 pollutants were detected at least one sampling location in summer, fall, winter and spring, respectively. Four micropollutants which are associated with textile industry were detected in every location in all seasons. Cluster Analysis found four main clusters for sampling locations from most polluted to low polluted, and six cluster for pollutants ranging from conventional to unique pollutants. Principal Component Analysis identified six components for every season explaining more than 80% of the variation in each. PCA results indicated the impact of textile, leather, metal industries and appliance-electronics production in the Çorlu Region.

KEYWORDS: cluster analysis, principal component analysis, micropollutants, Ergene River, Çorlu Stream

PAPER ID: CEST2021_00671

Development of a non-target screening workflow for the evaluation of micropollutants fate during oxidation processes

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ABSTRACT

Non-target screening (NTS) is of great interest for environmental monitoring because it enables the screening of numerous pollutants, including unknown products. However, methods to identify unknowns are still time-consuming and only deal with a limited portion of the signal. The objective of this work was to develop a NTS workflow that enables an automated and comprehensive characterization of the evolution of a sample during water treatment, using high-resolution mass spectrometry (HRMS). Considering different conditions (matrix, micropollutant concentration), methods based on the obtention of raw formulas of detected compounds were evaluated. Oxidation processes (chlorination, UV/H_2O_2 or ozonation) were applied to wastewater samples to obtain contrasted HRMS fingerprints and to assess the relevance of the workflow to characterize transformation products (TPs). Batch experiments were conducted to confirm the ability of such a workflow to properly characterize the modification of the sample. Different extraction methods were also applied to enlarge the range of detected TPs. Preliminary results show that the workflow is able to rapidly compare the fingerprints of the samples (e.g., highlighting the presence of oxidation products characterized by the incorporation of oxygen atoms into compounds). The applied workflow also enables the tracking and identification of specific TPs formed by oxidation.

KEYWORDS: Micropollutants, non-target screening, oxidation, transformation products, wastewater

PAPER ID: CEST2021_00350

Assessment of the pH-effect on the toxicity, uptake & biotransformation of Fluoxetine in Zebrafish (*Danio rerio*) embryos by LC-ESI-QTOFMS

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ABSTRACT

Over the recent decades, there is great interest from the scientific community in emerging contaminants, such as pharmaceuticals. Previous studies have demonstrated that they are ubiquitous in aquatic ecosystems, mainly due to insufficient removal by wastewater treatment plants (WWTPs). In light of their potential risk to the aquatic environment and organisms, immediate action is required.

According to a recent study, many pharmaceuticals belong to the group of ionizable organic compounds (IOC) and they can change their partition coefficient depending on the pH of the surrounding medium. Ionizable organic compounds (IOCs), such as Fluoxetine, are substances that can exist in an aqueous phase in both the ionic and/or neutral form. The ambient pH value can influence this proportion. Although slight variation in the pH can cause considerable changes in the uptake and the toxicity, until now, the pH-effect has not rigorously been considered in risk assessment.

The pharmaceutical Fluoxetine (FLX), is a selective serotonin reuptake inhibitor (SSRI). It is one of the most widely prescribed antidepressants and it has been recognized as one of the most toxic human pharmaceuticals in the aquatic environment. Therefore, it is necessary to assess its potentially toxic effects on aquatic organisms.

Zebrafish (*Danio rerio*) embryo (ZFE) has been considered as a well-characterized experimental model organism in the fields of molecular genetics and developmental biology. It is also a very promising model organism for toxicokinetic experiments since it poses similar biotransformation systems to mammals. Hence, it is extensively used as model organism in ecotoxicology research studies, in order to investigate the toxic potency of drugs and chemicals.

The aim of this study was to assess the influence of different pH values of the test medium on the acute toxicity, bioaccumulation, and biotransformation of the antidepressant FLX in zebrafish embryos.

Furthermore, it was examined if biotransformation data could be used in a complementary way to the internal concentration of the parent compound, for a holistic interpretation of toxicity at different pH values.

For this purpose, the fish embryo toxicity test (FET) with ZFE was conducted according to the OECD 236 Guidelines at three different pH values. The toxicity assay was used for the calculation of internal concentrations and LC50 values of FLX. Regarding the sample preparation, the extraction and homogenization were performed by bead-beating technology, using the Cryolis Evolution homogenizer (Bertin Technologies, France). The water samples from exposure experiments and the ZFE extracts were analyzed by RPLC and HILIC in both positive and negative ionization mode using LC-ESI-QTOF-MS.

Regarding the identification, target screening approach was followed for the identification of the parent compound and the biotransformation products were identified through an in-house developed suspect and non-target screening workflows. Moreover, the internal concentrations (C_{int}) in ZFE were determined and the potential bioaccumulation of FLX was evaluated by determining the bioconcentration factors (BCFs). Different biotransformation products (bio-TPs) were detected in the ZFE extracts. The biotransformation of FLX by zebrafish embryos, as well as the contribution of bio-TPs to the concentration of the parent compound was extensively studied. Finally, a potential biotransformation pathway of FLX in zebrafish embryos was proposed.

KEYWORDS: Fluoxetine, toxicity, pH-values, zebrafish embryos, internal concentration, bioconcentration, biotransformation, LC-ESI-QTOF-MS

PAPER ID: CEST2021_00827

Water quality monitoring in the Dnieper River Basin using advanced analytical methodologies

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ABSTRACT

The Dnieper River Basin is the main freshwater resource for Ukraine. Despite being used as source for drinking water, its water quality does not always meet the environmental standards. The basin is highly affected by regional and transboundary (from western Russia and Belarus) anthropogenic pollution loads **(Safranov et al. 2016)**. Among others, regular and thoroughly planned environmental monitoring activities contribute to water quality management and pollution control. Over the last decade, Ukraine, as a member of European Union's Eastern Partnership countries, has agreed to adapt its water legislation to EU policies **(Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part, 2014)**. Apart from the EU's priority substances that have defined environmental quality standards (EQS) **(Directive 2013/39/EU)**, contaminants of emerging concern released in the aquatic environment may have serious impact on the ecosystem and are examined as potential candidates for future legislation **(Dulio et al. 2018)**. Regularly, some of these emerging contaminants are included in the EU Watch Lists, so that more data on their occurrence is collected to draw conclusions on their actual risk **(Commission Implementing Decision (EU) 2020/1161)**. The assessment of the potential risk of the detected compounds in the environment is based on Predicted No-Effect Concentrations (PNECs).

In this study, a monitoring campaign to assess the chemical pollution in the Dnieper River Basin was conducted in October 2020. The campaign involved the collection of surface water samples from 27 sites of the basin including the Dnieper River, its main tributaries, canals, reservoirs and the estuary. Some sites were directly impacted by wastewater discharges, while other sites were used for the production of drinking water. Moreover, 5 sites were chosen for collection of fish samples to investigate the potential bioaccumulation of organic contaminants in freshwater organisms (biota). The presence of heavy metals in biota samples was investigated as well.

Generic sample preparation protocols for surface water and biota were employed for the extraction of a broad range of medium polar to polar emerging contaminants amenable to liquid chromatography-high resolution mass spectrometry (LC-HRMS) analysis. Data was acquired through the data-

independent acquisition mode (broadband collision-induced dissociation (bbCID)) in *m/z* range of 50-1000. Analysis data for surface water and biota samples was screened for the presence of target emerging contaminants using an in-house developed database of 2,232 compounds **(Gago-Ferrero et al. 2020)**. The screening criteria consisted of mass accuracy ± 2 mDa, retention time shift ± 0.2 min, evaluation of isotopic patten, detection of adduct ions and in-source and bbCID MS fragment ions. Method validation for a representative subset of target compounds and compound-specific validation for quantitation of the detected compounds was performed. Further screening for more than 65,000 suspect compounds was achieved by uploading the analysis data to NORMAN Digital Sample Freezing Platform (DSFP) **(Alygizakis et al. 2019)**. Heavy metals such as Cd, Hg, Ni, Pb were determined in biota samples by ICP-MS after acidification with nitric acid, microwave digestion and dilution.

Target screening revealed the presence of 161 environmental contaminants in total in surface water collected from the Dnieper River Basin. Pharmaceuticals, plant protection products and industrial chemicals were the main classes of the detected compounds. The highest frequency of detection (above 50%) was observed for the pharmaceuticals carbamazepine, fluconazole, lopinavir and the pesticides carbendazim, bentazon, terbuthylazine. The site of the Ros River (tributary of the Dnieper), where the city Bila Tserkva is located, had the highest cumulative concentration of environmental contaminants, probably impacted by the activities of nearby-located water treatment facilities. Other sites with high levels of chemical contamination were another site of the Ros River in Korsun Shevchenkivskyi, a site of the Dnieper River that receives the discharges of the wastewater treatment plant of Kiev (Bortnytsia aeration station), and a site of the Bilous River (tributary of the Dnieper) in the Chernihiv Oblast.

37 contaminants at concentration levels exceeding the EQS or lowest PNEC value were detected at least in one of the collected surface water samples. The highest exceedance was observed for the pesticides terbuthylazine, nicosulfuron, fipronil, carbendazim, and the pharmaceutical candesartan in surface water collected from some of the aforementioned sites. Moreover, great attention should be given to the EQS exceedance of atrazine, which is a priority substance in water **(Directive 2013/39/EU)**, as well as to 7 detected compounds that are included in the EU Watch List 2020 **(Commission Implementing Decision (EU) 2020/1161)**, from which fluconazole, prochloraz and tebuconazole had concentration levels exceeding the PNEC value. Furthermore, emerging contaminants with concentration above PNEC in sites used for drinking water intake must be under careful consideration.

4 organic chemicals and 2 heavy metals were detected at least in one biota sample, with the concentration levels of 4-formyl antipyrine exceeding PNEC in all samples and Hg exceeding EQS in the biota sample collected from a site of the Desna River (tributary of the Dnieper) 3 km away from the Desna Water Intake Station.

Almost 400 organic compounds were tentatively identified (confidence level of 3 or above) through suspect screening by employing NORMAN DSFP, whereas the analysis data was stored in the platform for future retrospective screening.

The results of this study were compared with older studies conducted in different river basins of Ukraine (the river basins of Danube **(Liska et al. 2021)**, Dniester **(Diamanti et al. 2020)** and Siverskyi Donets **(Nikolopoulou et al. 2021)**) and the sea environment where the Dnieper ends up (the Black Sea **(Slobodnik et al. 2017; Slobodnik et al. 2018)**). More than half of the environmental contaminants identified in the Dnieper River Basin were detected in other Ukrainian rivers and the Black Sea as well. This comparison demonstrates an overview of the anthropogenic activities and the lifestyle in Ukraine that directly affect the ecosystem.

KEYWORDS: Dnieper River Basin, environmental monitoring, LC-HRMS, organic and inorganic chemicals, risk assessment

PAPER ID: CEST2021_00832

Determination of the occurrence of pharmaceuticals in Irish surface waters

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ABSTRACT

The rising consumption of pharmaceuticals in the last decade have led to the contamination of global surface water ecosystems from µg/L to ng/L concentrations. The concentrations, fate and toxicological implications of pharmaceuticals and their residues remain generally unknown. The continual release, stability and biological activity of these "micro-pollutants" can lead to chronic environmental exposure, with ensuing behavioural and health-related effects to wildlife and potentially to humans. The objective of this project is to determine the presence and concentrations of pharmaceuticals in surface water and relate it to potential environmental effects to aquatic ecosystems. 12 pharmaceuticals are investigated in this study including diclofenac, trimethoprim, ciprofloxacin, sulfamethoxazole, amoxicillin, gemfibrozil, venlafaxine, carbamazepine, Estrone, 17α-ethylene estradiol, 17β-estradiol. These pharmaceuticals were selected from the water framework directives "Watch List", or are recognised as contaminants of emerging concern. Seasonal surface water grab samples were collected and further underwent pre-treatment and concentrated using solid phase extraction (SPE) with OASIS HLB cartridges. Detection was performed by high-performance liquid chromatography tandem mass spectrometer (HPLC-MS/MS). Outcomes from this research will aim to provide a robust method for the systematic monitoring of the occurrence of pharmaceuticals in surface waters at environmentally relevant concentrations.

KEYWORDS: pharmaceutical, surface water, micro-pollutant, Watch List

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SESSION 16 - CLIMATE CHANGE MITIGATION AND ADAPTATION

Thursday 2 September - afternoon

Stakeholder Mapping & Analysis for Climate Change Adaptation in Greece

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ABSTRACT

Stakeholder mapping and analysis is essential in Climate Change Adaptation (CCA) projects to assess and identify the needs of stakeholders (SHs). For the mapping of actors involved in adaptation planning and implementation in Greece, a multi-criteria analysis is followed.

The SHs involved in CCA in Greece were divided into national and regional level stakeholders. The stakeholder analysis was based on the mapping of SHs identified through the organizational charts of relevant institutions and by other projects with a direct or indirect link to CCA. The relative importance of each stakeholder for the purposes of this analysis was assessed by evaluating their Power, Proximity and Urgency with respect to CCA and assigning specific weighting factors for each criterion, to calculate a single Priority Index. Based on the Priority Index value, SHs were classified as low, medium and high priority for CCA both at the national and regional level.

At the national level, ministerial directorates are assessed as high priority, followed by academic and research centers as medium priority. At the regional level, high index values were calculated for the Special Directorate of Environment and Spatial Planning. The General Directorate of Civil Protection and Directorate of European Programs are assessed as medium and low priority respectively.

KEYWORDS: Stakeholder mapping, Multi-criteria analysis, Climate change adaptation, Weighting factors, Priority Index

PAPER ID: CEST2021_00142

Dairy farms management and carbon storage in the soil fractions

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ABSTRACT

The dairy sector is one of the main economic activities in the Spanish region of Galicia, located in the northwest of the country. In dairy farms, the type of farm management has a clear effect on climate change mitigation by modifying crucial processes such as carbon storage in the soil. This study aimed to evaluate the effect of the dairy farm management (extensive, intensive and organic) on carbon storage in each soil aggregate fraction in dairy farms of Galicia. A total of 21 dairy farms were selected of which 7 farms were based on intensive conventional production, 7 farms were based on extensive conventional production and 7 farms were based on organic production. In each farm, two plots were selected and for each plot, two composite soil samples were collected. In the laboratory, soil samples were fractionated in macroaggregates (250–2000 μm), microaggregates (53–250 μm) and silt + clay (< 53 μm) to estimate the carbon storage in each soil fraction. The results show that the organic farms implied a higher amount of carbon storage in the different soil fractions than the extensive and intensive farms, being the carbon storage in the smallest soil fractions very stable and maintained in the soil in the long-term.

KEYWORDS: climate change, extensive, intensive, organic

PAPER ID: CEST2021_00302

Effect of the forage maize-pasture rotation on the soil carbon storage in Galicia (NW Spain)

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ABSTRACT

Galicia is a region in NW Spain with high economic dependence on dairy cattle where livestock feeding is mainly based on the production of forage maize. In this region, one of the major challenges for the forage maize production systems is to maximize the economic return while minimizing environmental pollution mainly associated with greenhouse gas emissions such as CO_2. In this context, crop rotations influence not only crop growth, but also the soil chemical properties such as the amount of carbon storage in the soil. This study aimed to evaluate the effect of the forage maize-pasture rotation on the carbon storage in the whole soil and each soil aggregate fraction (250–2000 µm; 53–250 µm and < 53 µm) under different climatic conditions in Galicia. In September 2020, a total of sixteen plots were selected in the interior and coastal areas of Galicia. In each area, four plots with a forage maize-pasture rotation and four plots without rotation with pasture were selected to collect composite soil samples. In the laboratory, the total soil carbon and the carbon storage in the different soil fractions were estimated. In this study, the crop rotation increased the amount of carbon storage in the soil in the long term.

KEYWORDS: climate change, agriculture, soil aggregate fractions

PAPER ID: CEST2021_00306

Effects of light stress on wheat and rye varieties grain composition

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ABSTRACT

Integrating woody perennials and agricultural crops combined is a centuries-old practice, nowadays called agroforestry. Because agroforestry is being promoted by public administrations, it is essential to obtain scientific knowledge about the effect of different factors (e.g. tree shade) on crop characteristics. In this study, the effects of light intensity variation on the nutrient composition of wheat (*Triticum aestivum* L,) and rye (*Secale cereale* (L.) M. Bieb.) grain were analyzed, focusing on the concentration of macronutrients such as N, P and Mg and micronutrients such as Zn, Mn and Fe. To evaluate nutritional quality, 17 wheat and 11 rye varieties, grouped by t their flowering time (precocity), were studied. A randomized complete block design with four replications per variety and light intensity was used to carry out this study. These varieties were grown, in pots, under greenhouse conditions, during 2016-2017. To simulate different intermediate (IS) and high shade (HS) conditions, polyurethane meshes of different hole diameter sizes 0.0075 cm^2 and 0.0026 cm^2, respectively; applied in April, were used. In both species, an increase in nutrient concentration was observed under HS conditions. Micronutrients showed the greatest sensitivity to the variation in light intensity, especially Zn and Fe in wheat and Zn and Mn in rye.]

KEYWORDS: Food safety, climate change, shade, nutrients, winter cereals, greenhouse

PAPER ID: CEST2021_00780

Effect of shade on production and grain yield in greenhouse wheat varieties

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ABSTRACT

The effects of climate change threaten food security by affecting the production and quality of crops that are part of the world's food base, such as wheat. The crop-tree association can act as a tool to mitigate and adapt to climate change, and it is important to analyze the influence of the shade cast by the tree canopy on the yield of important global cereals. This study analyzes the effect of shade (IS: intermediate shade and HS: high shade) on grain yield (GY), straw yield (SY) and number of grains m^2 (G m^{-2}), in 17 varieties of winter wheat, with growth cycles of different lengths (early, medium, late). The wheat was sown on two late dates (December 2016 and January 2017), under controlled greenhouse conditions. Straw yield decreased in shady conditions in medium and later varieties, sown in January. Only a decrease of grain yield and number of grains was observed when late varieties were sown in January when HS was applied to plants. These results seem to indicate that the variation in light intensity has a lesser effect in those varieties that are sown in December.

KEYWORDS: *Triticum aestivum* L.; commercial varieties; shade, precocity, sowing date

PAPER ID: CEST2021_00779

Sustainable development assessment on Grass-based circular business models for rural agri-food value chains (GO-GRASS)

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ABSTRACT

Climate change affects temperate areas by increasing the risk of suffering extreme climatic events and sharping major problematics. Moreover, climate change and its related effects jeopardize water and food supply. Rural areas are key for sustainable development and provide socio-economics advantages, but it also exists a downside on key aspects such as less job, education and infraestructures accessibility for its inhabitants. The European Commission is strongly committed to improving life quality and business opportunities in rural areas. Thus, the GO-GRASS is an H2020 project that aims to create innovative business opportunities in rural areas based on grassland and green fodder. Key Performance Indicators (KPIs) development is a very useful instrument for organizations management. that allows testing the efficiency of a system considering elements and standards related to a specific topic or work field. Within the GO-GRASS, KPIs development is key to evaluate the sustainability of grass-based value chains and assessing the replication potential of demos business models. Based on SAFA indicators and GRI standards, the evaluation of value chains was geared to economic, social and environmental issues to obtain finally, a set of eight, six and 10 KPIs selected by the project´s experts that allows grass-based value chains evaluation.

KEYWORDS: Grassland, Value chain, Bioeconomy, Key Performance Indicator, Business model.

PAPER ID: CEST2021_00787

Livestock Greenhouse Gases emissions and its contribution to Climate Change. The case study of a Cyprus cow farm

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ABSTRACT

Human population is expected to increase from 7.8 to 9.4 billion by 2050. At the same time the demand for agricultural products will increase by about 50-70%. As a result, there is a growing awareness that rapid growth in global production and consumption of livestock products is contributing to serious environmental problems, the most notable being the contribution to climate change. The livestock sector contributes 8-14% of global Greenhouse gases emissions (GHGs). Animal agriculture produces greenhouse gases in the form of CH_4 from enteric fermentation, N_2O from use of nitrogenous fertilizers, and CH_4 and N_2O from manure management and deposition of animal manures on pastures, and CO_2 from energy consumption. Under the European program ClimaMed LIFE17 CCM-GR-000087, this study focuses on the emissions from a cow farm, in order to identify and evaluate the sources of GHGs emissions, and also to promote mitigation actions. In specific, LIFE ClimaMED aims at developing and delivering innovative, reliable, rapid and cost-effective technologies of Tier 3 level for the on-site measurement of CO_2, CH_4 and N_2O emissions and SOC stock changes from agricultural fields at real time, in order to assist scientists, public authorities and policy makers in collecting, quantifying, evaluating, mapping and reporting spatial data for GHGs emissions and SOC stock changes from the Mediterranean agricultural and livestock sector.

KEYWORDS: GHGs, Livestock, Climate Change, LIFE ClimaMed

PAPER ID: CEST2021_00050

Integrating Seaport Infrastructure Monitoring Approaches to Improve Smartness and Climate Adaptive Capacity

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ABSTRACT

Seaport infrastructure monitoring promotes the development of an effective management system that ensures functionality, structural capacity and safety. Monitoring approaches are considered to be a useful tool in an attempt to deal with growing global trends, such as seaport "smartness", or with challenging issues such as climate crisis, while enhancing the financial performance and the capability of a seaport to remain competitive in the trading environment. Therefore, the present paper proposes a framework for integrating monitoring processes and relevant data analyses to improve seaport smartness and adaptive capacity to climate change. The framework is applied at the seaport of Lavrio, located in central-eastern Greece, where in-situ inspection and condition assessment is performed through utilizing modern monitoring techniques. The research outlines the significance of establishing a robust monitoring system such as the one hereto described to minimize the impact of natural hazards, perform suitable maintenance strategies and optimize the required periodic control of seaport facilities.

KEYWORDS: Monitoring, Smart Ports, Climate Change, Climate Adaptive Capacity, Seaport Infrastructure

PAPER ID: CEST2021_00123

Precipitation variability, trends and extremes for the region of the Arabian Peninsula

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ABSTRACT

The Arabian Peninsula is generally known as a region characterized by low annual precipitation amounts and a great seasonal and spatial variability. However, its location and geomorphological characteristics lead to diverse climatic conditions in different sub-regions and smaller scales. At the same time, extreme rainfall events and floods often pose a threat to human life and activities. Therefore, a better understanding of the spatiotemporal features of precipitation is more than necessary. Towards this way a thirty-year (1986-2015) climatic analysis has been prepared with the aid of the state-of-the-art numerical modeling system RAMS/ICLAMS. The model output has been extensively evaluated against in situ measurements and satellite records revealing a good behavior. The analysis consists of three main parts; the mean climatic characteristics, the rainfall trends and the analysis of extremes. The last are studied employing the principles of the extreme value theory, taking into consideration both the duration and the intensity of the rainfall events. Among the main findings, the spatial distribution of the precipitation trends showed insignificant differences for the examined period. Furthermore, it was found that the eastern and the top half parts of the Arabian Peninsula presented the lowest risk regarding extreme events. Apart from the pure scientific interest, the findings can be quite useful in different sectors such as civil protection, constructions and reinsurance.

PAPER ID: CEST2021_00853

SESSION 17 - ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Thursday 2 September - afternoon

Is Greece greener than the data shows? Calculation of Green GDP and comparison with neighboring countries

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ABSTRACT

Is Greece greener than the current economic indicators show? GDP is used as the leading economic indicator of economic growth and progress. GDP as a measure, among other things, lacks an environmental component. In this paper, we have developed a Green GDP for Greece and neighboring countries and compared them with each other, precisely to compensate for the shortcomings of environmental components in GDP. Green GDP consists of classic GDP minus the costs of pollution, overexploitation of resources, and CO_2 emissions into the atmosphere. In this way, or with this calculation method, we have obtained a more detailed and precise presentation of economic growth at the expense of ecology. The paper's main objective is to show whether Greece and neighboring countries, which have the same geographical position, have the same or different environmental policies and how much this policy affects economic development and vice versa. Excessive pollution or exploitation of resources shows a more real economic growth that is sure to pay off in the future for future generations. In this way, we can calculate how much our progress today is a burden for our children or their children in the future, and we can assess whether today's economic growth is worth it in such a way.

KEYWORDS: Green GDP, cost of pollution, CO_2 emissions, Greece.

PAPER ID: CEST2021_00393

A data-driven approach to predict phytoplankton blooms using satellite-derived water quality and hydrometeorological drivers

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ABSTRACT

The present work leverages simulated hydrometeorological factors and satellite-derived chlorophyll-a to predict phytoplankton dynamics for Mulargia reservoir (Sardinia, Italy). A Random Forest (RF) model was (a) calibrated to minimize out-of-bag errors of chlorophyll-a predictions for a 5-year-long period (2015-2019), and (b) benchmarked against a naïve predicting alternative for multiple forecasting horizons. Calibration and benchmarking revealed that the RF model can predict the temporal dynamics of phytoplankton growth accurately up to ten days in advance (mean absolute scaled errors ranged from 0.5 to 0.9). Permutation variable importance metrics and the individual conditional expectation plots revealed that moderate temperatures, high soluble phosphorus loads, and low light intensities favor the occurrence of phytoplankton growth in Mulargia. This finding is consistent with the dominance of *Planktothrix* sp. that has been observed in the reservoir. Conclusively, this work lays the foundation for an operational forecast model to help local stakeholders with the present and future reservoir management.

KEYWORDS: Machine learning; forecasting; phytoplankton blooms; remote sensing; hydrometeorological predictions

PAPER ID: CEST2021_00420

Comparison of regression model and artificial neural network model in noise prediction in a mixed area of Dhaka City

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ABSTRACT

The equivalent noise levels regularly exceed acceptable limits within Dhaka city, the capital of Bangladesh, especially in the mixed urban areas (where trips are generated to serve commercial, residential, and industrial demands). The study aims to assess the noise level in mixed urban areas, build noise prediction models and allow scopes for ensuring sustainable environmental management. Two traffic noise prediction models were assessed: a regression model and an artificial neural network (ANN) model to predict the equivalent noise level (L_{eq}). Traffic and noise level data were collected from two mixed urban areas, statistical analyses were performed to describe the existing trends and to evaluate both model's responses in predicting equivalent noise level (L_{eq}). The ANN model (coefficient of determination: 0.82) showed better performance than the regression model (coefficient of determination: 0.70). The predicted equivalent noise levels from the ANN model were compared to acceptable limits to display the extent of noise pollution using GIS. The traffic noise models can assist in environmental impact assessment to protect the communities susceptible to the adversities of noise pollution.

KEYWORDS: Noise pollution, Equivalent noise level, Prediction model, Regression, Artificial Neural Network.

PAPER ID: CEST2021_00482

Reducing sewage sludge ash variability in the context of P-recovery by optimizing the storage management using Monte-Carlo simulations

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ABSTRACT

Phosphorus (P) is a critical raw material and the EU largely depends on P-imports to cover its demand. This is increasing efforts to recover P from secondary P-sources such as municipal sewage sludge ashes (SSA) from mono-incineration. Usage of SSA for mineral fertilizer production requires compliance with certain quality standards regarding P-concentrations and trace element levels. This is particularly challenging in view of the variability in composition and amount of sewage sludge due to different technologies applied by the wastewater treatment plants (WWTP) and various catchment areas when sludge is jointly incinerated. By applying different sewage sludge treatment processes along the process chain, homogenization of the output quality of mono-incineration plants may be achieved. To investigate the effects of input variability and treatment processes on SSA composition a Monte-Carlo simulation approach was used. The simulations included probability distributions of sewage sludge composition data from 57 WWTP. Missing data were compensated by mean substitution to generate a complete set of input distributions. The resulting distributions of SSA nutrient and contaminant concentrations obtained by the simulation were compared.

KEYWORDS: phosphorus, P-recovery, Monte-Carlo-simulation

PAPER ID: CEST2021_00136

Exploitation of Crowdsourcing Tools and Earth Observation data: A Systematic Literature Review

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ABSTRACT

Crowdsourcing is a method gaining ever wider use in practice and leverages human intelligence to solve problems in a considerable number of study fields. Howe (Howe 2006) coined the concept defining: "Crowdsourcing represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined network of people in the form of an open call." This systematic review aims to understand the Crowdsourcing tools and Earth Observation (Satellite, aerial & in-situ) data and their contribution to environmental conservation and sustainability. The review involved 29 papers with particular focus on Technology Readiness Level (TRL), data fusion methods applied and topics such as types of users and their incentives and tools used to engage users and to collect the data. This article provides a glimpse of the Citizen Science (CS) data collection combined with Earth Observation data and explores the development of this swiftly emerging and evolving subject. We discuss two central implications in terms of research-implementation spaces for Crowdsourcing tools and EO data fusion: (1) the need to centralize the role of the people in order to have more accurate outcomes and (2) the most commonly used tools for crowdsourcing. This systematic literature review provides collective insights about the most commonly used tools for crowdsourcing that characterize well it's one of the monitored domains, concluding that in complex environments remote sensing still exceeds citizen information. Our review identified limitations and recommendations derived from the monitored papers, that will improve the efficiency and provide an opportunity to look at multifaceted problems from numerous standpoints.

KEYWORDS: Remote Sensing, Earth Observation, Citizen Science, Crowdsourcing tools

PAPER ID: CEST2021_00182

Understanding the EU ETS Market Structure Using Transactions of Core Participants

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ABSTRACT

European Union Emission Trading System (EU ETS) is a key instrument of EU's climate policy and the largest international cap-and-trade system. Every allowance transaction is recorded in an electronic registry, called European Union Transaction Log (EUTL). Utilizing the vast amount of EUTL data, we exploit the EU ETS transaction network as a means for understanding in depth the allowance market structure. We observe that the network follows the core-periphery structure and identify a small subset of core transactors. We provide strong evidence that despite its small size, the part of the network built around core transactors captures all the key properties of the entire EU ETS transactions network. Moreover, due to high and more regular trading, the transactions of the core members lack the "noisy" behaviour typically appearing in the periphery. Through extensive evaluation, we demonstrate that the core transactions can provide better results in explaining and forecasting the allowance price. Our work provides a compact and useful tool which can be used not only towards understanding a large and complex allowance market, but also towards evaluating one of the most prominent environmental policy instruments, the EU ETS.

KEYWORDS: Emission Trading System, cap-and-trade, ETS transaction network, core-periphery structure, forecasting

PAPER ID: CEST2021_00522

Dynamic and embedded multi-criteria assessment methodology for the environmental monitoring and control of large civil engineering projects

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ABSTRACT

The research presents a novel dynamic and embedded multi-criteria methodology for the environmental monitoring and control of large-scale civil engineering works. The principal steps are argued, along with the identification of the appropriate indicators and their evaluation criteria. In order to allow the real-time monitoring and share the results with the stakeholders, the integration with a Geographic Information System, developed on a web-based platform, is highlighted. The application and validation of the proposed methodology is shown with reference to a real case of application of an upgrading of a port area. The results show the usefulness of the proposed methodology in order to standardize monitoring activities and provide immediate information to control the environmental pressures, avoid potential negative impacts and identify the best mitigation actions.

KEYWORDS: EIA, web-GIS, port, proactive approach, environmental components

PAPER ID: CEST2021_00580

An Advanced Boussinesq-Type Model for Wave Propagation in Coastal and Harbour Areas

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ABSTRACT

In this paper, an advanced numerical model for the simulation of wave propagation and transformation in coastal areas and inside ports is presented. This model is a fully dispersive and highly nonlinear 2DH Boussinesq-type model, extended to cover real-life applications, capable of simulating the transformation of complex multi-directional irregular wave fields in coastal and harbour areas with varying bathymetries. This version of the model is coupled with wave overtopping empirical formulae as described in the EurOtop (2018) manual. The numerical model when compared with experimental data showed that a more than satisfactory agreement was achieved in most cases. A real case study, in the coastal zone of Rethymno in the Island of Crete, Greece, including the including the current port infrastructure, is also presented.

KEYWORDS: Boussinesq-type model, coastal processes, irregular multi-directional waves, numerical simulation, wave overtopping.

PAPER ID: CEST2021_00743

Study of the Airflow Around the Occupants in a Virtual Chamber Equipped with Impingement Ventilation System

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ABSTRACT

The study of the airflow around the occupants in a virtual chamber equipped with impingement ventilation system is made. This numerical study is carried out using a coupling of an integral numerical model, that simulates human thermal response systems, and differential numerical model, that simulates the Computational Fluids Dynamics. The air velocity field, the Draught Risk field and the carbon dioxide concentration around the occupants, is made. The study was performed for winter typical conditions in a virtual chamber occupied by four occupants. The results show that the airflow, promoted by the impingement ventilation system, with a descendent airflow in the corners of the chamber, promotes an ascendant ventilation system around the occupants. The air velocity is higher in the floor level, the Draught Risk is lower around the occupants and the carbon dioxide concentration released by the occupants' respiration is transported directly to the extraction system, located above the head level.

KEYWORDS: Numerical simulation, Impinging ventilation system, Human thermal response, CFD, Draught Risk

PAPER ID: CEST2021_00691

The Expected Dynamics of the Wind Conditions in the West Iberian Nearshore in the Context of the Climate Change

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ABSTRACT

The target area of the present study is the western side of the Iberian coastal environment. Although not so high as in the North or the Baltic seas, the wind power potential can be considered significant in this nearshore. Furthermore, since this coastal environment is rich also in terms of other marine renewable energy resources, this represents a very good place for a joint exploitation of ocean energy. On the other hand, the climate change induces new configurations of the environmental matrix, with important impact on the coastal environment. From this perspective, the objective of the present work is to analyze the expected dynamics of the wind conditions in the west Iberian nearshore, in the context of the climate change. The study is focused on estimating the average and extreme wind conditions for the 30-year time interval 2021-2050. The climatic wind fields provided by the Global Change Assessment Model are considered for the near future period under the Representative Concentration Pathway scenario 4.5. This scenario assumes that emissions will increase until 2040 and then decline. In parallel, an analysis of the historical wind data for the 30-year period 1990-2019 is also performed based on ERA5 data.

KEYWORDS: Iberian nearshore, wind power, maximum wind speed, near future, RCP4.5

PAPER ID: CEST2021_00323

Assessment of thermal indices applicability in Cyprus

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ABSTRACT

Thermal indices are commonly used to assess outdoor thermal environments. This study aims to examine the applicability of popular thermal indices for the assessment of thermal sensation in Cyprus. Field surveys were conducted in outdoor public sites in five districts of the Republic of Cyprus. The surveys involved environmental monitoring and questionnaire-based interviews of pedestrians. The pedestrians reported their thermal sensation using a nine-point scale, the actual thermal sensation (ATS). Thermal sensation predicted by Discomfort Index, Heat Index, Humidex (HU), Physiologically Equivalent Temperature (PET), Predicted Mean Vote (PMV), Standard Effective Temperature, Universal Thermal Climate Index, and Wet-Bulb Globe Temperature (WBGT), was compared to ATS. Spearman's rho, Goodman and Kruskal's gamma, percentage of correct predictions, and distribution of indices' predictions per category of ATS were used to assess indices' applicability and find the index that best predicts thermal sensation. The analysis was performed for participants living in Cyprus (locals) and for visitors (non-locals). The indices predicted successfully a low percentage of ATS ranging in locals between 9.6% (HU) and 20.7% (PMV), and in non-locals between 13.9% (WBGT) and 29.9% (DI). Overall, PET performed better predicting successfully 16.8% of ATS in locals and 27.3% in non-locals.

KEYWORDS: thermal index, thermal sensation, index evaluation, field survey, Mediterranean climate

PAPER ID: CEST2021_00249

Pedestrian preferences of urban design features in city squares of Athens, Greece

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ABSTRACT

Public open spaces improve the quality of life in cities and form places for community gatherings and outdoor activities. This study examines the preference of pedestrians for the design features of urban squares. Field surveys on the perception of environmental stimuli were conducted in five squares in Athens, Greece in three seasons (summer, autumn and winter), while a mobile station monitored environmental conditions at the moment of the interview. The questionnaire included an item on the preference for improvement of urban design features (i.e., vegetation, water elements, view, and sport spaces) at the monitoring sites. Overall, 1,858 pedestrians participated in the survey. Of these, 84.4% reported a preference for the monitoring site to be improved for urban design. More vegetation (60.7%) and adding water elements (28.9%) were the most popular suggestions. The preference for increasing vegetation was prevalent in all three seasons (summer, 63.8%; autumn, 61.5%; winter, 57.3%; $p=0.05$). The preference for water elements was more prevalent in summer (39.6%) than autumn (31.5%) and winter (17.3%; $p<0.001$). The results show that most participants would prefer the monitoring sites to be improved for urban design reporting vegetation as the main element for improvement.

KEYWORDS: urban design, design preference, field surveys, pedestrian

PAPER ID: CEST2021_00254

Nonlinear Autoregressive Neural Networks for Air Temperature forecasting

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ABSTRACT

In the field of climatic conditions forecasting, the linear classical time series models are inadequate for modelling and predicting accurately the air temperature variability. This work presents the novel application of nonlinear autoregressive neural networks (NAR) in air temperature forecasting. Hourly air temperature data were extracted from the Chania Airport station located at the island of Crete in Greece, for a 10-year period. The NAR is a multi-layer, dynamic, recurrent neural network that employs feedback connections for multi-horizon time series forecasting. Multiple NAR networks were trained with feedback connections for 6, 12 and 24 hours and for forecasting horizons up to 24-time steps. In the context of evaluating the performance of the trained NAR networks the Mean Absolute Error (MAE) was used and specifically the errors are examined in terms of their dependence with the atmospheric circulation. The results indicate that the use of a high degree of feedback decreases the forecasting error and increases the forecasting horizon of reliable air temperature estimation. The forecast error is dependent on the atmospheric circulation and higher MAE values are related with depressions that effect the study area.

KEYWORDS: Air temperature, Machine Learning, Artificial Neural Networks, Dynamic Neural Networks, Forecasting

PAPER ID: CEST2021_00485

The potential of UAV multispectral imagery to estimate chlorophyll content of vine leaves

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ABSTRACT

As is known, chlorophyll is an important biophysical parameter used to monitor the overall physiological status of plants. The aim of this research was to study the potential of UAV multispectral images for estimating the contents of leaf chlorophyll in vineyards. For this purpose, a UAV flight was conducted (eBee SQ with Parrot Sequoia multispectral camera) and simultaneously in-situ measurements of leaf chlorophyll content of vine were performed using MC-100 Chlorophyll Meter. A total of 51 samples were collected: each sample representing the average of 5 measurements from the top of a single plant. Pearson correlation analysis was applied to test the relationships between spectral reflectance, Normalized Difference Vegetation Index (NDVI), Normalized Difference RedEdge Index (NDRE) and in-situ measured leaf chlorophyll content. A Partial Least Squares Regression (PLSR) model was also applied to predict chlorophyll content using 6 predictor variables: NDVI, NDRE and green, red, red edge, near infrared bands. The results showed that among spectral reflectance, the red band was most sensitive to chlorophyll variations ($r = -0.46$). Positive correlation between chlorophyll content and NDVI/NDRE also was found ($r = 0.67$ and $r = 0.57$, respectively). Promising results were obtained for the PLSR model ($R^2_{Val} = 0.49$, $RMSE_{Val} = 43.68$), which proves the high potential of multispectral UAV imagery for chlorophyll monitoring in vineyards.

KEYWORDS: Vineyards, UAV, Chlorophyll content, PLSR, Remote Sensing

PAPER ID: CEST2021_00131

Dual Discounting for the Environmental Decision-Making

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ABSTRACT

Nowadays, making sustainable decisions is one of the main priorities of government policies. Therefore, it is increasingly urgent to define investment decision support tools that ensure a long-term balance between environmental integrity, intergenerational equality, and economic efficiency. This research intends to demonstrate the crucial role of the Social Discount Rate (SDR) in Cost-Benefit Analysis (CBA). This issue is of particular interest for projects with environmental impacts, which would be excessively underestimated using traditional discounting procedures.

The aim of this paper is to characterize an innovative econometric model of environmental-economic discounting for a fair assessment of environmental effects. This can be done by introducing environmental quality into the logical-mathematical scheme of the SDR. The main novelty is the definition of the environmental quality according to the investment sector of the project in order to obtain specific discount rates for the following issue categories: (i) biodiversity; (ii) forests; (iii) fisheries; (iv) climate and energy; (v) air pollution; (vi); water resources; (vii) agriculture.

The estimation of environmental and economic discount rates for projects in Italy with impacts on air pollution allows testing of the defined model.

KEYWORDS: Environmental Decision-Making, Economic evaluation of Projects, Social Discounting.

PAPER ID: CEST2021_00523

SESSION 18 - SUSTAINABLE WATER MANAGEMENT IN THE MEDITERRANEAN – TECHNOLOGICAL SOLUTIONS, DEMONSTRATION AND DEPLOYMENT

Thursday 2 September - Afternoon

Application of two different strategies for the simultaneous disinfection and decontamination of urban wastewater using solar photo-Fenton and solar/H_2O_2 processes

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ABSTRACT

Simultaneous removal of contaminants of emerging concern and bacteria inactivation in simulated urban wastewater treatment plant effluent (SUWWE) through solar Advanced Oxidation Processes (AOPs) namely solar photo-Fenton (SPF) with Ethylenediamine-N,N′-disuccinic acid (EDDS) (H_2O_2=50 mg/L, Fe(III)= 0.1 mM, EDDS=0.1 mM), and the photochemical process based on sunlight/H_2O_2(H_2O_2=50 mg/L). Furthermore, the application of a sequential treatment was investigated by firstly applying sunlight/H_2O_2 followed by SPF at same reagents concentration and at neutral pH in a Raceway Pond reactor. Process efficiency was evaluated in terms of (i) degradation of five contaminants of emerging concern (CECs, namely Caffeine, Carbamazepine, Diclofenac, Sulfamethoxazole and Trimethoprim) at 100 µg/L each and (ii) bacteria inactivation (*E. coli*, *S. enteritidis* and *E. faecalis*), at 10^3 CFU/mL each. The results showed that SPF and sunlight/H_2O_2 as standalone processes are not effective enough for simultaneous CECs removal and bacteria inactivation while sequential combination of sunlight/H_2O_2 and SPF operated in RPR would be a suitable solution for simultaneous CECs removal and bacteria inactivation.

KEYWORDS: sunlight/H_2O_2, solar photo-Fenton, EDDS, wastewater treatment

PAPER ID: CEST2021_00744

Fostering the non-conventional water re-use in agriculture in Mediterranean countries: the MENAWARA project

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ABSTRACT

The Mediterranean region is considered as one of the world's most water-stressed areas where some countries have less than 1000 m^3 $capita^{-1}$ $year^{-1}$. This situation, exacerbated by climate change, is due to, but not restricted to, the relatively uneven distribution of precipitation, high temperatures and increasing water demand, especially for agricultural purposes. Under this context, the use of Non-Conventional Water (NCW), as drainage and treated wastewater, is one of the most sustainable alternatives to cope with water shortage.

The MENAWARA project is designed to enhance access to water through the treatment of wastewater to be reused as complementary irrigation and to strengthen the operational capacity of stakeholders of the quadruple helix, including local farmers, in 8 intervention areas of Palestine, Jordan, Tunisia, Spain and Italy. The actions will reduce the stress on freshwater sources from the agriculture sector and will improve the quality of treated wastewater in agriculture. Clean and environmentally friendly technological, managerial, and operational innovation will be applied and results shared among relevant stakeholders. MENAWARA will play an important role in reducing water insecurity by designing the most suitable post-treatment or Managed Aquifer Recharge (MAR) system for each intervention area and by promoting sustainable development in rural areas.

KEYWORDS: Non-conventional water reuse, Waste Water Treatment Plants (WWTPs), Managed Aquifer Recharge, Mediterranean Region

PAPER ID: CEST2021_00805

Development and demonstration of an eco-innovative system for sustainable treatment and reuse of municipal wastewater in small and medium size communities in the Mediterranean region

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ABSTRACT

Treated municipal wastewater is considered a valuable non-conventional water resource. However, a substantial number of wastewater treatment plants installed in the Mediterranean region have proven to be unsuccessful copies of systems operating in technolo-gically advanced countries. In addition to high operating and maintenance cost, these systems are often unsuited to address the local challenges of wastewater treatment. Therefore, treated municipal water is commonly under-exploited throughout the region. To address these challenges, the AQUACYCLE project aims to develop an eco-innovative wastewater treatment process scheme, comprised of anaerobic digestion, constructed wetlands and a solar photocatalytic reactor, for cost-effective treatment of urban wastewater and maximum environ-mental benefits. This paper presents the distinct features of the novel process scheme and the characteristics of three such demonstration units to be installed in Tunisia, Lebanon and Spain to test and validate the efficiency and cost-effectiveness of the hybrid system.

KEYWORDS: municipal wastewater, reclamation, anaerobic digestion, constructed wetlands, solar photocatalytic oxidation

PAPER ID: CEST2021_00806

Exploring the Living Lab approach for developing sustainable wastewater treatment and reuse systems in Mediterranean agriculture

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ABSTRACT

In the water-poor Mediterranean region, people have always had to cope with scarcity, developing adaptation strategies to meet their essential needs. However, the adaptation capacities in place are put to the test by climate change, unsustainable water use and wastage, contributing to the depletion of the resources when water needs driven by economic and demographic growth are ever-increasing (MedECC, 2019). Agriculture, is foremost leading to the unsustainable exploitation of surface and groundwater resources. Addressing the lack of water efficiency, achieving a greater mobilization of non-conventional water resources and an adequate reuse in irrigated agriculture, have a significant potential to enrich supply, preserve resources and contribute to restore groundwater capacities. This paper will outline the basic concept of Living Labs and its usability to overcome several constraints that hinder the intensification of wastewater treatment and reuse in agriculture, and to ensure the adoption of innovations is successful, sustained and scaled.

The Living Lab approach will help take into account the needs and address the concerns of different user groups when developing new techniques, technologies and rules, or adapting existing ones. In the ENI CBC MED project MENAWARA, seven Living Labs in Italy, Jordan, Palestine, Spain and Tunisia are under implementation.

KEYWORDS: Living Labs; Wastewater Treatment and Reuse; Agriculture; Adaptation; Public Private People Partnership.

PAPER ID: CEST2021_00807

Floating wetlands as Nature-based Solutions for marine water pollution control in Mediterranean: Challenges and future perspectives

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ABSTRACT

Mediterranean Sea is widely regarded as one of the most threatened environments in the world because of the high population densities, the lack of consistent waste-management schemes, the large influxes of tourists and the strategic merchant navigation. The growing environmental awareness of society, the advancement of Nature-based Solutions, and the need for reliable and cost-effective solutions create a favorable environment of opportunities for the Floating Wetlands which appear as an attractive ecotechnology able to address marine environmental problems in a sustainable way. Floating Wetlands are man-made ecosystems inspired by nature that are using natural processes in order improve water quality, while providing a series of ecosystem services that benefit both human and nature. Aim of this work is to reveal the growing importance of Floating Wetlands as Nature-based Solutions for marine water pollution control, to highlight the benefits of their application for economy and society and to identify future challenges and opportunities.

KEYWORDS: Floating wetlands, Nature-based Solutions, marine pollution, petroleum hydrocarbons, Mediterranean

PAPER ID: CEST2021_00810

Green walls for greywater treatment and reuse in Mediterranean countries

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ABSTRACT

This paper describes four case studies in which two types of green walls are implemented for greywater treatment and reuse in Mediterranean countries, Living walls and Green façade. Green walls are vertical vegetated systems that can be integrated into urban environments, providing various benefits. The green walls described in this paper were implemented as part of the NAWAMED project in Mediterranean countries in public facilities with the aim of demonstrating the potential of Nature Based Solutions and reducing the use of potable water by reusing treated greywater. The pilot projects are located in Italy, Jordan, Lebanon and Tunisia, and the treated greywater is mainly reused for irrigation and toilet flushing. In addition, technical indications are provided to foster future implementations of green walls for this specific application and to disseminate sustainable water management schemes.

KEYWORDS: Greywater; Sustainable Water Management; Green Walls; Nature-Based Solutions.

PAPER ID: CEST2021_00811

SWOT analysis of the institutional, policy and regulatory framework governing wastewater treatment and reuse in Tunisia, Lebanon and Spain

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ABSTRACT

This paper offers a concise overview of the main strengths, weaknesses, opportunities and threats, as derived from the institutional, policy and regulatory framework governing wastewater treatment and reuse in three Mediterranean countries. The SWOT analysis is based on a desk review of available reports, assessment studies and interviews with representatives of the public authorities involved at the national, regional and local level in Tunisia, Lebanon and Spain. This stakeholder-based SWOT analysis was performed to develop a strategic action plan for the implementation of an eco-innovative domestic wastewater treatment process scheme that is promoted in the aforementioned countries through pilot demonstration and operational application, with the aim to change the present paradigm of viewing wastewater as an unsafe effluent, to that of an abundant all-year-round resource that has multiple uses.

KEYWORDS: domestic wastewater, water reuse, governance framework, stakeholders' involvement, sustainability

PAPER ID: CEST2021_00819

Assessment Study on the Socio-Economic and Environmental Impact of Comprehensive On-site Wastewater Management and Reuse in Rural Areas

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ABSTRACT

During the last 4 years Palestinian Wastewater Engineers Group (PWEG) has succeeded in implementing a comprehensive low cost and low tech. decentralized wastewater management and reuse scheme in Marj Al Ghazal village in the arid Jordan Valley (JV) improving the access to non-conventional water resources. This was achieved by the construction of 11 household grey wastewater treatment plants and 11 modified septic tanks serving 47 households hosting 228 persons. Water consumption in the JV is above average national consumption amounting to 190 L/C/day, a total of 34,200 L/day of treated grey wastewater (GWW) is reused in irrigation of medjul date orchard 13500m^2 (135 medium age tree), 2 greenhouses of 300m^2 each. The saved water cost (0.25 Euro/m^3) is 3,121 Euro per year. The total cost of septic tanks suction amounting to 16,000 Euro/ year is saved. 10,800 Kg of medjul date with a total average cost of 27,340 Euro is yearly harvested thanks to the continuous availability of the treated GWW. A total cost of 3,000 Euro/ year is spent over the operation and maintenance of the treatment plants. In addition, a total cost of 5,468 Euro/ year is spent over the medjul trees growing and harvesting. A net yearly profit of 37,993 Euro is made available due to the reuse of the treated GWW in the whole village. An average yearly profit per household of 808 Euro is achieved. The beneficiaries' satisfaction was tested.

KEYWORDS: Rural, Onsite, Grey-wastewater, Environment, Socio-Economic.

PAPER ID: CEST2021_00821

SESSION 19 - ADVANCED OXIDATION PROCESSES

Thursday 2 September - afternoon

Oxidation of carbamazepine by photo-Fenton treatment

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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 H_2O_2:1.8 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: CEST2021_00017

Degradation of textile dyes in water by gas-liquid NSP-DBD plasma

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ABSTRACT

Textile dyes represent some of the most complicated environmental pollutants due to their variety and complex structure. Cold atmospheric plasma (CAP) is regarded as a highly competitive advanced oxidation process towards the removal of organic pollutants from wastewater. In this study, a gas-liquid nanosecond pulsed dielectric barrier discharge (NSP-DBD) plasma reactor was used for the degradation/mineralization kinetics of three popular dyes (Orange II, Methylene Blue and Methyl Orange). The experimental setup used to treat polluted water samples consisted of a gas-liquid DBD reactor driven by nanosecond pulsed voltage supplied by means of a nanosecond pulse generator producing positive high-voltage pulses of rising time about 4 ns. The applied high voltage pulses and the circuit current were monitored on a digital oscilloscope and measured using a high voltage probe and a current transformer, respectively. The inter-electrode gap was fixed at about 10 mm. The distance between the dielectric surface and aqueous solution surface was about 3 mm and its gap was filled with dry air injected over the aqueous phase at a constant flow rate. We found that the degradation kinetic order is MB>MO>OII. Under the optimized operating window, all dyes are completely degraded at treatment times ranging from 15 to 20 min with the corresponding energy yield being 1.5-2.0 g/kWh.

KEYWORDS: Nanosecond pulsed dielectric barrier discharge; Cold atmospheric plasma; Wastewater treatment; Organic dyes; Reactive nitrogen and oxygen species; Degradation mechanisms.

PAPER ID: CEST2021_00132

Ultrasound-assisted Fenton-like degradation of methylene blue using electrospun nanofibrous membranes

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ABSTRACT

New materials supported by Green Chemistry have been receiving widespread attention because they are fulfilling the sustainable development goals (SDGs) agenda, for which clean water development is a top priority. Recently, electrospun nanofibers membranes are being frequently used to decontaminate organic pollutants such as dyes because of their easy operation, flexibility, economic feasibility and high removal efficiency. In the present study, green polyvinyl alcohol-based electrospun nanofibers membranes (PVA NF) were produced at room temperature and applied for efficient capturing methylene blue as a common organic pollutant. A series of experiments were conducted to affirm their catalytic activity. In particular, dye degradation studies were initiated by dissolving a selected amount of Fe (III), H_2O_2, PVA NF membrane and ultrasound (ULTS). Results showed that ultrasound could generate hydroxyl (•OH) radical and triggers dye removal percentages, which are of significant contribution in terms of peroxide-free Fenton-like catalysis. Finally, this study has proven that electrospun nanofibrous membranes could be a potential economic and efficient carrier for the Fenton catalytic process to capture large amounts of organic pollutants from industrial effluents.

KEYWORDS: Electrospun nanofiber membrane, Green Chemistry, clean water, Fenton-like, methylene blue

PAPER ID: CEST2021_00211

Comparison of caffeine oxidation by Fenton reagent in combination with UV light and ultrasound waves

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ABSTRACT

The oxidation of aqueous caffeine solutions ($[Ca]_0$=100.0 mg L^{-1}) was analysed, operating at pH=3.0 and 25ºC 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 analysed.

KEYWORDS: AOPs, caffeine, Fenton reagent, ultrasounds waves, ultraviolet light

PAPER ID: CEST2021_00338

Application of solar photo-Fenton oxidation coupled with granular activated carbon as a viable option for the removal of contaminants of emerging concern in the urban wastewater of India

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ABSTRACT

It has been estimated that approximately 62 billion litres of sewage are generated every day in India, with only 37% of sewage being treated (Saxena et al., 2021). Wastewater treatment issues such as dysfunctional UWTPs with many of them operating at low service levels compared to the design capacity and a lack of a tertiary treatment facility, lead to the direct discharge of untreated or inadequately treated sewage into receiving environments, daily. Moreover, this type of untreated/partially treated sewage was shown to be popular for agricultural irrigation in water stressed rural regions around the country. This practice carries severe health risks to exposed farmers, due to their continued exposure to pharmaceutical residues and to pathogenic bacteria, which may not be treatable by commonly used antibiotics due to the development of antibiotic resistance (Saxena et al., 2021). Pathogenic bacteria were also shown to persist in secondary-treated effluents of urban wastewater treatment plants (UWTPs) in India, thus being still detected in irrigation canals that supply irrigation water to farmers (Saxena et al., 2021), highlighting the risk for an increase in the prevalence of antibiotic-resistant bacteria (ARB) due to the selective pressure applied by the presence of antibiotic residues in contact with the remaining bacteria.

Therefore, the objective of this study was to evaluate the application a solar-driven Advanced Oxidation Process namely the solar photo-Fenton oxidation, coupled with a polishing adsorption step using Granular Activated Carbon (GAC) at a pilot scale, for the treatment of simulated Indian wastewater (SWW). This investigation took place in the framework of the EU-India 'PANIWATER' project (H2020-SC5-2018-1/820718), with the goal of applying a real-case scenario where a mixture of chemical and microbial CEC in wastewater of a rural region in India is effectively treated under real solar irradiation, in order to produce a safe-to-use treated effluent.

The optimum conditions of the solar photo-Fenton oxidation for the assessment of the removal of the chemical and microbial CEC were: $[H_2O_2]_0$=100 mg L^{-1}, $[Fe^{2+}]_0$=5 mg L^{-1} and [pH]=2.8. The pilot-scale GAC adsorption step involved the use of 6.5 kg of a charcoal-based GAC (Norit ROZ3) in a two-column setup.

The assessment of the removal of the CEC that were spiked into the SWW at an initial concentration of $[C]_{ini}$=100 μg L^{-1} at the end of the solar photo-Fenton oxidation (T30W,n=247.7 min), led to an efficient removal of the chemical CEC. More specifically, acetaminophen and diclofenac were completely removed (>99%), followed by erythromycin (98%) and ofloxacin (90%). The contact time of 15 minutes with GAC after solar photo-Fenton oxidation of the treated effluent, was adequate for further effective CEC removal. All compounds exhibited a final removal >90% after GAC except

sulfamethoxazole, which exhibited a removal of 88%. In more detail, the GAC contact contributed to the additional removal of compounds by 1-50%.

The solar photo-Fenton oxidation process was effective for the inactivation of total pathogenic *Escherichia coli*, *Enterococcus faecalis* and *Salmonella enteritidis* after $T_{30W,n}$=42.9 min. This finding showcases the potential of such an advanced oxidation process for the effective disinfection of wastewater effluents, thus rendering them clear from important pathogenic bacterial groups such as the ones examined herein. The spiked ARB into the SWW of an initial concentration of $4x10^4$ CFU mL^{-1}, were inactivated after 5 min of oxidative treatment. Due to the fact that ARB are a sub-category of total bacteria and as a result behave in the same manner as total bacteria once under oxidative stress, the addition of H_2O_2, the acidic pH and the exposure of the experimental reactor to real solar irradiation achieved their complete inactivation (<LOD) after 5 minutes of solar photo-Fenton oxidation.

Finally, the solar photo-Fenton oxidation coupled with GAC adsorption was shown to be a valuable treatment combination for use in developing countries such as India, for the removal of chemical and microbial CEC that may pose serious human health risks when found in wastewater effluents used for disposal or agricultural irrigation purposes.

KEYWORDS: Advanced oxidation processes, Antibiotic-resistant bacteria, Wastewater treatment, Activated carbon adsorption, Pharmaceuticals

PAPER ID: CEST2021_00642

Regeneration of dissolved Fe(II) from Fenton sludge at a microbial fuel cell using a novel biocathode

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ABSTRACT

Fenton reactions are widely applied for degrading recalcitrant pollutants, but the resulting ferric sludge remains a challenge. A novel concept for regenerating Fe(II) solution at pH 6 from ferric sludge generated in neutral Fenton is proposed. A microbial fuel cell (MFC) with biocathode and addition of citric acid was used for the first time to regenerate Fe(II) from ferric sludge. The concentration of dissolved Fe(II) reached 120 mg/L in the biocathode, which was much higher than that obtained in abiotic cathode (<1 mg/L). The chemical cost of regenerating Fe(II) was only 3.3% of the commercial Fe(II). Subsequently, the regenerated Fe(II) solution was used for Fenton treatment to remove pharmaceuticals from the municipal wastewater effluent. A wide range of pharmaceuticals was successfully removed at neutral pH in 60 min, and the efficiency of the treatment was similar to when the same dosage of commercial Fe(II) was applied.

KEYWORDS: Regeneration; Ferric sludge; Iron-reducing bacteria; Biocathode

PAPER ID: CEST2021_00750

Magnetite-decorated catalytic membrane reactor for the continuous-flow CWPO of micropollutants

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ABSTRACT

This work aims at developing a contactor type Catalytic Membrane Reactor (CMR) for its application in the continuous removal of micropollutants by Catalytic Wet Peroxide Oxidation (CWPO). For such goal, a porous alumina membrane tube was homogeneously decorated with magnetite nanoparticles following an optimized method (ion-adsorption, microwave drying, calcination and reduction). In this interfacial system, the water effluent and the H_2O_2 solution are separated by the catalytic porous membrane, where a controlled reaction zone is formed. The Fe/CMR (0.5% wt.) developed was applied for the treatment of a representative micropollutants mixture (sulfamethoxazole (SMX), metronidazole (MNZ) and carbamazepine (CBZ)) under ambient conditions and slightly acidic pH (pH_0 = 5). The initial concentration of each compound was established at 100 μg L^{-1}. Despite the relatively low micropollutants conversion achieved (22.1%, 27.8% and 32.2% for MNZ, SMX and CBZ, respectively), the catalytic system showed a high stability in long-term application (100 h). Further research is currently on the way with the aim of increasing the iron load in the surface of the membrane in order to improve the catalytic performance of the system.

KEYWORDS: structured catalyst; catalytic membrane reactor; continuous water treatment; micropollutants; magnetite.

PAPER ID: CEST2021_00763

Evaluation Of Photochemical Degradation Of Antiviral Acyclovir By Uvc/Ps & Uvc/H_2o_2 In Synthetic Fresh And Hydrolyzed Urine

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ABSTRACT

The increasing presence of contaminants of anthropogenic origin in the aquatic environment raises the concern of the scientific community (Patel et al., 2019). Antiviral drugs play an important role, as their presence in aquatic bodies is associated with antiviral resistance and chronic toxicity to aquatic organisms (Nannou et al., 2020). Acyclovir is one of the widest antivirals as it is preferred for the treatment of various diseases such as herpes simplex virus, hepatitis virus, and cytomegalovirus. Acyclovir has been detected in WWTPs and industrial effluents as well as drinking water. In the present study, the UVC/PS and UVC/H_2O_2 treatment of ACV was investigated in synthetic fresh (SFU) and hydrolyzed urine (SHU). Specifically, the effect of each component of these complex aqueous matrices on the performance of the treatment methods was evaluated. It was found that UVC/H_2O_2 system is effective in ACV decomposition even SHU and SFU, as almost complete degradation of the antiviral is achieved in a short time of treatment. In contrast, UVC/PS system presents a lower efficiency in ACV degradation. It was found that the presence of urea in SFU and NH_3 in SHU, inhibits the photo-generated sulfate radicals and consequently significantly slows down the decomposition of antiviral.

KEYWORDS: Acyclovir, antiviral, AOPs, UVC/H_2O_2, UVC/PS, fresh urine, hydrolyzed urine

PAPER ID: CEST2021_00638

SESSION 20 - SPATIAL ENVIRONMENTAL PLANNING

Friday 3 September - morning

A qualitative assessment of Environmental Impact Studies in Greece

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ABSTRACT

Environmental Impact Assessment (EIA) is a proactive methodical process that investigates and predicts the potential direct, indirect and cumulative impacts of a proposed project/activity on various environmental components, ideally from project/activity initiation to decommissioning. The output of the above process is the Environmental Impact Study (EIS) that should be of high quality and include all the relevant information.

The aim of this study is to evaluate the quality of EIS of projects/activities in Greece. The sample consists of 75 complete EIS, conducted after the issue of Law 4014/2011 and includes projects/activities of both categories A1 (extremely significant impacts) and A2 (significant impacts) and of various groups of projects (e.g. hydraulic projects, environmental infrastructure systems, renewable energy sources, industrial and related facilities). The methodology includes a structured evaluation of the above EIS, using the quality evaluation criteria checklist (8 categories and 92 evaluation criteria) of the Environmental Impact Statement Review Package developed by the Impact Assessment Unit (IAU) of Oxford Brookes University. The findings showed that the majority of EISs perform above the average grade of 2.5, when compared against the evaluation criteria. However, the studies omit important environmental and social issues, such as public consultation and alternatives.

KEYWORDS: Environmental Impact Assessment, Environmental Impact Studies, evaluation criteria checklist, Oxford Brookes University Environmental Impact Statement Review Package

PAPER ID: CEST2021_00038

Offshore solar farm siting in the Aegean Sea

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ABSTRACT

Climate change and its environmental effects have raised the need to use mild forms of energy. Solar photovoltaic panels and wind turbines are by far the biggest drivers of the rapid increase in renewable energy electricity generation. There are several technologies of photovoltaic systems such as ground systems, photovoltaic installed on roofs, floating systems, etc.

The aim of this paper is to identify and prioritize the appropriate sites for offshore solar farm (OSF) siting in the Aegean Sea (Greece), considering various restrictions and several evaluation criteria. The methodology includes: i) definition of the study area, ii) selection of exclusion criteria iii) geospatial depiction of incompatible sites, iv) selection of assessment criteria and v) application of entropy weight method and TOPSIS to hierarchically rank the sustainable sites for offshore solar farm deployment.

Nine (9) eligible Greek marine sites in the Aegean Sea (of total surface area that equals to 17.25km^2) have been identified and are candidates for further evaluation. The three first most appropriate sites for the OSF siting in the Aegean Sea correspond to marine areas located close to, Thasos, Samothrace and Crete. The exploitation of offshore solar energy could be the way to make many coastal regions, islands and remote locations sustainable.

KEYWORDS: Solar farm siting, entropy weight, TOPSIS

PAPER ID: CEST2021_00080

Integrating Ecosystem Services (E.S.) in spatial planning: a literature review

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ABSTRACT

Integration of ES in spatial planning constitutes a critical issue in the context of establishing resilient and sustainable policies. In this paper, a literature review was performed, to evaluate the integration of ES in spatial planning practices through institutional and governmental planning documents. The results indicated that ES have been gradually capturing the interest of the planning scientific community. However, the number of publications concerned with this topic is still very limited and with no clear methodology on the issue of integrating the ES concept in spatial planning. This paper suggests that the integration methodology to be built should focus more on urban environments, and with the intention to achieve integration within areas defined by ecosystem boundaries rather than administrative ones.

KEYWORDS: Ecosystem Services, Spatial Planning, Review

PAPER ID: CEST2021_00384

CIRC4FooD: An urban food production system inspired by the circular economy

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ABSTRACT

The environmental footprint of the current, linear food system is a key challenge that must be dealt with for a transition to sustainability -a fact highlighted in the recent Circular Economy Action Plan of the European Commission. Agricultural practices are drivers of polluting food production, while cities form critical hubs of wasteful food consumption. Urban agriculture has emerged as a promising practice for shortening supply chains while building urban resilience. The aim of this article is to present CIRC4FooD: a system for urban food production inspired by the circular economy, aiming at reducing the use of resources and the environmental impact of food production and consumption in the city. CIRC4FooD is comprised of four sub-systems: rainwater collection system, vegetable garden precision irrigation, composting system and a smart irrigation system. The latter collects data from all sub-systems, providing input to an online platform for monitoring and assistance, where the users can be informed about the growth of the vegetables and their water or fertilizer needs. The CIRC4FooD system is currently being piloted in three scales at the city of Trikala in Greece: raised beds and small municipal gardens in public space (small scale), domestic vegetable gardens (medium scale) and a city park (large scale). The expected results, apart from sustainability gains, include the optimization of the water harvesting installations and precision agriculture software, as well as the development of an integrated, circular urban agriculture system widely available to cities and citizens.

KEYWORDS: Urban Agriculture, Circular Economy, Rainwater Harvesting, Precision Irrigation, Composting

PAPER ID: CEST2021_00508

Lisbon – European Green Capital 2020: the allotment gardens contribution

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ABSTRACT

The main objective of this paper is to define the role and the importance of the urban allotment gardens in the consideration of Lisbon as the European Green Capital in 2020. In the first part of the paper, we seek to trace the historical evolution of vegetable gardens in the context of city development. In the second part, one proceeds to its mapping and its identification and characterization considering the multiple functions that allotment gardens play both to improve the quality of the urban environment and to improve the quality of human life. In this sense, the different ecosystem services that allotment gardens provide to the society are addressed, as well as their contribution to the qualification of Lisbon's urban landscape and urban food systems. For this, we used a research methodology that crossed the field work (the survey of the vegetable gardens), with bibliographic and documentary sources. The present diachronic and diatopic study about urban allotment gardens in Lisbon aims to legitimize the historical model of urban development based on the deeply intricate relationships between the city and the agriculture as a strategy to be adopted in the context of the long-term development of both Society and Nature.

KEYWORDS: Lisbon, vegetable gardens, multifunctionality, ecosystem services, food security

PAPER ID: CEST2021_00410

17th International Conference on Environmental Science and Technology

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Investigating the water, energy, marine land uses, food, climate interlinkages in marine environment

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ABSTRACT

The conflicts observed in the marine environment between the installation of renewable energy production, aquaculture activities and tourism, highlight the need for a more coherent management. To this end, maritime spatial planning is being developed at the cross-sectoral level, so that human activities at the ocean could be carried out in an efficient, safe and sustainable way. Along these lines, this paper is focusing on identifying the interlinkages between water, energy, marine land use, food and climate in the marine environment (Marine NEXUS). For the marine environment of Greece, an analysis of the interlinkages and the complex pathways are qualitatively analyzed based on their impacts on all aspects of the marine environment.

KEYWORDS: Marine NEXUS, coastal and off-shore environment

PAPER ID: CEST2021_00008

Assessing the role of Posidonia banquettes in coastline protection against erosion, through UAV technology and granulometric analysis: Preliminary results from the case of Schinias-Marathon National Park, Attica, Greece.

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ABSTRACT

Coastal environments and in particular beaches are valuable natural assets, offering a wide array of ecosystem services and economic benefits. In this study UAV technology with RTK-GPS is used in order to map in detail, the beach morphological characteristics, aiming to the impact of the presence of *Posidonia oceanica* beach-cast deposits. The principal aim of this research is to evaluate the relation between the banquettes and the sediments, as well as the banquette's significance concerning the beach protection. Particularly, the distinctive goals are: a) to identify the differences in volume, shape and area covered by the banquettes, and b) to analyze the relationship between banquette deposition and the changes of the sedimentary budget. The presence of the fine-grained sediments and the calculation of the sediment budget enclosed in the total volume of the banquette (692.57±8.3m^3 (Mission 2)) will re-evaluate their role concerning the coastline protection.

KEYWORDS: posidonia oceanica banquettes, uav survey, volume-area-sediment calculation, coastal protection

PAPER ID: CEST2021_00091

SESSION 21 - AIR POLLUTION

Friday 3 September - morning

The impact of COVID-19 partial lockdown on air pollution levels – A case study of Cyprus

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ABSTRACT

This study aims to analyze the changes in air pollution levels during lockdown measures in Cyprus. Lockdown measures came into force from March 13th 2020, few days after the first COVID-19 case was registered. The study analyses the data from different air quality monitoring stations in Cyprus in order to estimate air pollutant concentration variations during lockdown period. The data collected was compared to the previous year's monthly values of emissions. Results show that during the lockdown period, there was a significant reduction on NOx, NO and NO_2 (65,07%, 75,20% and 59,67% respectively) at the traffic air quality monitoring stations. A lower reduction was observed for CO (28.50%) and C6H6 (58,34%). SO_2 concentrations did not show significant reductions while ozone levels (O3) increased. The results clearly show the traffic-related air pollution and necessitate further design strategy plan about the allocation of the traffic volume and the promotion of public transportation and the use of alternative fuels.

KEYWORDS: COVID-19; Lockdown measures; Air quality; Traffic emission reduction

PAPER ID: CEST2021_00646

Sniffing VOCs emitted by books

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ABSTRACT

Headspace solid-phase micro extraction-gas chromatography/mass spectrometry (HS-SPME-GC/MS) was performed for the analysis of volatile organic compounds (VOCs) emitted from books. Towards this, books of different ages were examined (old = 50-300 years and new = 2-25 years) using a CAR/PDMS fiber. The examined books were placed into an in-house made glass sampling chamber, where they remained enclosed for 24 h prior to SPME sampling and subsequent analysis. SPME is a green and non-destructive preconcentration technique based on the absorption of analytes on a fiber coating placed inside the sample's headspace volume. The results were in line with previous reports; the most prominent VOCs released from old books were furfural, acetic acid, and acetone, whereas new books emitted toluene, acetone, and heptanal. This natural process takes place over time due to the decay of paper and degradation of ink and its mitigation is important for the preservation of texts that are considered cultural heritage. The method can be leveraged for monitoring the decay process, as well as the effect of external pollution on the books.

KEYWORDS: VOCs; HS-SPME-GC/MS; books; indoor air; degradation.

PAPER ID: CEST2021_00505

A versatile decision-support tool to assess air quality and health effects

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ABSTRACT

This work presents a web-based policy tool for the development of effective particulate matter (PM) pollution strategies. The tool is based on an integrated modelling approach, from emissions to health effects, which allows testing measures to improve air quality, focused on PM2.5 levels, and quantitatively assess their impact on the health and well-being of the populations. The tool was developed in the framework of the LIFE Index-Air project and this work describes its particular application to Athens (Greece) simulating the effect of two air quality improvements measures on the PM2.5 levels. The application of the tool for the reference scenario indicates that Athens did not comply with the European air quality standards (25 $\mu g.m^{-3}$) for the annual PM2.5 levels in 5% of the simulation domain. Two mitigation measures were simulated: i) fireplace improvement, and (ii) introduction of passenger electric vehicles. The results show that, in Athens, the electrification of the fleet is more effective, allowing to reduce up to 3 $\mu g.m^{-3}$ on the annual average of PM2.5 concentrations. The tool allows for rapid exploration of potential air quality and health improvements resulting from different control measures, supporting stakeholders in decision-making.

KEYWORDS: Air quality modelling, Artificial Neural Networks, Integrated Assessment Model, PM2.5, Athens

PAPER ID: CEST2021_00532

Relationship of satellite-derived atmospheric CH_4 concentrations with agriculture sector CH_4 emissions in Turkey

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ABSTRACT

In this study, bottom-up annual CH_4 emissions from agriculture (rice cultivation, enteric fermentation and manure) were calculated with the IPCC Tier 1 approach on county-level, and province totals were obtained for the first time in Turkey. Konya, which produces the highest annual CH_4 emissions (117 Gg CH_4/yr), is followed by Izmir, and Manisa provinces. TROPOMI-derived CH_4 measurements for a year from December 2018 to November 2019 were used to estimate the monthly and annual concentrations (ppb) for counties and provinces in Turkey. The monthly average CH_4 concentrations were between 1855-1870 ppb, and the highest levels were observed between June and September, which also coincides with the agricultural processes cause CH_4 emissions. TROPOMI CH_4 concentrations and agriculture-related CH_4 emissions agreed for provinces of İzmir, Aydin, Tekirdağ, Mersin, Adana, Hatay, Osmaniye, Kilis, Mardin and Şirnak, but conflicts for Ardahan, Van, Ağri, Kars and Erzurum. The results indicated agreement with agricultural CH_4 emissions in western and southern parts of Turkey rather than northern and eastern parts.

KEYWORDS: CH_4, Remote Sensing, Agriculture, TROPOMI

PAPER ID: CEST2021_00661

TROPOMI NO_2 and SO_2 Temporal Changes over Large Point Sources and Their Relationship with Electricity Production

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ABSTRACT

This study focuses on the spatial distribution and temporal changes of NO_2 and SO_2 pollution over large point sources using high-resolution TROPOMI retrievals, and aims to find a correlation between the retrievals and electricity production. SO_2 retrievals showed highest signals over power plants, whereas NO_2 retrievals showed highest signals over large cities. Daily and monthly time series of NO_2 and SO_2 for the selected nine coal power plants were compared with electricity production for two years. Correlations between NO_2, SO_2, and electricity production were calculated for daily and monthly averages for every power plant. Then, the monthly averages with more than 23 days data (~75%, May-October) were used for correlation analysis. Highest correlations were observed for lignite-fired Afsin Elbistan Power Plant with highest total capacity in Turkey. The monthly correlations for May-October were found as 0.71 for NO_2, 0.84 for SO_2 for Afsin Elbistan Power Plant, as 0.45 for NO_2 and 0.43 for SO_2 for all selected power plants. Temporal changes in electricity production can be captured on monthly-basis, however, the correlations were lower on daily-basis. Point sources located close to land-sea boundaries and multiple sources located in the same region were poorly captured using satellite retrievals.

KEYWORDS: TROPOMI, power plants, NO_2, SO_2, temporal distribution

PAPER ID: CEST2021_00770

The limitation of the methane (CH_4) emission in the Upper Silesian Coal Basin as a result of the Polish Mining Group closing program.

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ABSTRACT

Hard coal mining is responsible for 9% of the worldwide methane emission to the atmosphere. Methane is the second strongest greenhouse gas after carbon dioxide, but its radiative power is 25-30 times stronger than the radiative power of CO_2 .In the Polish reality, hard coal mining is one of the most important branch of economy due to big amounts of deposited coal in numerous coal seams which is being produced by many coal companies. The biggest active coal basin in the European Union – the Upper Silesia Coal Basin is responsible for 3% in the total greenhouse gases emission and 28% in the total CH_4 emission in Poland. The Polish Mining Group (PMG) – the biggest extraction company in the EU announced that all active coal mines incorporated in the Group will be closed until 2049. Hard coal extraction has been decreasing in Poland since 1997 and the amount of released methane from coal mines direct to the atmosphere exceeded 735 million m^3 in 2015 and remains high till now. The purpose of the study is to predict the results of PMG closuring program on methane emission changes in the Upper Silesian Coal Basin until 2049.

KEYWORDS: Methane emission, hard coal mining, the Upper Silesian Coal Basin (USCB), the greenhouse effect, air pollution

PAPER ID: CEST2021_00035

Performance of a Miniaturized, Lightweight, and Cost-effective Parallel-Plate Differential Mobility Analyzer

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ABSTRACT

Size resolved measurements of aerosol particles are essential for understanding key processes in the atmosphere and assessing their potential impacts on human health and climate. This has led to an increasing demand for compact and portable, yet cost-effective, instruments for characterizing the atmospheric aerosol.

A commonly employed instrument for sizing aerosol particles in the sub-micrometer range is the Differential Mobility Analyzer (DMA). Commercial DMAs weigh several kilograms, and have a cost higher than 10 kEUR. When employed in aerosol size spectrometers, they attribute a poor time resolution to the system (in the range of several minutes), as they require scanning of their operating conditions. This limits their ability to probe rapidly changing aerosols caused by certain processes. One way to overcome this limitation is to employ several DMAs operated at fixed conditions (instead of one in which the operating conditions are scanned), but doing so multiplies the weight, the size and the cost of the entire system.

Here we report on the design and testing of a lightweight, miniaturized and cost-effective Parallel-Plate DMA. The weight of this DMA is reduced to less than 1 kg, whereas its manufacturing cost is two orders of magnitude less than that of their commercial counterparts.

KEYWORDS: cost-effective and lightweight instruments, size distribution, new particle formation

PAPER ID: CEST2021_00739

SESSION 22 - ENVIRONMENTAL IMPACT OF MARITIME TRANSPORT

Friday 3 September - morning

An analysis of THETIS-MRV data on CO_2 emissions by Ro-Pax ships

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ABSTRACT

Maritime transport is responsible for about 2.5% of global greenhouse gas (GHG) emissions. These emissions are expected to increase significantly if mitigation measures are not taken. In 2013, European Commission set out a strategy towards reducing GHG emissions from the shipping industry. In this respect, from 1 January 2018, large ships over 5000 gross tonnage calling at European ports are to monitor and report their CO_2 emissions and other relevant information to THETIS – MRV database. The aim of this study is to analyse the EU-MRV database for the year 2019 for Ro-Pax ships. The total fuel consumption (and CO_2 emissions) and the fuel consumption per transport work were reported. The effect of factors such as the power of the main engines, the year of build, the vessel's length and the service speed to CO_2 emissions was investigated.

KEYWORDS : Climate change, shipping, European Union

PAPER ID: CEST2021_00148

Shipyards, Shipbreaking industry and the contribution of the industry 4.0

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ABSTRACT

Over the past years, a trend to monitor and control the procedures in various industries, has been attempted. It is known that the ship recycling procedure produces waste that turn to be highly dangerous for the environment, while the threat of atmospheric emissions is not yet solved. Today the majority of the ship building and ship breaking industrial activities take place in countries of eastern and south Asia, under the worst conditions in terms of working safety and environmental damage, even though there is an established legal framework. On the other hand, the initiative of Industry 4.0 offers a solution that can handle the environmental hazardous conditions and improve the recycling procedures. Environmental degradation, climate change, air pollution and other major environmental problems are the outcome of the rapid industrialization of the past centuries. The rise of the Fourth Industrial Revolution with the probable benefits of the new technologies can constitute the "payoff" to the environmental damage of the past. Main technology pillars of the industry 4.0 in such as Big Data, Analytics, Machine Vision, Collaboration Platforms, Simulation and Additive Manufacturing Augmented Reality, can scientifically diminish the environmental footprint of the ship breaking and ship building industry.

KEYWORDS: Ship breaking, Shipyard, Industry 4.0, Digital transformation.

PAPER ID: CEST2021_00282

Development of a tool for calculating ship air emissions

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ABSTRACT

This paper describes the development of a ship air emissions calculator, which will be part of the ECOMARPOL platform of the Intelligent Research Infrastructure for Shipping, Supply Chain, Transport and Logistics (EN.I.R.I.S.S.T.). The tool developed with the Python programming language and is based on a variant of the Bottom-up method. The input parameters are the main particulars of one or more ships and produces results in the form of tables and diagrams for the analysis of ship air emissions by ship type, emission type, speed and age. The tool may be used for different vessels and calculates air emissions including: carbon dioxide (CO_2), sulphur oxides (SOx), nitrogen oxides (NOx) and particulate matter (PM). Furthermore, this paper presents two illustrative applications that showcases the potential of the developed tool. The first one used departure and arrival data of 100 ships within the European Economic Area (EEA) in 2018, while for the second, Automatic Identification System (AIS) movement data of a Bulk Carrier in the Baltic Sea for 24 hours were collected. The development of such tools is considered important as they can contribute to establish appropriate measures for reducing air emissions and help the shipping industry to comply with existing regulations.

KEYWORDS: Ship air emissions; Bottom-up method; Emissions calculator; Sensitivity analysis; Environmental impact of shipping

PAPER ID: CEST2021_00474

Assessing the Environmental Impact of Maritime Transport for the Port of Mytilene with a Focus on the Emission Accounting of the Port of Arrival

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ABSTRACT

Global accounting of the environmental impact from maritime transport is an ongoing conversation. This study introduces the idea that emissions from open-sea cruising can accounted as stock at the port of arrival. An example is presented for the case of Mytilene (for a single month) where the in-port and open sea emissions are calculated and presented. In this specific analysis, during a single calendar month, 518 individual routes were identified with 42.47% being passenger ships and 33.98% being Ro-Ro/ passenger ships. The routes with the higher impact have been identified to be the ones with the highest combination of Deadweight Tonnage and frequency of arrival. Characteristically 117 of the total routes can be attributed to vessels with Deadweight Tonnage over 3000 tons. In the later part of the work, the study discusses two important aspects that should be under consideration in the overall maritime transport analysis. Firstly, the in-port emissions with a focus on sulphur oxides and secondly the integrated accounting of shipping emissions.

KEYWORDS: Emissions, Accounting, Maritime Policy, Marine fuels, Methodology

PAPER ID: CEST2021_00472

National-scale environmental data analysis for shipping and transport: The National Research Infrastructure EN.I.R.I.S.S.T.

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ABSTRACT

This paper presents the state-of-the-art research conducted as part of EN.I.R.I.S.S.T. regarding the emerging impact of shipping and transport to the environment. More specifically, it presents the digital platforms and services that are developed as part of the research infrastructure and are related to environmental sciences. The first is the "EcoMarpol Platform", which caters for collecting and analyzing pollution-driven data as well as calculating the environmental imprint (atmospheric emissions, waste production, chemical pollution of marine waters and sediments) of maritime activities. This platform additionally includes the online monitoring of in-port emissions from shipping and pollution from ship-to-ship transfer operations or accidents and the environmental risk assessment management. The other platform is the "Passenger Sustainable Travel Platform", as part of which a tool for calculating aircraft emissions (CO_2 and air pollutants) will be developed and applied in the Greek airspace and airports.

KEYWORDS: in-port emissions, airport emissions, waste production, research infrastructure.

PAPER ID: CEST2021_00614

Calculating Carbon Footprint in ports through a new Standard Tool: case study applications

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ABSTRACT

One of the main environmental problems in ports is Climate Change and its consequences. Since 1979, many international organizations have been working to control Climate Change. A literature review and a practical research were carried out to set up the basis to create a tool. These studies showed in recent years many ports have started to calculate their Carbon Footprint. However, there is no unified method in ports to do so. In addition, based on the results of the practical research, the development of a practicable tool for the calculation of Carbon Footprint in ports was highly demanded.

Therefore, a new standardized tool was developed and validated by 20 experts. This tool was tested with the existing results of the Port of Oslo and Ports de la Generalitat. The results obtained were in line. Finally, a case study model was created to test all the functionalities of the tool. The calculated emission values were compared with those obtained with the OCCC tool and MITECO tool. The outcomes were very similar with minor changes due to different emission factors. The results of this test process prove that the new tool is suitable to be used by ports around the world.

KEYWORDS: Climate Change, Carbon Footprint, Greenhouse Gas (GHG) emissions, Ports, Case studies

PAPER ID: CEST2021_00711

Port Environmental Management Insights 2020

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ABSTRACT

This paper presents the results of research conducted in collaboration with 97 ESPO EcoPorts members that completed the Self-Diagnosis Method (SDM), most of them members of the EU TEN-T network. SDM is a concise checklist against which ports can self-assess their environmental management performance, and it is also a precursor to the International Quality Standard of Environmental Management System, EcoPorts PERS (http://www.ecoports.com) – the only standard dedicated to the port sector. Participating ports can compare their results with the benchmark performance of the EU port sector as a whole. The system is anonymous. SDM is managed by the European Sea Ports Organisation (ESPO).

A set of 60 environmental management performance indicators were selected from those present in the SDM (around 300). These key environmental indicators were categorized as follows: i) Environmental Management - summarized in an Environmental Management Index; ii) Environmental Monitoring; iii) Top 10 Environmental Priorities, and iv) Services to Shipping offered by the port authority in order to facilitate greener shipping. Responses were analyzed and the results are discussed in this paper. 2020 results were compared with data from previous years, allowing the analysis of trends over time. Despite Covid-19, results over the years show trends of continuous improvement in port environmental management performance in terms of the provisions necessary to deliver compliance and sustainability of port operations.

KEYWORDS : Environmental management of Ports, Environmental indicators, Benchmark performance.

PAPER ID: CEST2021_00052

Evaluation of environmental impact assessment factors in maritime industry

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ABSTRACT

The environmental impact of shipping industry includes the pollution caused by vessels to air and water environment. The water pollution is primarily caused by ship accidents and by untreated ballast water. To avoid maritime accidents, a complex system of regulations and safety management measures has been initiated to minimize and possibly avoid similar maritime disasters in the future. On the other hand, untreated ballast water, despite the ease of management by shipping companies, is considered one of the greatest threats to the oceans internationally and one of the greatest threats to biodiversity. The International Convention on the Control and Management of Ballast of Ships and Sediments, entered into force in September 2017, aims to prevent the risk of importation and the proliferation of foreign species following the discharge of untreated ballast from ships. An option to reduce this risk is to install water treatment systems on the ballast. Air pollution from ships is another concern that has great significance and impact on health and the environment. Vessels emit large amounts of pollutants into the air, mainly in the form of sulfur oxide, nitrous oxide and particulate matter, which are constantly growing and affecting humans. Vessels also produce 3% of the world's total greenhouse gas emissions such as carbon dioxide, contributing to global warming and extreme weather. From 1 January 2020, the IMO imposed a new global sulfur emission ceiling of 0.5% on fuel content, a reduction from the current limit of 3.5%. Pursuant to the previous analysis, three systems/indicators that apply to vessels are going to be assessed, based on Clarkson's SIN Data, in order to evaluate their impact in correlation to the measure of compliance to the relevant regulations so far: • The ship must have an equipped and installed ballast treatment system. • The ship must be equipped and fitted with a special filter to reduce sulfur emissions. • The vessel must comply with Tier III regulations to reduce nitrogen oxide emissions.

KEYWORDS: Water & Air Pollution, Ballast Water Management, NOx emissions, SOx emissions

PAPER ID: CEST2021_00602

SESSION 23 - FOOD WASTE

Friday 3 September – Morning

A detailed characterisation of household food waste and the implications of sorting behavior on potentials for anaerobic digestion and nutrient recovery

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ABSTRACT

This study investigates household food waste (HH FW) generation in two socio-economically different areas in Lübeck, Germany. The applied waste characterisation protocol provided a detailed insight into the generation and separation behavior of FW collected in the municipal collection system. In total, four characterisation campaigns were conducted in both areas. Results show that about 47% of FW is avoidable. The socio-economic low area generated more FW with a lower source-separation performance. The share of avoidable FW was also higher in this area. The most common fractions found in total FW were *fruit and vegetables*, *leftovers and canned food* and *bread*. In addition to a substantial avoidable fraction, these commodity groups need to be prioritised in management strategies, such as for anaerobic digestion or composting.

KEYWORDS: Food waste, Waste characterisation, Waste management, Anaerobic digestion, Circular economy

PAPER ID: CEST2021_00058

Strategies for the improvement of VFAs recovery in the nanofiltration process within the circular economy framework

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ABSTRACT

Over the past decades, the anaerobic digestion (AD) process has been employed as a potential medium to produce valuable resources from the waste-based feedstock. Moreover, the use of AD technology can generate not only resources, but it also creates an avenue for useful chemicals recovery to further use in commercial purpose, which is a part of the circular economy consortium. Volatile fatty acids (VFAs) are one of the most precious chemical feedstock that can be recovered from anaerobically digested effluent through the use of a pressure-driven membrane filtration process. In an effort to improve the recovery percentages of VFAs from anaerobically digested effluent, this study proposed a sustainable pathway by reusing the permeate effluent in the nanofiltration process. For this purpose, particles free feed solution was produced using the ultrafiltration process and sequentially subjected to the nanofiltration process in the presence of a 200-300 Da nanofiltration membrane. Each permeate was mixed with a known amount of fresh feed and continues up to 3 cycles to be improved the recovery percentages of total VFAs concentrations. Results indicated that recycling strategies could be a potential way to modulate the concentration of VFAs compounds.

KEYWORDS: Food waste, volatile fatty acids, nanofiltration, resource recovery, recyclability

PAPER ID: CEST2021_00156

An overview of pressure-driven membrane technologies for a sustainable recovery of volatile fatty acids (VFAs)

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ABSTRACT

Currently, petroleum-based volatile fatty acids (VFAs) sources are not acceptable towards sustainable development goals (SDG); therefore, biobased-derived VFAs are of interest. Anaerobic digestion has been identified as a useful technology for the production of biobased VFAs from organic waste residue because of their environmental sustainability, easy operation and affordability. The anaerobically digested liquid comprises several inorganic and organic compounds/particles, including VFAs, which is one of the main challenges nowadays since the particles/compounds free VFAs are highly demanded. Hence, pressure-driven membrane filtration technologies (microfiltration, ultrafiltration, nanofiltration and reverse osmosis) is being widely used due to their higher VFAs recovery efficiency. Microfiltration and ultrafiltration usually applied as pretreatment for removing coarser particles, while nanofiltration and reverse osmosis possess a remarkable role in recovery performances. This report is highlighted on the various types of membrane used for VFAs recovery percentages and critically discuss their influence. Afterwards, it was confirmed that lower pore size membranes offer better recovery percentages of VFAs over higher pore size membranes due to their permeability rate.

KEYWORDS: anaerobic digestion, membrane chemistry, pressure-driven membrane filtration, volatile fatty acids, resource recovery

PAPER ID: CEST2021_00160

Can the seasonal variability affect the BMP of fruit and vegetable waste?

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ABSTRACT

Fruit and vegetable waste (FVW), largely produced in open markets, is characterized by highly putrescible materials, thus being a proper substrate for anaerobic digestion. This study investigated the effect of the seasonal variation of FVW, on the biochemical methane potential (BMP). To this end, FVW with an average composition between the wastes collected from open markets in Amman (Jordan) and Sfax (Tunisia) was considered. Three sets of batch BMP tests were carried out using three seasonal FVW compositions under mesophilic conditions (34°C). The selected fruits and vegetables were chopped until reaching a particle size of 10 mm. Sewage sludge was used as inoculum, and the batch experiments were performed with an inoculum/substrate ratio of 2 (g VS basis). VFAs, TS and VS content, COD, TAN, pH and alkalinity were monitored. Results show a final methane yield of 493.1 ± 27.7, 394.2 ± 69.6 and 373.3 ± 32.4 NmL CH_4 g SV^{-1} for the winter, spring and summer composition, respectively. Due to the high biodegradability of all substrates, more than 80% of the total methane production occurred in the first 7 days, with a simultaneous reduction of the soluble COD and VFAs. For the highest performing substrate, a 40% reduction of VS was observed.

KEYWORDS: anaerobic digestion, open market waste, methane, energy recovery

PAPER ID: CEST2021_00264

Seasonal variation of the biochemical methane potential of fruit and vegetable wastes produced in the Mediterranean area.

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ABSTRACT

Fruit and vegetable wastes produced massively in open markets are a suitable feedstock for biogas production and digestate of high fertilizing value. A first step of designing anaerobic digestion systems for treating these wastes efficiently is to study the impact of the seasonal variation on the biochemical methane potential. Moreover, during mechanical pretreatment applied to reduce the size of the waste mixtures, several fractions derive which affect the rate of the methane production as well as the ultimate methane yield. Fractionation of the chopped wastes through sieving resulted in fractions of different parts of wastes and size, affecting the initial rate and the ultimate methane yield. It was found that the smaller fraction yielded methane at an initial higher rate but at lower ultimate value than the larger fraction. These results were consistent in all waste mixtures chosen to represent the typical composition of the organic fraction of wastes generated in open market in autumn/winter, spring and summer. In all cases examined the BMP of these wastes varied between 360 and 527 NmL CH_4 g VS^{-1} with an average value of 436±51 NmL CH_4 g VS^{-1}.

KEYWORDS: biogas, fruit and vegetable wastes, Mediterranean, open markets

PAPER ID: CEST2021_00385

SESSION 24 - WATER AND WASTEWATER TREATMENT AND REUSE

Friday 3 September - morning

Enhanced-Electrocoagulation For Organic Matter Removal From Surface Drinking Water Sources: Operational Parameters And Energy Consumption

Daraei H.[1,5,*], Intwala P.D.[1], Awad J.[1,4], Bertone, E.[2], Chow, C.W.K.[1], Duan J.[1,3], Stewart, R.A.[2] And Van Leeuwen J.A.[1,3]

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ABSTRACT

In this study, an Enhanced Electro-Coagulation (En-EC) technique is described for the removal of dissolved organic carbon (DOC) from surface drinking water sources. Assessment of the En-EC technique included investigation of the impacts of operational factors on the organic removal efficiency (R%) and energy consumption (C_E). A decision support system for En-EC control was developed, referred to as Water Treatment Control for Electro-Coagulation (WTC-ECoag). Experiments were conducted using two surface water samples with contrasting water qualities. An electrocoagulation (EC) cell equipped with the capability for measuring consumed coulombs (C) during the process was used. Three different sets of experiments were conducted to investigate the impact of process parameters (i.e. the electric current (I_{EC}), the pH during EC process (pH_{EC}), and the coagulant dose) on the R% and C_E. The R% was determined during the process based on absorbance at 254 nm (A_{254}). The C_E was calculated through the monitoring of the I_{EC} and electric potential during the process. In the I_{EC} impact study, similar R% but different C_E results (under constant coagulant dose and pH conditions) were obtained for different applied I_{EC}. The investigation of pH_{EC} impact (under constant coagulant dose and I_{EC} conditions) indicated an optimum pH_{EC} of 6 for the process. Investigation of the impact of coagulant dose (under constant pH and I_{EC} conditions) indicated a maximum R% of 73% and 92% for low and high DOC waters, respectively. It is concluded that En-EC has potential as an alternative to conventional dosing processes for enhanced coagulation.

KEYWORDS: Enhanced Electrocoagulation, Dissolved Organic Matter, Surface Drinking Water sources, Energy Consumption, Coagulant dose control system.

PAPER ID: CEST2021_00443

Continuous Flocs Image Analyser (C-FIA) For Flocs Dynamics Tracking During Conventional Water Treatment

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ABSTRACT

In this paper an image analyser termed 'Continuous Floc Image Analyser (C-FIA)' developed for tracking the dynamics of floc formation, growth and settling during conventional water-treatment (i.e. coagulation, flocculation, and settling processes) is described. The C-FIA is proposed as an alternative to light-beam scattering and signal-based analysers such as Photometric Dispersion Analyser (PDA). A primary configuration of the C-FIA was developed for collecting video recordings of flocs in a flowing suspension of water sample during the treatment process. A MATLAB script was developed to analyse the image data. A Flocculation Index (FI) based on RGB[1] data associated with video frame pixels was calculated as a measure of flocs concentration. The practicality of the C-FIA in comparison with the PDA was tested using jar testing under laboratory conditions for two different surface water samples with contrasting water qualities. The results demonstrated the C-FIA capability to track the floc dynamics during the conventional treatment process using the FI. The C-FIA showed distinct baseline, rapid mixing, flocculation, and settling stages by providing different levels of FI for each stage. The results obtained indicated impacts of light intensity and light beams radiation angle to the photography cell on the resulted FI. This through its effects on the pixels RGB values of the floc images and raw water image used for determining the background FI value. The comparison of the FI data obtained through the C-FIA with the PDA indicates similarity in FI signal trends during process time by either technique. To achieve a more reliable signal with comparable results between experiments, a more advanced configuration with higher consistency in the photography system is needed.

KEYWORDS: Continuous Floc Image Analyser, Photometric Dispersion Analyser, Coagulation, Flocculation, Settling.

PAPER ID: CEST2021_00444

Presence And Removal Of Organic Micropollutants In 8 Different Wastewater Treatment Plants And Risk Assessment Of Treated Effluent

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ABSTRACT

Increasing attention has been paid in the recent years to the presence of Organic MicroPollutants (OMPs) in water, being considered a source of a high risk for public health and environment (Rodriguez-Narvaez et al., 2017). The present study belongs to a wide research activity carried out since 2018 and still ongoing having the aim to assess the occurrence with time and removal rate of OMPs in full-scale Wastewater Treatment Plants (WWTPs) (Di Marcantonio et al. 2020). The present paper shows the results of the monitoring activity conducted on the influent and effluent of 8 WWTPs focusing on 14 selected OMPs belonging to different classes (e.g. caffeine, illicit drugs, pharmaceuticals). The study activity included measuring in the same samples the traditional water quality parameters (e.g. COD, nitrogen species, TSS) to evaluate if there is any correlation between their removal and that of the selected OMPs. The investigated plants were chosen being representative of different treatment processes, of the type of final disposal of the treated water and the characteristics and extension of the area served by the sewage network. Finally, the environmental risk assessment was carried out based on the values of OMPs measured in the effluent of the plants.

KEYWORDS: Caffeine, Emerging contaminants, Illicit drugs, Pharmaceuticals, Wastewater treatment plants.

PAPER ID: CEST2021_00459

Monitoring the algae biomass growth developed on hollow fiber membrane bioreactor

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ABSTRACT

This work focuses on using non-destructive imaging techniques to monitor in-situ the formation of algae biomass on hollow fiber membrane bioreactor treating wastewater. Optical Coherence Tomography (OCT) was employed to acquire cross-sectional scans of the algae growth in real-time under continuous operation. The proposed approach allowed evaluating in real-time the impact of the biomass on the bioreactor performance in terms of TMP increase and permeate quality.

KEYWORDS: Algae harvesting, Fouling, MBR, Wastewater treatment, flux.

PAPER ID: CEST2021_00664

Electro-bioremediation of nitrate contaminated saline groundwater

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ABSTRACT

Sustainable exploitation of coastal aquifers is often hindered by the presence of contaminants and high salinity levels. This study proves for the first time the electro-bioremediation of nitrate contaminated saline groundwater. Two 3-chamber bioelectrochemical systems (BES) were operated in potentiostatic mode for the treatment of a synthetic medium mimicking saline groundwater from the Nitrate Vulnerable Zone of Arborea (Sardinia, Italy). This groundwater is characterised by high nitrate concentrations (>33 mgNO_3^--N/L) and conductivity (>3.5 mS/cm). The electrochemically active microbial community grown on the surface of the biocathode was able to achieve nitrate removal rates and efficiencies of 6.8±0.4 mg/L·d and 87±2%, respectively. Conductivity significantly decreased (from 4.11±0.2 to 0.17±0.2 mS/cm) by enhancing the electromigration of ions from the middle chamber to the peripheral anodic and bio-cathodic chambers. Under the applied conditions, WHO (World Health Organization) drinking water threshold limits for nitrate (11.3 mgNO_3^--N/L) and conductivity (2.5 mS/cm) were satisfied. Moreover, high chloride migration was observed (63±7 mg/L·d), suggesting its possible recovery as chlorine in the anodic chamber using a specific electrode (Ti-MMO), within a circular economy-based approach. The results pave the way to the potential development of a new electro-bioremediation technology for water recovery (i.e., simultaneous denitrification and desalination) and sustainable chemicals production (i.e., chlorine).

KEYWORDS: conductivity, denitrification, desalination, microbial electrochemical technology, value-added products.

PAPER ID: CEST2021_00481

Letrozole and tamoxifen in municipal wastewater and their photodegradation in ultraviolet (UV) treatment

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ABSTRACT

The incidence of cancer has increased worldwide and hormone antagonists are a group of pharmaceuticals used in the treatment of breast cancer. It is well known, that most of the pharmaceuticals are only partially removed or transformed during traditional wastewater treatment processes and the residues enter the environment through wastewater effluents. In aquatic environment, these pharmaceuticals pose a risk, as they may cause adverse effects on development and reproduction of organisms. In this study, the presence of two hormone antagonists, letrozole and tamoxifen, in wastewater influent and effluent samples was determined. Ultraviolet (UV) treatment is widely used technique to disinfect wastewater and drinking water. The potential of UV irradiation to degrade these selected pharmaceuticals was also studied in laboratory conditions. Preliminary results show the presence of studied pharmaceuticals in wastewater samples at low ng/L levels. Tamoxifen showed high degradation rates in UV treatment, whereas letrozole seemed to be quite resistant. Further studies to determine the occurrence of studied pharmaceuticals in environment are in progress. The experiments to improve the UV treatment are also planned.

KEYWORDS: hormone antagonists, wastewater, photodegradation, emerging contaminants

PAPER ID: CEST2021_00681

Evaluation of real bilge water toxic effects on methanogenic activity

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ABSTRACT

Bilge water (BW), an oily residue that is accumulated at the bottom of vessels, is mainly generated from pipes' and engines' leakage and consisted of lubricating and diesel oil, cleaning solvents, oily sludge and other hydraulic/engine spills from seawater filtrations as well as fresh and seawater. Undeniably, anaerobic treatment of BW could ensure energy and economic benefits as well as waste minimization. However, refractory organics present in BW is possible to inhibit the anaerobic biomass and production of methane-containing biogas. In the present study, Anaerobic Toxicity Assay (ATA) was used in order to evaluate the effect of BW on methanogenic activity of anaerobic granular sludge (AGS). BW was provided by Ecofuel Ltd (Zygi, Cyprus), which collects and treats this type of wastewater. AGS was collected from a mesophilic upflow anaerobic sludge blanket reactor (UASB). Batch experiments were performed in triplicate, using two concentrations of BW in combination with CH3COOH and HCOONa to test the inhibition of acetoclastic methanogens and hydrogenotrophic methanogens, respectively. Gas measurements were taken daily up to four days and periodically thereafter during three months. Soluble Chemical Oxygen Demand (COD) and microbial community profile were also monitored over time.

KEYWORDS: bilge water, anaerobic toxicity assay, anaerobic granular sludge, microbial consortium

PAPER ID: CEST2021_00531

Photocatalytic degradation of magenta effluent from the printing industry with composite catalyst

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ABSTRACT

Water pollution is one of the most current problems related to human life and survival. The high degree of pollution of the human environment is contributed, among other things, by the discharge of industrial wastewater into rivers, among which wastewater from the graphic industry is of great importance. With conventional wastewater treatments, such as secondary biodegradation, many pollutants cannot be completely removed. Synthetic dyes can be a potential hazard for living organisms. Also, heavy metals are present in some types of printing inks. On the other hand, with advanced technologies, it is possible to obtain high quality water. Photocatalytic degradation is a promising and widely used method when it comes to the treatment of wastewater and air contaminated with both organic and inorganic pollutants. Photocatalytic processes have many advantages when it comes to removing pollutants from water in low concentrations. The aim of this paper is to investigate the possibility of applying the process of photocatalytic degradation, using titanium (IV) oxide modified with magnetite nanoparticles, in the treatment of magenta effluent originating from the graphic industry. In order to optimize the entire process, a new statistical method of definitive screening design (DSD) was used, where the influence of individual process parameters.

KEYWORDS: photocatalytic processes, graphic dyes, degradation, new catalysts, heterogeneous catalysis

PAPER ID: CEST2021_00776

APOC technology as an eco-innovative decentralized sanitation system for wastewater treatment and reuse facilities in the rural locality of Bent Saidane-NE Tunisia

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ABSTRACT

Decentralized wastewater treatment systems (DEWATS) in rural areas can be a smart alternative that helps communities to strengthen rural sanitation in improving clean water and sanitation management. To address these challenges, AquaCycle project, funded by the European Union under the ENI CBC MED Program, aims to bring an eco-innovative APOC system that combines anaerobic digestion (AD), constructed wetland (CW), and solar photocatalytic oxidation (SPO) for decentralized wastewater rural sanitation in a cost-effective, economic, green, sustainable, and environmental healthy, manner. The APOC system will be established in the rural locality of Bent Saidane (Governorate of Zaghouan, Northern East of Tunisia) as an appropriate implementation site with a 90.12 km^2 area and a flow capacity of 5 to 25 m^3/day. About one hectare will be planned for treated wastewater irrigation purposes. Based on the annual average values of the physicochemical and bacteriological raw wastewater quality, a spontaneous biodegradability was noted. Compared to conventional wastewater systems, APOC system will provide reliability, affordability, environmental and financial benefits, that make such system particularly appropriate for rural sanitation in relation to the transition to the circular economy.

KEYWORDS: decentralized wastewater treatment, anaerobic digestion, constructed wetland, solar disinfection, Bent Saidane Tunisia.

PAPER ID: CEST2021_00650

SESSION 25 - ADVANCED OXIDATION PROCESSES

Friday 3 September - morning

Removal of amoxicillin from processing wastewater by ozonation and UV-aided ozonation: kinetic and economic comparative study

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ABSTRACT

A novel empirical and scaling up simulation study is presented for degradation and mineralization of real residue of amoxicillin (AMX) pharmaceutical formulation in wastewater. A set of UV-ozone-based experiments was used in the kinetics modeling of AMX, considering several chemical/photochemical mechanisms (direct ozonation, radical reactions, and photolysis). Finally, the modeling data was used for scaling up purposes, considering CAPEX and OPEX costs on the US Gulf Coast basis. In terms of experimental results, amoxicillin (AMX) pharmaceutical effluent was successfully degraded by ozone technology in high pH value. The semi-batch ozonation process was effective after 60-min treatment in all experimental conditions, producing degradation intermediates recalcitrant to the ozone oxidative process. From the bench-scale kinetics, scaling up simulations indicate that the smaller gain provided by adding a UV unit does not compensate for the increase in capital and operational costs of adding irradiation equipment, suggesting as the best cost-effective approach the application of direct ozonation.

KEYWORDS: Advanced oxidation processes, ozone, pharmaceutical formulation, kinetic modeling, engineering economics

PAPER ID: CEST2021_00636

Degradation of cytostatic drugs in water by ozonation

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ABSTRACT

This work presents the degradation of five cytostatics found in Portuguese WWTP effluents: bicalutamide (BICA), capecitabine (CAP), cyclophosphamide (CYC), ifosfamide (IFO) and mycophenolic acid (MPA) using non-catalytic ozonation. Experiments were performed with 1 µM of each cytostatic at pH: 7.3 and room temperature (23 ºC). Tests in presence of *t*-BuOH demonstrated that CAP and MPA were quickly eliminated by direct ozonation, whereas BICA, CYC and IFO were more slowly degraded via hydroxyl radicals (HO•). Increasing the O_3 dosage from 1 to 3 mg_{O3}/mg_{DOC}, CAP, MPA and IFO were completely removed, and BICA and CYC were converted to an extent higher than 90% after 3 h. Runs in river water and WWTP secondary effluent revealed that the presence of inorganic ions and organic matter did not affect the fast degradation of CAP and MPA. Nonetheless, there was an inefficient O_3 usage, which resulted in only around 40% elimination of BICA, CYC and IFO after the same reaction time.

KEYWORDS: cytostatic drugs, oxidation, water treatment, emerging contaminants

PAPER ID: CEST2021_00389

Influence of the addition of M2+ (M: Co, Cu, Zn) on the properties and activity of W-TiO2 and Mo-TiO2 photocatalysts for water remediation

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ABSTRACT

In this study, ternary systems of M1M2TiO_2 (M1:Co, Cu, Zn) M2 (WO_3, MoO_3) were prepared and tested for the photocatalytic degradation of sulfamethoxazole. It was found that W-oxo species can be used without significant alteration of the TiO_2 activity, while only Cu is a possible candidate for the ternary system either due to its chemical hardness and/or its p-type semiconducting nature.

KEYWORDS: TiO_2, WO_3, SMX

PAPER ID: CEST2021_00426

Valorization of olive stone by-product as Fenton-like catalysts for olive mill wastewater treatment

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EXTENDED ABSTRACT

The olive oil industry is responsible for the generation of highly-loaded and complex effluents (olive mill wastewaters, OMW) that pose several environmental threats. In particular, OMW's polyphenolic fraction is known for its recalcitrant behavior and phytotoxic properties (McNamara *et al*., 2008). In a perspective of by-products' valorization within the same agro-industry, olive stones (OS) were transformed into porous activated carbon (AC) materials for Fe-anchoring. In line with the circular economy trend, the resulting Fe-catalysts were then used in the heterogeneous Fenton-like oxidation of OMW.

OSAC supports were synthetized by sequential carbonization and CO_2-activation of OS in a horizontal tube furnace (800 °C). Three distinct Fe-impregnation routes were employed to synthetize OSAC-Fe catalysts: incipient wetness impregnation (IWI), adsorption (Ads), and hydrothermal (HT). All materials were extensively characterized by several techniques, including X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), transmission (TEM) and scanning (SEM) electron microscopy, as well as N_2- and CO_2-physisorption. Screening of the resulting catalysts was performed with a synthetic solution simulating the toxic polyphenolic fraction of OMW; then a real OMW solution was used with the most promising materials.

All catalysts presented well-developed microporosity with a slight contribution of mesopores in their structure. XRD confirmed the formation of mixed iron-oxides (hematite, magnetite) as the active-phases. Key differences in the catalyst's Fe-loadings, metallic particle sizes and surface dispersion were observed, highlighting the importance of the impregnation procedure step in the production of catalysts (*Esteves et al*., 2021). Despite their developed porosity, the catalysts' adsorptive capacity was substantially exhausted after one 240-min cycle. Thereafter, hydroxyl radicals ($OH^{\bullet}$) were identified by radical scavenging tests as the main oxidizing agents of the phenolic compounds.

After four consecutive cycles, catalysts prepared by IWI and Ads performed better than the one synthetized by HT (53 and 48% vs. 38% phenolic content removal, TPh, respectively), also showing higher stability (4-5 times lower Fe-leaching from the support). Using the most promising catalyst ([OSAC-Fe-IWI] = 2.0 g/L) under smooth operational conditions (25 °C, no pH adjustments, $[H_2O_2]$ = 0.5 g/L), 61% TPh, 38% chemical oxygen demand (COD), and 22% total organic carbon (TOC) removals were achieved with real OMW samples. The produced effluent also showed a toxicity reduction towards *V. fischeri* from initial 100% to 31% after only 240 min (as inferred by the decrease

of bioluminescence inhibition after 30 min of contact with the bacteria). Under the same experimental conditions, promising catalytic performances were also attained by OSAC-Fe-Ads, emphasizing the importance of the superior Fe-surface dispersion in this sample, despite the lower Fe-load obtained as a result of the impregnation procedure.

Though legislated discharge values were not met, the significant toxicity reductions of the OMW combined with an improvement of biodegradability indices, suggests that the stress of a downstream biological step would be greatly reduced by a preliminary oxidation step. Moreover, the heterogeneous Fenton-like process is able to tackle some constraints associated to analogous homogeneous processes, such as the formation and downstream management of Fe-sludges and strict pH range of operation.

KEYWORDS: Activated Carbon, Catalyst, CWPO, Fenton

PAPER ID: CEST2021_00475

On the Fenton oxidation of polystyrene microplastics

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ABSTRACT

This work aims at evaluating the fate of polystyrene (PS) microplastics along Fenton oxidation. Experiments were carried out under relatively severe operating conditions (80 ºC) given the high persistence of these solids to oxidation. Slight mass losses (up to 10%) were found after the Fenton treatment of microplastics in the micro range (100–250 mm). Nevertheless, the particles clearly suffered important changes in their surface due to the introduction of oxygen groups, which made them more acidic and hydrophilic. These surface alterations completely changed the sorption properties of microplastics. For instance, their adsorption capacity for diclofenac was sharply decreased from 102 to 28 mg g^{-1}. Apart from surface modifications, microplastics clearly decreased their size after Fenton oxidation, which was more evident in the 50–100 mm range. To further evaluate the oxidation yield of PS microplastics upon Fenton oxidation, particles in the sub-micro range (140 nm) were treated. Notably, up to 75% TOC mineralization was achieved, which proved that microplastics can be completely oxidized to CO_2 upon Fenton oxidation. Finally, the biodegradability of the dissolved compounds leached from oxidized microplastics was evaluated. Remarkably, bacterial growth efficiency was higher in the solution coming from the oxidized PS microplastics than that of the fresh one.

KEYWORDS: Water treatment; Fenton oxidation; microplastic; nanoplastic; polystyrene.

PAPER ID: CEST2021_00759

CEST 2021

Ozonation against a diverse suite of antibiotic resistance determinants in wastewater

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ABSTRACT

This work aimed at investigating the impact of bench-scale ozonation, as tertiary treatment, on the removal and inactivation of selected antibiotics, antibiotic-resistant bacteria, antibiotic resistance genes and toxicity from wastewaters effluents. The novelty of this study concerns the in-depth investigation of the ozonation process for the removal of a diverse suite of antibiotic resistance determinants in two distinct wastewater matrices, i.e., conventional activated sludge (CAS) and membrane bioreactor (MBR) treated effluents. The results revealed the complete degradation of the antibiotics within 5 min of contact time in both effluents. The inactivation of total cultivable bacteria in the examined wastewater matrices was described by an exposure-based Chick-Watson kinetic model. Furthermore, the abundance of the examined bacterial groups, including antibiotic-resistant bacteria and genes, decreased to values below the limit of quantification, indicating that ozone could improve the quality of wastewater in terms of antibiotic resistance. No substantial mineralization was observed, while the toxicity increased after treatment by ozone compared to the initial (untreated) wastewater effluents. Overall, the results of this study could contribute to the understanding of the fate of both the antibiotics and antibiotic resistance determinants during ozonation, with an emphasis on the impact of the wastewater matrix.

KEYWORDS : ozone; wastewater disinfection; antibiotic resistance; genes;

PAPER ID: CEST2021_00212

Caffeine oxidation by sono-Fenton treatment

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ABSTRACT

Oxidation of waters containing caffeine was conducted by a sono-Fenton treatment employing an ultrasound power of 720 W at pH=3.0 and T=25°C. The catalytic action of ferrous ion was studied in a range of [Fe]=0-100.0 mg/L and oxidant concentrations between [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, 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, 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, color, turbidity, sono-Fenton

PAPER ID: CEST2021_00015

Toxicity study of Norfloxacin degradation by advanced oxidative process

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ABSTRACT

Advanced oxidative processes (AOPs) are promising techniques that have been developed to treat and remove these organic contaminants in surface waters and effluents. The objective of this work was to evaluate the toxicity of products generated from UV/H_2O_2 degradation of solutions containing 5 µg/mL of Norfloxacin (NOR) and 1.4 mmol/L of H_2O_2 at pH 4.0, 7.0 and 9.0 against the micro crustacean *Artemia salina*. For the toxicity test, *Artemia salina* eggs were hatched in a solution containing 2.7% sea salt, for 48 h, with temperature at 27 °C and forced aeration. The ecotoxicity test was performed on 24-well plates. For each well, 10 nauplii of *A. salina* containing a control of the dilution solution, a positive control of toxicity and test solutions in the proportions of 100% were transferred, 50% and 25%, after 48 h mortality was verified. The data show that there was 100% mortality of *A. salina* in the wells containing 100% of the solution obtained through the degradation in all tested pH ranges, whereas the solutions containing 50 and 25% of the degraded drug showed a low rate of mortality demonstrating that there is no toxicity of products formed from degradation in the last two conditions described.

KEYWORDS: micropollutant; ecotoxicity, antibiotics UV/H_2O_2

PAPER ID: CEST2021_00352

SESSION 27 - ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY

Friday 3 September - afternoon

Greenhouse gases in the urban environment of Athens, variability and sources

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ABSTRACT

Yearlong greenhouse gases (CO_2 and CH_4) concentration measurements were performed for the first time in the city of Athens, from 21/12/2018 to 31/12/2019, and analyzed in relation to atmospheric levels, wind direction at a local, regional and long-range transport scale. Clear diurnal and seasonal variations of both greenhouse gases were detected, with elevated levels during night and early morning hours, associated with traffic/heating emissions and leakages of residential natural gas for CO_2 and CH_4, respectively. With the use of respective measurements at the regional background site at Finokalia, Crete, the contribution of local anthropogenic emissions within the city was estimated, compared to regional levels. For CO_2, maximum levels were clearly observed during winter, suggesting an important impact of combustion of fossil fuel and especially of biomass on CO_2 levels during winter. On the other hand, the local CH_4 levels did not seem to exhibit a seasonal trend and were similar in all seasons, suggesting that local sources of CH_4 remain quite constant year-round. Backward modeling simulations (FLEXPART) indicate an industrial zone and a petrochemical zone, situated to the north and to the west of Athens respectively, as possible CH_4 regional sources as well as possible CO_2 contributions from southern directions attributed to shipping emissions from the port of Piraeus. The present study provides knowledge needed for the determination of greenhouse gas emission mitigation strategies in Athens.

KEYWORDS: Greenhouse gases, CPF, PSCF, FlexPart

PAPER ID: CEST2021_00552

Interannual large-scale variability in the Eastern Mediterranean Sea and interactions with the Aegean Sea

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ABSTRACT

The Mediterranean Sea and its eastern sub-basin are marginal oceanic basins subjected to strong anthropogenic and natural pressures. During the last decades new findings have revised the way of assessing the circulation and physical functioning of the eastern Mediterranean Sea. Natural oscillations have been discovered while the impact of climate change has also been observed. Interannual variability has also been evident in the Aegean Sea, which is in close connection with the eastern Mediterranean. The continuous monitoring of the marine environment and the creation of long time series of marine observations is required in order to understand the functioning of the complex Mediterranean and Aegean ecosystems. The Hellenic Centre for Marine Research supports the creation of such time series by deploying multidisciplinary instrument moorings at specific key-points of the Aegean Sea, in an effort to provide scientific results essential for both sustainable development and mitigation of environmental pressures.

KEYWORDS: Mediterranean Sea, Aegean Sea, Cretan Sea, Climate change

PAPER ID: CEST2021_00748

Developing a framework for local climate change adaptation plan (LCCAP): The case of Mandra-Attiki, Greece

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ABSTRACT

The present work deals with the development of a preliminary climate change (CC) adaptation action plan at local level. The area of interest area is the greater area of Mandra Municipality, Attica, Greece; a suburban area that in November of 2017 had experienced a major flood incident with human casualties. The suggested methodology follows a combined 2-step, top-down and bottom-up, approach. The top-down approach deals with current CC policies and related guidelines at European, national and regional level, such as: European CC Policy (Green Paper 2030, Climate Neutral Europe 2050), National CC Adaptation Plan (National Climate Change Strategy ESPKA), Regional CC Adaptation Plan of Attica Region (PESPKA), Flood Risk Management Plan of Attica Region with emphasis to the Low Zone Aspropyrgos-Elefsina. In the bottom-up approach we focus on the main characteristics/variables of the area under study that have impacted significantly in the recent flood incident. Natural and man-made environmental variables that are necessary to be monitored on a regular basis are highlighted. A matrix of flood incidents effects is developed in order to define the most affected variables by sector. Among the outcomes of this analysis a road map of requirements will be proposed for local adaptation CC Plans (LACCPs) to increase city resilience in flood events.

KEYWORDS: City resilience, natural and man-made environmental variables, policy implementation, adaptive capacity

PAPER ID: CEST2021_00363

Estimating Flood Risk at town scale: the case of the 2017 flash flood in Mandra, Greece.

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ABSTRACT

Effective flood management requires the priori assessment of the flood event, its consequences, and thus its risk, which give insight into what situations we expect and allow us to evaluate possible measures, including the implementation of an Early Warning System. In the present work, we briefly describe a methodology for flood risk assessment at town scale, which combines the typical hazard assessment via hydrodynamic calculations using the 1D/2D HEC-RAS model, with a rather original procedure for vulnerability assessment on a building level. We apply this high-resolution methodology at a part of the town Mandra to show that the buildings with the highest flood risk are located along Koropouli Street; these are the buildings that suffered the highest damages during the disastrous flood of November 2017.

KEYWORDS: Flash Floods, Flood Risk, Flood Vulnerablility, HEC-RAS 1D/2D model, Mandra town (Attica)

PAPER ID: CEST2021_00850

Flood modelling using a combined 1D/2D model: the case of the 2017 flash flood in Mandra, Greece.

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ABSTRACT

The design of an efficient Early Warning System for floods in a specific region requires the knowledge of the hydrodynamic behavior of floods that affects flood arrival times and thus the available warning times. In the present work, we attempt to answer the following research question "Is a combined 1D/2D model sufficient to simulate adequately flood propagation in an urban area?" To answer this question, we apply the combined 1D/2D HEC-RAS model to simulate the propagation of the disastrous flash flood that occurred in Mandra in Attica, Greece, in November 2017. Calculations showed that maximum water depths in the two streams of Mandra Soures and Agia Aikaterini ranged from 1.2 to 6.0 m, while along Koropouli Street that was one of the main streets, which suffered severe flooding, they ranged from 1.00 to 2.65 m and were generally in good agreement with measurements. The calculated inundation area showed a practically excellent agreement with the observed area, while calculated flood arrival times were close to the actual values.

KEYWORDS: Flash Floods, HEC-RAS 1D/2D, Mandra (Attica), Hydrodynamic Modeling

PAPER ID: CEST2021_00612

Holocene record of palaeoclimatic impact in Epanomi coastal lagoon basin, Thermaikos Gulf, North Greece

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ABSTRACT

Sediment cores of 4m were sampled in Epanoni coastal lagoon basin in Eastern Thermaikos Gulf. Within this study, we present results of Magnetic Susceptibility (MS) measurements and sedimentological analysis (XRD and grain-size distribution) for the first meter EP1-1 aiming to contribute to the reconstruction of the paleoclimatic regime in Thermaikos Gulf during the Holocene. Based on MS and XRD, we concluded that probably a wet episode is reflected at 3760±25 BP resulting in greater material transfer with higher values of magnetic susceptibility. The increased ratio of the coarser sediments in depths 40-50cm suggests an increased run-off. Subsequently that, the presence of gypsum in the upper layers of 14-39cm depth indicates a dry period with intense evaporation.

KEYWORDS: Paleoclimate, Epanomi coastal lagoon, Holocene, Thermaikos Gulf

PAPER ID: CEST2021_00786

System-Dynamic models for groundwater management in SW Messinia, under different climatic scenarios

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ABSTRACT

SW Messinia, Greece, is an interlinked coastal-inland area in the Eastern Mediterranean region. Extensive olive tree plantations and tourism are the main human activities in the area, both of which depend on groundwater resources to cover their irrigation and supply needs. The same groundwater sources are also the main freshwater sources for the Gialova lagoon, a coastal wetland with high ecological and commercial value. The combined effect of human interventions and climatic conditions over a period of 60 years has led to increased saline conditions in the wetland since the 1960s, and unless freshwater inputs are enhanced by restoring hydrologic connectivity between the wetland and the surrounding freshwater bodies, salinity in the lagoon is expected to increase even more under drier and warmer conditions predicted to occur in the future (Manzoni et al., 2020). However, surrounding fresh water bodies have high nutrient inputs and unless these are reduced, any increased connectivity could further degrade the sensitive ecosystem of the wetland (Bray et al., submitted). Under the COASTAL EU project, we have developed a System Dynamics model that combines tangible (e.g. runoff, water demand, salinity, population, tourist arrivals) and intangible (such as awareness and willingness to cooperate) attributes of the local social ecological system. This model is used as a basis for discussions with local stakeholders and for promoting social learning by connecting local concerns with lagoon management. These connections are considered essential for achieving the transition towards collaborative integrated agricultural practices that will enable the restoration of lagoon connectivity accounting for changing climatic conditions (increased temperature, reduced precipitation).

KEYWORDS: Land-Sea Interactions, Social Ecological System, Climate scenarios, System Dynamics

PAPER ID: CEST2021_00775

Methane distribution over Greece as derived from Sentinel-5P TROPOMI data

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ABSTRACT

Global warming, induced mainly by greenhouse gases emitted by human activities, is an environmental issue of crucial importance for society. Greenhouse gases, such as methane (CH_4), need to be monitored and their anthropogenic emissions quantified in order to be reduced. We here present, the first systematic investigation of CH_4 columns over Greece derived from the Sentinel-5 Precursor TROPOMI satellite instrument L-2 high spatial resolution data for the period 2019-2020. We gridded the data in 0.2°x0.2° grids and find an increase in CH_4 columns between 2019 and 2020 and a clear seasonal pattern in CH_4 column with high columns in summer and fall and the lowest in winter. We also identify Athens, Thessaly, Thessaloniki, Thrace and the Crete as areas with high CH_4 columns.

KEYWORDS: methane, remote sensing, variability, TROPOMI

PAPER ID: CEST2021_00758

CO_2 and NO_2 distributions over Greece as seen by OCO-2 and TROPOMI

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ABSTRACT

Greenhouse gases are the driving force behind human-induced global warming. Carbon dioxide (CO_2) is the greenhouse gas (GHG) with the longer lifetime in the atmosphere, in the order of hundreds of years, and the largest contribution to the radiative forcing of the atmosphere due to its increasing levels since the pre-industrial era. Therefore, monitoring and restraining CO_2 anthropogenic sources is an urgent matter. Nitrogen dioxide (NO_2) is co-emitted with CO_2 and due to its short atmospheric lifetime (of the order of a day) it can be used to pinpoint CO_2 emission sources. Satellite observations of CO_2 levels provide invaluable information in order to understand its levels, and sources and sinks. In this study we investigate the distribution of CO_2 and NO_2 over Greece for 2019 using data from the Orbiting Carbon Observatory-2 (OCO-2) satellite for CO_2 and from the Sentinel-5 Precursor TROPOMI satellite instrument for NO_2 in order to identify hot spots for CO_2 emissions.

KEYWORDS: carbon dioxide, nitrogen dioxide, remote sensing, TROPOMI, OCO-2

PAPER ID: CEST2021_00777

Influence of fires on atmospheric composition over Greece as seen by TROPOMI S5P

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ABSTRACT

The present study uses data from the TROPOspheric Monitoring Instrument (TROPOMI) on board Copernicus Sentinel-5 Precursor satellite to investigate the impact of the forest fires plumes on atmospheric aerosols and gases. For this purpose, the Aerosol Index, nitrogen dioxide (NO_2) and carbon monoxide (CO) Level-2 data have been analyzed. The results show that the fire in Kineta, Attica (in 2018) and the fire in Corinthia (in 2021), enhanced the total CO concentration levels by up to 5.5 times (from $1.5x10^{18}$ to $10x10^{18}$ molecules/cm^2) and up to 4 times from $1.5x10^{18}$ to $6x10^{18}$ molecules/cm^2), respectively. Similarly, the tropospheric NO_2 concentration levels have increased by up to 15 times (from $1x10^{15}$ to $16x10^{15}$ molecules/cm^2) and up to 40 times (from $1x10^{15}$ to $4x10^{16}$ molecules/cm^2), respectively. Fires have also increased the atmospheric load of absorbing aerosol as reflected by the increase of the dimensionless AI by up to 6 times (from 0 to 6 and from -2 to 4 respectively).

KEYWORDS: wildfires, remote sensing, carbon monoxide, nitrogen dioxide, aerosol index, TROPOMI

PAPER ID: CEST2021_00781

SESSION 28 - ENERGY TECHNOLOGIES AND SUSTAINABILITY

Friday 3 September - afternoon

Fine dust impact by wood energy of a structured oil heating replacement in Luxembourg – Possibilities, pathways and impacts

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ABSTRACT

Heating and cooling needed in 2015 the half of final energy consumption in EU and is the biggest energy sector in EU 28. Often, the energy supply is provided by petroleum products and has to be transformed into low greenhouse gas supply according the agreements of the Paris follow-up-process. This article is based on the “heating oil fade-out study” commissioned by the Luxembourg Ministry of Energy and estimates for Luxemburg the possibilities and pathways of decreasing heating oil in private heating sector and its impact on local environment. Main questions are: To what extend wood heating solutions are overtaking the place from heating oil solutions? What are alternative possibilities? And what is the environment impact regarding to the fine dust emission in the heating energy transition? A bottom-up approach using heat mapping data examines four sample communities in Luxembourg. The analysis shows that wood pellets in spite of using heat pumps as primary heat supply solution are needed in large quantities for the heat oil fade out due to the recently and also in future still existing energetically low building standards and limited prospects of further expansion of the natural gas network. By using fine dust filters, an increase of fine dust could be avoided.

KEYWORDS: oil heating replacement[1], spatial planning, fine dust impact, heating transition

PAPER ID: CEST2021_00064

A comparative evaluation of urban metabolism methodologies

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ABSTRACT

Globally, urban metabolism analysis has become a significant tool for the study of urban ecosystems. Urban metabolism as a concept represents an integrated platform for analyzing the urban dynamics and supporting the planning processes in cities as social-ecological systems within the concept of sustainability. Moreover, urban metabolism provides relevant information for cities in terms of energy efficiency, material flows, and waste management. Since the first study of urban metabolism by Wolman in 1965 until today the scientific committee developed and improved different methodologies and indicators for the urban metabolism analysis. This study focuses on the comparison of the three main methods that have been widely used for the study of urban metabolism which are emergy analysis, material flow analysis and ecological footprint analysis. Each one of the methodologies is based on specific principles and indicators, presenting different strengths and weaknesses. As a general conclusion, urban metabolism methodologies are facing problems related to data scarcity at the city level, the fluid nature of urban metabolisms, the lack of standardization, difficulty in tracking informal or decentralized systems, the lack of data accuracy, difficulty in understanding specific concepts.

KEYWORDS: Urban metabolism, Energy analysis, Ecological Footprint Analysis, Material Flow Analysis

PAPER ID: CEST2021_00049

Simulation And Performance Evaluation Of Owc Device Operating In Coastal Regions

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ABSTRACT

Wave energy converters are constantly being deployed in nearshore and coastal areas characterized by increased wave potential. The performance of the devices installed in the nearshore and coastal environment, where the sea bottom terrain may present significant variations, can be evaluated by formulating and solving interaction problems that involve water waves, structures and the seafloor. In this work a novel Boundary Element Method (BEM) is developed and applied to the investigation of a simplified Oscillating Water Column (OWC) system in the two-dimensional space, taking into account the interaction of the incident wave field with the bottom topography, in the context of the linear wave theory for normally incident waves. Numerical results that highlight the effect of seabed inhomogeneities on the hydrodynamic performance of OWC devices are presented, in combination with other parameters that determine the device's performance, like the structure's dimensions and power take off system. Finally, results related to the flow field developed during the operation of the device are presented and discussed.

KEYWORDS: Oscillating Water Column, wave energy, BEM

PAPER ID: CEST2021_00745

Support Structure Suitability for Offshore Wind Farms Development in Greece based on a Sustainable Site-Selection Framework

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ABSTRACT

Site-selection and spatial planning form a crucial step toward the successful development of Offshore Wind Farms (OWFs). Deployment of wind turbines in different water depths has raised the issue of selection of the most suitable support structures. In this work, a well-structured site-selection framework is proposed for the appropriate OWF development in Greece. The methodology includes two successive phases: (Phs.1: Siting Phase) the identification of suitable sites for OWF installation using Geographic Information Systems (GIS) based on sixteen exclusion criteria (e.g., water depth and wind power density); and (Phs.2: Support Structure Suitability Phase) the determination of most appropriate and commercially available support structure(s) for each suitable site. The proposed exclusion limits are retrieved from the authors' systematic review in offshore wind energy research and based on the maximization of environmental sustainability, and the technical and economic viability of OWFs. Twenty sustainable site solutions of either fixed (e.g., jacket) or floating (e.g., Hywind) support structures are proposed. The suggested methodology could support policy makers towards the global and national proper development of such wind energy projects.

KEYWORDS: site-selection; spatial energy planning; offshore wind; support structure; GIS

PAPER ID: CEST2021_00025

17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

The role of biomass and biowaste in the green energy transition of islands and an introduction to the μgas-to-grid concept

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ABSTRACT

The green transition of the energy sector in islands has always been a challenging task. The connectivity of islands with the (mainland) central grid can be problematic, especially when the distance is significant. In such cases, isolated electrical grids need to be developed on the islands, and the most common fuel of choice has historically been diesel/ fuel oil. On a second level, diesel/ fuel oil is also used for the heating of buildings. In European Union, a green energy transition is underway and renewable energy systems are increasing their overall fraction in the total energy mix, with wind and solar (variable renewable energy systems) being the ones with the highest added installed capacities. It should be denoted that isolated grids have stability issues when variable renewable energy (VRE) systems are integrated. This present study analyzes the case of Lesvos island and presents the opportunities that are available for the case of biomass and biowaste utilization in this green energy transition. The seasonal availability of pruning from olive trees and liquid biowaste, i.e. cheese whey wastewater (CWW) and olive mill wastewater (OMW), have been assessed for the island and a thorough survey of the operating production facilities in the island has been implemented and will be presented. On the one hand, pruning from olive trees can be gasified and a gasification modeling case will be presented (MAGSY model). On the other hand, liquid biowaste can be anaerobically digested for the production of biogas and the methane potential of each type of liquid biowaste has been measured. Energy production from biomass/ biowaste can assist the grid stability during a green transition to higher VREs utilization, since a "gas-battery" can be always be available and can cover any shortages. Finally, the idea of μgas-to-grid will be presented, where different biomass sources will be converted into gaseous fuels and injected into a small natural gas grid. The idea of the μgas design would consist of the local small-scale conversion of biomass/ biowaste into gaseous fuels and the centralized upgrade of the gases before the injection to a small natural gas grid. This idea can assist the second level of energy transition, when the isolated island grids will be connected to the central grids but the demand for greener fuels for heating in buildings or for the transportation sector will have to be addressed. This study will discuss the crucial role that biomass can play in both two levels of energy transition.

KEYWORDS: Syngas, Biogas, Natural gas grid, Biowaste, Isolated Grid, Sustainable Energy

PAPER ID: CEST2021_00530

17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

Assessing the Utilization of Fuels Cells for the Valorization of Produced Excess Energy in Isolated Grids – The Green Transition of Agios Efstratios

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ABSTRACT

The island of Agios Efstratios is a unique case, since a pilot green energy transition program is taking place. Wind and solar photovoltaic technologies have seen tremendous growth during the past decade and various policy measures have been introduced in support of their growth. For the cases of islands that are not connected with the mainland grid the integration of renewable energy systems (RES) is a challenge, due to the variable performance for wind and solar. This study investigates the integration of electrolysis and fuel cells as a method to increase the penetration of RES in the isolated system of the island and to store hydrogen for other uses like green transportation. The software RETSCREEN was used for the analysis and the available excess energy from the renewables showed that it can support the operation of a 200 KW fuel cell system and the replacement of two small 90 KW diesel engines and would increase the overall RES penetration. At the same time, more than 20 tons of hydrogen could be stored annually for other uses.

KEYWORDS: Wind, Solar PV, Fuel Cells, Electrolysis, VRE

PAPER ID: CEST2021_00535

CEST 2021

17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

Energy Supply of a Conference Center Towards Nearly Zero-Energy Building in Accordance with the Standards of the European Green Deal

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ABSTRACT

In December 2019, the European Commission proposed the European Green Deal, a set of policy initiatives that aim to transform the European Union into a low carbon economy and achieve climate neutrality by 2050. Building renovation is a core element of the European Green Deal, promoting the decarbonization of heating and cooling and enforcing stricter building performance standards. The purpose of this paper is to implement principles of the Renovation Wave in an international conference and research center: “The Orthodox Academy of Crete”. More specifically, the paper focuses on how to cover annual energy demands of the conference center and examines the installation of PV panels, wind turbines and hybrid solar wind system. All the alternatives cover the energy demands of the building. The most economic feasible alternative in each scenario is chosen based on financial criteria of Net Present Value and Internal Rate of Return. According to the results, the installation of PV solar system is the most economic feasible solution that covers completely the energy demands of the conference center.

KEYWORDS: European Green Deal, Renovation Wave, Energy Supply, Renewable Energy Sources, Conference Center, Orthodox Academy of Crete.

PAPER ID: CEST2021_00785

Utilization of paraffin wax as phase change material for solar thermal energy storage

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ABSTRACT

In this work, a thermal energy storage system based paraffin wax as phase change material (PCM) was designed, constructed and tested when it was integrated with a solar water heater (SWH). For the purpose of comparison, the SWH was also tested when water was used as a storage medium. The system was tested for successive days at different mass flow rates of the heat transfer fluid varied from 0.08 to 0.16 kg/s. The maximum energy stored in 110 kg of water used as storage material is 15.9 MJ/day, compared to 11.9 MJ when 50 kg of paraffin wax was used as storage material. This means that the PW not only capable of store 75% of the energy stored in water per day but also it achieves a 50% reduction in the storage volume. The low storage temperature gives also more superiority to the wax as storage material especially in the domestic application where just warm temperature is needed.

KEYWORDS: solar water heater, PCM, paraffin wax, energy storage

PAPER ID: CEST2021_00801

SESSION 29 - ECOLOGY, ENVIRONMENTAL CHANGE AND MANAGEMENT

Friday 3 September - afternoon

Small-scale fisheries in Istrian waters (northern Adriatic): preliminary results on catch analysis and presence of thermophilic species

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ABSTRACT

Small-scale gillnet fisheries in northern Adriatic have latterly shown certain alterations, mainly related to more frequent occurrence of thermophilic species due to ongoing climate changes. This research presents data on gillnet catch in Istrian waters (Raša and Medulin Bay) in order to show the ratio of thermophilic fish species in the total catch. Net deployment was performed twice a month, from October 2020 to January 2021. A total of 29 fish species were recorded, five of which are categorized as thermophilic: leerfish (*Lichia amia*), pompano (*Trachinotus ovatus*), greater amberjack (*Seriola dumerili*), Mediterranean barracuda (*Sphyraena sphyraena*) and bluefish (*Pomatomus saltatrix*). This category was represented with 4.68% of the weight in the total catch. *L. amia* was the most represented thermophilic species with 70.23% of the total catch weight of thermophilic species. Among native species, bullet tuna (*Auxis rochei*) was the most represented (49.78%), followed by the gilthead sea bream, *Sparus aurata* (30.17%). Results have shown significant presence of thermophilic fish species in the gillnet catch in Istrian waters during the main fishing season. Although that could have significant implications in terms of conservation, management and sustainable use of the living resources, seasonal exploitation of thermophilic species could be considered as an opportunity for local fishermen.

KEYWORDS: small-scale fisheries, Istrian waters, catch analysis, thermophilic species

PAPER ID: CEST2021_00682

Factors affecting the populations of Sea Turtles, *Caretta caretta*: The Case of Greece

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ABSTRACT

The current paper presents the results of an archival research work undertaken as part of a Thesis of the Program of Environmental Studies at Deree – the American College of Greece. The research undertaken aimed at assessing the extent of the problem related to the injuries and fatalities of the loggerhead sea turtles *Caretta caretta* in Greece, through detailed analysis of incidents recorded in press. Furthermore, the research identifies the patterns followed in injuries, in an effort to form recommendations for improved monitoring and protection. As the loggerhead sea turtle, *Caretta caretta* comprises an endemic species of Greece and a keystone species for the area, its protection is considered vital for the marine environment of the region. Despite the protection schemes and activities that are in place in Greece, there is high occurrence of traumas and deaths of sea turtles. The presented work will try to identify the gaps in monitoring and the related needs as a means to overcome the obstacles towards more efficient conservation of the species.

KEYWORDS: Loggerhead turtles, Threats to sea turtles, *Caretta caretta* Monitoring, Marine species protection

PAPER ID: CEST2021_00764

CEST 2021

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Experimental studies of the course of CO_2/CH_4 exchange sorption on hard coal subjected to confining pressure.

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ABSTRACT

Studies were carried out on exchange sorption of CO_2/CH_4 on four samples of hard coal differing in the degree of coalification. The samples were subjected to various confining pressures in the range from 1.5 MPa to 30 MPa. The author's conception of the measuring apparatus made it possible to use cylindrical samples of considerable length. This made it possible to register the phenomena as a function of time and distance. Measurements at each of the investigated pressures were carried out according to the following sequence: (1) pumping out the coal sample, (2) injecting CH4 at the pressure of 0.8 MPa until sorption equilibrium was reached, (3) exchange of gas at the sample inlet from CH4 to CO_2, (4) decrease of pressure at the sample outlet, (5) observation of sorption exchange: amount of injected CO_2, CH_4 emission, gas pressure at the inlet, outlet and inside the sample, confining pressure exerting axial stresses, change of sample volume as a result of swelling.

The conducted research allowed us to determine the influence of confining pressure on the key parameter - sweep effeciency of coals. This parameter is the ratio of CH_4 recovered from coal to the total sorbed CH_4. It is most often presented as a function of displaced volume, which is the ratio of injected CO_2 to total sorbed CH_4.

Sweep effeciency was about 90% in the coals studied. The effect of confining pressure on this parameter was insignificant, but in all cases the sweep effeciency value was highest for the lowest confining pressure and decreased with increasing pressure.

The strongest effect of confining pressure was observed with respect to the kinetics of the exchange sorption process. The sorption exchange process for the lowest confining pressure (1.5MPa) occurred about ten times faster than for the highest confining pressure (30MPa).

During CH_4 sorption, the coal material swelled, and the volume change at CH_4 pressure at 0.8MPa ranged from 0.45% to 0.8% of the initial volume for 1.5 MPa. A high confining pressure of 30MPa resulted in a swelling reduction of 0.1% to 0.2%. Further swelling was recorded during exchange sorption, from about 0.6% to 1.2% for the lowest confining pressure and from about 0.2% to 0.6% for the highest confining pressure.

KEYWORDS: CO_2/CH_4 exchange sorption, experiments in reservoir conditions, swelling of coal at confining pressure

PAPER ID: CEST2021_00625

Effect of confining pressure on sorption parameters and structure of coal in terms of analyzing the possibility of underground CO_2 storage with CH_4 recovery.

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ABSTRACT

An original apparatus was constructed, allowing observation of sorption processes occurring in hard coal briquettes. The investigations were carried out on four hard coals from poland and france differing in the degree of coalification. The coal briquettes were subjected to confining pressure with values in the range of 1.5-30 mpa. The pressure of sorbates (co_2, ch_4) was regulated and controlled in the range up to 1mpa. With the measurement system, the effect of swelling of coals on the sorption processes was observed. Successive sorption points were recorded, from which isotherms were extrapolated and kinetics of combined processes of sorption and gas transport were analyzed. All the coals studied showed a decrease in the amplitude of the langmuir isotherm for ch_4, with increasing confining pressure. This decrease ranges from 0.2 to 0.5 $cm^3 ch_4/g$ for each 10 mpa change in confining pressure. For one of the coals tested, the decrease in the amplitude of the langmuir isotherm with increasing confining pressure was higher than the others and was about 2 cm^3ch4/g per 10 mpa change in confining pressure. The swelling of the coal material examined at the last point of the ch4 sorption isotherm (0.8 mpa) ranged from 0.45% to 0.8% of the initial volume for a confining pressure of 1.5 mpa. A high confining pressure of 30mpa resulted in a reduction of swelling to between 0.1% and 0.2%. The reduction in sorption capacity of coal relative to co_2 after sorption exchange was also analyzed. The relative reduction of the co_2 sorption capacity at an ambient pressure of 30 mpa versus 1.5 mpa ranged from about 4% to 8%. Before and after the sorption processes, the structural parameters of the coal briquettes were investigated using porosimetric and optical methods. Parameters such as volume and distribution of micropores and specific surface area were determined. Performing sorption tests on samples subjected to such high confining pressure, at sorbate pressures up to 1mpa, corresponds to the parameters of the rock-gas system that occur in typical hard coal seams.

KEYWORDS: coal, confining pressure, sorption, porosity

PAPER ID: CEST2021_00626

Laboratory studies of coal permeability under conditions corresponding to in situ, in terms of assessing the possibility of underground CO_2 storage with CH_4 recovery

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ABSTRACT

Investigations of processes accompanying the exchange sorption of CO_2/CH_4 under confining pressure in the range of 1.5 MPa to 30 MPa have been carried out. The research was carried out on innovative apparatus for testing filtration, sorption and CO_2/CH_4 exchange sorption processes under isobaric conditions on sorbent subjected to confining pressure. This apparatus enables the analysis of occurring phenomena both in time and space of the tested sample. The effect of confining pressure on the kinetics of sorption processes and on the permeability of the coal material was investigated. The effect of swelling of the coal material during sorption processes was also investigated, with particular emphasis on the effects of this process on gas transport.

The investigations were carried out under stationary confining pressure conditions, during which the He and CO_2 flow rates were determined for various pressure gradients, and under dynamic conditions, where the confining pressure changed linearly in the range of 30-1.5 MPa with very rate (about 5 MPa per 24h), at constant gas pressure gradients. For the studied material, the permeabilities in relation to CO_2 and He were in the range 5-200 mD. The decrease in permeability for a change in the confining pressure of 30-1.5 MPa was about tenfold.

KEYWORDS: exchange sorption, coal permeability, ECBM, CO_2, CH_4

PAPER ID: CEST2021_00627

Linear Bivariate Expressions for Marine Benthic Macrophytes Ecological Status Description

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ABSTRACT

Regarding ecological status assessment with marine benthic macrophytic indicators as per European Water Framework Directive (WFD), linear models are being reviewed (either starting from discontinuous forms or modifying quadratic and algebraic forms). Through use of simple concepts, model flexibility is demonstrated in terms of application to different indicators and varying marine environments. Four variants of the Ecological Evaluation Index (EEI) approach yield similar results (same or adjacent ecological status classifications in 18 out of 20 points) for a Saronikos Gulf data set; they are further compared with variants of the Quality of Rocky Bottoms (CFR) approach over WFD-related aspects (ecological status classification, coverage, richness).

KEYWORDS: Water Framework Directive, marine benthic macrophytes, CFR model, RPI approach for EEI model

PAPER ID: CEST2021_00159

Using monk seal faeces as a non-invasive technique to monitor the incidence of microdebris

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ABSTRACT

Marine litter monitoring and assessment is required under the EU Marine Strategy Framework Directive to prevent any harm on marine ecosystems and their biota. Sampling to evaluate effects of marine litter, including microdebris, in top predators is difficult. Usually, microdebris is examined in the gastro-intestinal tract of stranded dead animals. However, the population of the endangered Mediterranean monk seal is too small for obtaining sufficient samples. The present study implemented for the first time a non-invasive technique for collecting monk seal samples to assess the microdebris ingestion in a systematic manner. A total of 12 samples of monk seal faeces were collected from marine caves in Zakynthos Island, Greece (INTERREG MED project “Plastic Busters MPAs”). A total of 166 particles were identified; 77% of the particles were smaller than 3 mm but a piece of net larger than 5 cm was also found. The majority of particles were filaments (84%), and only one sphere was found. Faeces contained on average 14 particles per sample, half of the average in previous studies using the whole digestive tract. The use of faeces represents an effective non-invasive tool to assess the incidence of microdebris and the trophic transfer of these pollutants.

KEYWORDS: Mediterranean monk seal, Microdebris ·Non-invasive technique, Zakynthos, Greece

PAPER ID: CEST2021_00203

Challenges and market trends in the offshore aquaculture industry

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ABSTRACT

In this paper the global market trends and design challenges in the offshore aquaculture industry will be presented, focusing on the use of innovative materials for the construction of fish cages. Newly designed cages offer sustainable and environmentally friendly solutions for offshore cage systems, effectiveness in the intended environmental conditions, as well as advanced fish production compared to traditional coastal aquacultures, in order to satisfy the changes in the consumer preferences and the continuously growing feeding demands of the world population. At the end of this paper, a short presentation of the MATISSE project (Study of the appropriateness and the adequacy of modern materials for offshore fish cage and nets – numerical and experimental investigation in realistic loading conditions) and its key results will be performed.

KEYWORDS: offshore, aquaculture, fish, environment

PAPER ID: CEST2021_00041

Effects of nitrogen fertilizer on photosynthetic light energy transfer and use in hybrid fescue under drought stress

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ABSTRACT

The aim of this study was to investigate the response of chlorophyll *a* fluorescence parameters of hybrid fescue (× *Festulolium loliaceum* (Huds.) P. Fourn.) under partly regulated environment and drought stress effect. The results showed that the increasing nitrogen content increased the values of the studied indicators. Meanwhile drought stress reduced them. At the highest fertilization level N90, the photosynthetic performance (PI_{total}) index increased by 89 % compared to N0, the effect of drought reduced this indicator by 50 %, but remained higher than PI_{total} of plants of N0 level. After the recovery period, these differences became even more pronounced. Similar regularities were found for other investigated parameters such as quantum yield of electron transport (phi(Eo)) and quantum yield for the reduction of end acceptors of PSI per photon absorbed (phi(Ro)). Total electron carriers per reaction center (Sm) also increased with increasing nitrogen content in the soil. The higher nitrogen content significantly increased the values of the mentioned indicators after the recovery period. These aforementioned changes in photosynthetic energy transfer also lead to higher plant biomass and lower losses due to drought stress.

KEYWORDS: drought stress, nitrogen fertilization, chlorophyll fluorescence, forage crop

PAPER ID: CEST2021_00120

Triclosan-induced changes in earthworm *Eisenia fetida* life cycle under elevated temperature

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ABSTRACT

Antimicrobials are important for preserving the quality of life and public health. Triclosan (2,4,4'-trichloro-2'-hydroxydiphenyl ether, TCS) is one of the most used antimicrobials in both pharmaceuticals and personal care products and it is a frequently detected emerging organic contaminant (EOCs). Earthworms *Eisenia fetida*, with their thin epithelium and their feeding, are directly exposed to soil pollutants, making them highly important for the assessment of the toxicity of inorganic and organic contaminants to soil biota. With potentially far-reaching consequences for life on Earth, climate change is an increasingly urgent issue. There is a growing awareness of the importance of anticipating the interactions between natural and chemical stressors, and the way they affect organisms and their performance. The purpose of the study is to assess the effect of elevated temperatures on changes in the life cycle of earthworm *E.fetida* induced by triclosan. Triclosan-contaminated (10 - 750 mg TCS kg^{-1}) soil studies with *E.fetida* were performed at different temperatures (20°C and 25°C). Earthworm lifecycle parameters (mortality rate, weight growth, reproduction) were determined. Results of this study showed that elevated temperature enhanced the negative effect of triclosan on *E.fetida* mortality at ≥100 mg TCS kg^{-1} concentrations. Reproduction of *E.Fetida* was the most sensitive to TCS exposure and the lowest tested TCS concentration severely affected *E.Fetida* reproduction.

KEYWORDS: triclosan, climate change, chronic toxicity, earthworms, temperature

PAPER ID: CEST2021_00135

Forage crops nitrogen use efficiency changes under drought conditions

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ABSTRACT

Ensuring sustainable agriculture and food security is one of the biggest challenges under changing climate. The frequency and severity of droughts is increasing as a result of climate change. These extreme events may lead to decreased forage crop productivity and financial incomes. Forage crop productivity strongly depends on plants nitrogen use efficiency which in turn may be affected by changed climate conditions. The aim of the study was to examine the influence of drought on the growth and nitrogen use efficiency of alfalfa (*Medicago sativa* L.) and *festulolium* (*Festulolium loliaceum* (Huds.) P.Fourn.) at different rates of nitrogen (N) supply (background, 60 and 90 kg N ha^{-1}). Alfalfa and *festulolium*, grown in a climate-controlled glasshouse, were subjected to short-term drought (7 days) under ambient CO_2 (400 ppm) concentration. After the cease of stress, plants were rehydrated and left for 7 days to recover under control conditions. The growth (aboveground and belowground biomass, height), plant N content, nitrogen use efficiency (uptake (NupE), use (NUE) and utilization (NutE)) of both plant species were evaluated. Drought had an adverse effect on N accumulation and N uptake, use and utilization efficiency in alfalfa and *festulolium*. Additional N supply reduced efficiency of N uptake and use.

KEYWORDS: drought, forage crops, nitrogen supply, nitrogen use efficiency

PAPER ID: CEST2021_00187

Environmental assessment using acoustic complexity indicators

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ABSTRACT

The procedure of sound recording offers new perspectives in ecology. Nevertheless, the existing tools that offer high resolution recordings are expensive. The use of acoustic indicators is proposed as an easy-to-use, rapid, non-intrusive, low-cost option in biodiversity assessment as well as in environmental noise management. The purpose of this research is to evaluate and prioritize acoustic indicators in terms of environmental noise management and biodiversity assessment in order to assist the development of a low cost Automated Recording Unit (ARU). The data collection areas are two similar public spaces of Mytilene, with the only difference being a differentiation regarding the levels of urbanization. A series of sound recordings were performed using a specific protocol. Signal analysis was performed using the R Statistics software. A list of spectral complexity indicators were extracted, evaluated and ranked in order for their incorporation to the ARU created. These indicator results were then visualized using the QGiS software in order to produce sound maps. In conclusion, the complexity indicators are the best solution for both biodiversity assessment and environmental noise management.

KEYWORDS: Acoustic environment; Soundscape; Biodiversity assessment; Noise assessment; Spectral indicators

PAPER ID: CEST2021_00315

Circular Economy Shadows

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ABSTRACT

The effects of the Circular Economy (CE) are positive and negative. However, the beneficial aspects are widely considered. The CE creates a link between economic growth and limited resources by cuts waste from the production system. Therefore, CE is associated with increased prosperity, the ecological added value from products and processes with reduced emissions. There are doubts related to the jobs generated by the CE, costs of other resources usage, and consumption reduction or maximization of existing products. The adopted methods in this paper are an inductive inference method supported by a case study. The study presents examples of spectacular problems coming from the transformation towards CE.

KEYWORDS: Green Economy, Management, Sustainable Development.

PAPER ID: CEST2021_00791

Brief Biology Of Sudanonautes Africanus (Crustacea: Brachyura: Eubrachyura: Potamoidea: Patamonautidae: Potamonautinae), In Ossiomo River, Niger-Delta, Nigeria

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ABSTRACT

Human activities pose an important impact for coastal environments. Particularly aquatic fuana is afflicted by the discharge of organic pollutants of anthorpogenic origin. Furthermore, recent studies show sinergies between diffferent pollutants, such as interactions between the presence of microplastics and organic pollutants intake [1]. Mussels are of a high environmental value, as filters feeders they are potential indicators of the ocurrence of organic pollutants and environment quality. In adittion, they are suitable for in-lab aquarium experiments, such as bioacumulation studies, which provide insigth about fate of pollutants in the organisms. In the present study, Mediterranean mussel (Mytilus galloprovincialis) was employed to assess the bioaccumulation of 20 pollutants, including pesticides, PFASs and pharmaceuticals. Mussels were purchased in a local market and distributed randomly in three groups: a group exposed to the mix of pollutants and the presence of microplastics (P+M), a group exposed just to the mix of pollutants (P) and the control group (C). Mussels were exposed to the pollutants through water and food from day 0 to 28 (exposition stage). Then, the water was replaced and the mussesl remained in the aquariums for 30 aditional days (depuration stage) to observe their capability to depurate the pollutants. Haemolypmh from mussels was extracted using solid phase extraction (SPE) with Phree™ phospholipid removal cartridges. On the other hand, the visceral mass was extracted using QuEChERS combined with dispersive solid phas extraction (dSPE) using Enhanced Matrix Removal (EMR-Lipid) clean-up. Both extracts were analysed by LC-MS/MS. Results for visceral mass showed variable concentrations for several pesticides, pharmaceuticals and PFASs during the exposition stage. However, just 2 PFASs and 4 pesticides were detected during the depouration stage. These results suggest effective bioaccumulation for these 6 compounds. On the other hand, haemolymph showed concentrations of 2 pesticides, 2 pharmaceuticals and 1 PFAS during the exposition stage, but no compounds were detected during the depuration stage. Slight differences in the concentrations were found when the mussels were exposed to microplastics. Results suggest that the presence of microplastics influenced a higher bioaccumulation for several PFASs and pesticides. Furthermore, they also suggest that the presence of microplastics can influence the depuration capability of mussels for different organic pollutants. However, further research ins need to elucidate the particularities of this processes.

KEYWORDS: exposition, depuration, microplastics, haemolymph, QuEChERS

PAPER ID: CEST2021_00416

The complex of natural enemies of invasive species *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) on greenhouse-grown tomato crops conditions from southern Romania

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ABSTRACT

An obvious consequence of climate change is represented by the rapid spread and establishment of the invasive alien pest worldwide. Soon after its introduction in Romania, the tomato leaf miner *Tuta absoluta* is considered the greatest threat to protected tomato crops in the area from south of the country. Pest control is based mainly on spraying of chemical insecticides but augmentative biological control started to be used more and more by farmers. The indiscriminate use of pesticides against *T. absoluta* may result in undesirable consequences and effects including toxicity to non-target organisms. Gaining knowledge about indigenous natural enemies that adapt to this invasive species is essential for establishing safer and eco-friendly strategy of control. A complex survey on the *T. absoluta* natural enemies was conducted in 2020 in four localities from the main greenhouse-grown vegetable cultivation areas in southern Romania. The list of *T. absoluta* antagonists includes eleven predators and three parasitoids species. The paper also examines how differences in technology and protection means, currently used by farmers, influence these natural enemies' diversity and dynamics by providing useful information for understanding their role in ecosystem services and a base for further modeling and development of sustainable IPM programs.

KEYWORDS: climate change, ecosystem services, invasive species

PAPER ID: CEST2021_00494

Histopathological alteration in gills and liver of Cyprinus Carpio after a short-term exposure to titanium dioxide nanoparticles

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ABSTRACT

With the rapid development of nanotechnology in past few decades, engineered nanomaterials (ENMs) have been extensively used in variety of domestic, commercial, and industrial products. Nano-titanium dioxide is one of the most widely used nano-material due to its UV light absorption, optical properties, thermally stable nature, and photocatalytic activity. Frequent use of nano sized titanium is likely to end up in the discharge of these particles into different environmental compartments. However, it is still uncertain if these nano materials are harmful to aquatic biota. In present study, titanium dioxide nanoparticles were prepared using liquid impregnation method and were characterized through SEM and XRD. Toxicity of selected five concentrations: 0.01, 1.5, 3.0, 10 and 100 mg/L of titanium dioxide nanoparticles on freshwater fish Cyprinus Carpio were assessed using histological biomarker approach. Gills and liver tissues showed increasing degree of damage including pycnotic nuclei, cytolysis, vacuolization, blood congestion and architectural loss along the exposure period of 96 hrs. This study elucidates the time and dosage dependent toxicity of titanium dioxide nanoparticles in the fish implying that short-term exposure to sublethal concentrations is sufficient to produce detrimental impacts on metabolic and physiological functioning of fish.

KEYWORDS: Titanium dioxide, Histopathology, Toxicology, Fish

PAPER ID: CEST2021_00372

GMOs Detection With Minimal Reaction Volume Real-Time PCR For Environmental Conservation

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ABSTRACT

Detection of GMOs with Real-time PCR is the standard technology for tracing their presence in different sample types ranging from food to plant materials. GM plant seeds are one of the main sources for GM dispersal in the environment, affecting genetic stability and biodiversity. A certified protocol of minimal Real-time PCR reaction volume with low cost is presented, that offers the ability to identify trace amounts of GMOs in seeds, maintaining high specificity, sensitivity, efficiency and robustness (≥95%). The proposed methodology can serve also sampling for environmental monitoring, where handling of increased sample numbers is difficult or/and the sample amount is very low and precious.

KEYWORDS: GMO, Real-time PCR, biodiversity

PAPER ID: CEST2021_00358

Gmo Policies For Environmental Protection In The Era Of Genome Editing

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ABSTRACT

In recent years, immediate human interference with nucleic acid sequences has resulted in what is popularly known as Genetically Modified Organisms (GMOs). The process, based on molecular technologies under the term genetic engineering, has added new information to the existing pool of genetic modifications produced from classical guided breeding or of spontaneous evolutionary occurrence under environmental pressure. On one hand, these products have been proposed as the future solution in food, medicine, health therapies including human genome modifications. On the other, they have also been accused that affect environmental stability and human health, especially in cases of DNA mix from distant species. Recent genetic engineering technologies, termed as genome editing, like clustered regularly interspaced short palindromic repeats (CRISPR), oligonucleotide-directed mutagenesis (ODM), zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs) or directed evolution PCR, are also under examination, as they lead to GMOs. In comparison to their species of origin, GMOs produced with newer technologies contain genetic modifications closer to naturally existing nucleic sequences, being difficult their detection and evaluation. Present and future policies for GMOs are presented under an emerging technology revolution.

KEYWORDS: GMO policies, genome editing, biodiversity

PAPER ID: CEST2021_00371

Real-scale Analysis of Riparian Vegetation Deformations and Flow Resistance of Vegetated Streams

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ABSTRACT

The objective of this study is the comparative analysis of the main hydrodynamic traits of vegetated streams and riparian vegetation 3D bending through the processing of real-scale measurements retrieved during field hydraulic experiments in a vegetated water body colonized by young flexible riparian weeds. The structural measurements of riparian vegetation bending were carried out by employing a built-in system of micro load cell sensors, implemented during three years of Research program and calibrated in specific Laboratory Flume tests, and then installed directly on the weed flexible stems in the field in real vegetated water streams. The measurements were carried out continuously, aiming at correlating the riparian weed deformation to the complete 3D water flow field. The promising outcomes of this study represent a useful tool for the prediction of the effects of riparian vegetation in vegetated channels colonized by such a widespread riparian species like reed beds.

KEYWORDS: Riparian vegetation bending; vegetated flows; real-scale measurements; field experiments.

PAPER ID: CEST2021_00689

Brief Biology Of Sudanonautes Africanus (Crustacea: Brachyura: Eubrachyura: Potamoidea: Patamonautidae: Potamonautinae), In Ossiomo River, Niger-Delta, Nigeria

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ABSTRACT

The crab species *africanus* is a very notable detritivore, feeding on dead organic materials. It makes use of energy from the food and transfers it into the food chain trophic level, contributing to the gross ecosystem efficiency. However, their threat to human consumption and activities is gradually high in the sub-Sharan regions. There is a need to exploit alternative methods for traditional domestic cultivation to ensure food security. This study reported the length-weight relationship, condition factor, sex ratio, fecundity, and GSI (gonadosomatic index) of *Sudanonautes africanus* to prospect possible domestication. The result of the biomass of *Sudanonautes africanus* indicated a mean range of 52-180 g. A positive relationship existed between the weight and length relationship of the male and female crab with positive (+) allometry. There was no significant difference between both sexes. However, the fecundity estimates showed a ripe carapace full of bright red gonad materials (stage V) specifically in the female with eggs range of 2.56 to 8.95 g and GSI range of 11.28-41.44%; with the minimum (15) and maximum (27) fecundity at July and June 2016 respectively. It was concluded that the species could be domesticated via aquaculture because of its potentials to adapt to various feed substrate and water parameters.

KEYWORDS: Cluster, Fecundity, Gonadosomatic, Morphometric, *Sudanonautes africanus.*

PAPER ID: CEST2021_00823

SESSION 30 - HYDROLOGY AND WATER RESOURCES

Friday 3 September – afternoon

A system dynamics model to quantify the impacts of restoration measures on the water-energy-food nexus in the Urmia lake Basin, Iran

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ABSTRACT

Water scarcity exacerbated by growing demand has created environmental, social, and economic challenges in the Urmia Lake Basin (ULB), Iran. Tackling these requires an integrated approach. A System Dynamics Model is developed simulating the water-energy-food nexus in the ULB as a holistic multi-sectoral system to assess the impacts of proposed restoration measures. Climate change is considered, as are the effects of increasing irrigation efficiency, increasing return flows, water transfers, crop land retirement, and reviving a portion of the lake on natural resources and the socio-economic state of the basin. Lake level is sensitive to climate change. A holistic restoration approach could be effective in restoring the lake to an ecological level. However, in doing so, electricity demand in agriculture could grow. A 20% retirement of irrigated wheat to curb water demand, when coupled with a 20% increase in yield on 80% and 50% of irrigated and rain-fed fields respectively, will not reduce overall wheat production. The effectiveness of various measures depends on monitoring and enforcement, particularly in restricting growth in agricultural water consumption. While proposed measures look positive, they may have unexpected consequences including increasing energy demand for electric pumps. This work can inform holistic decisions for Urmia Lake restoration.

KEYWORDS: Policy analysis; system dynamics modelling; Urmia Lake; water-energy-food nexus.

PAPER ID: CEST2021_00006

Perspectives, challenges and directions for future research into the water-energy-food (WEF) nexus

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ABSTRACT

In 2018, Albrecht et al. published a review of water-energy-food (WEF) nexus literature, coming to five main criticisms in nexus research. The five central conclusions of that review together with a consideration of on-going projects and recent nexus research insights form the basis for this critical review. The current state of nexus research, and in particular modelling research, is examined and updated to reflect recent advances and correct misperceptions, and put them in the context of larger epistemological issues. The main conclusions are:

1)The considerable and growing diversity in nexus studies precludes a one-size-fits-all approach. Indeed, it has never been an objective to develop a 'grand unified nexus theory or model';

2)A lack of 'fundamental equations' between many nexus parameters hinders full quantification of nexus linkages, though data-driven, stochastic and agent-based approaches offer avenues for development;

3)The use of qualitative and social science methods in nexus studies is rapidly gaining traction, especially when blended with quantitative modelling outcomes;

4)Progress has been made in attempting to break disciplinary siloes, especially when considering integrated assessment models and system dynamics models.

KEYWORDS: nexus challenges; nexus critique; nexus perspectives; water-energy-food nexus

PAPER ID: CEST2021_00007

Effect of the dependence structure and time irreversibility of streamflow in flood inundation mapping with focus on the long-term persistence behavior

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ABSTRACT

The marginal structure of streamflow, with focus on the right tail behaviour, is considered as the main factor in flood risk assessment, while little is known on the effect of the temporal dependence structure and irreversibility of streamflow. Interestingly, the second-order dependence behaviour of streamflow is shown to highly deviate from a white noise behaviour (i.e., temporal independence), and to rather exhibit a Hurst-Kolmogorov (HK) behaviour, with strong autocorrelation and irreversibility at small scales and long-term persistence at large scales. The HK dynamics is known to be characterized by large uncertainty and variability, and therefore, it is expected to have a non-negligible impact on flood inundation mapping, especially in cases of successive storm events. Through benchmark experiments and real case scenarios, we investigate the influence of these effects in several output features of flood risk modelling such as flood depth, velocity, and duration, and we discuss possible consequences for insurance policies.

KEYWORDS: stochastics, flood, streamflow, dependence, irreversibility

PAPER ID: CEST2021_00128

Preliminary hydro-geochemistry characterization of the complex geological framework of the Coreca area (Calabria, South Italy).

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ABSTRACT

Hydrogeochemical characterization combined with statistical methods has been used to investigate groundwater quality and related geochemical processes in the complex geological framework of Coreca (Calabria, South Italy). Coreca is characterized by a peculiar geological setting that affects the groundwater quality mainly exploited for irrigation use. Two groups of waters were identified: Ca-HCO_3 waters strongly controlled by the interaction with Ca-rich phases; Mg-HCO_3 waters related to the interaction of meteoric water with the metamorphic Units. In Mg-HCO_3 group was identified a good correlation between Cr and Ni (not observed in Ca waters) and a negative correlation between Cr, Ca and Al in agreement with direct interaction with ultramafic rocks characterized by low concentration in CaO and Al_2O_3. The concentration of major and trace elements has been compared with the Italian law limit values and the drinking water guidelines provided by the World Health Organization (WHO). Only samples S20, S25 and S29 showed Mn and Ni concentration higher than the Italian law threshold. The study allows defining how a multidisciplinary approach represents a useful tool to trace the factors controlling the groundwater evolution and quality especially in areas with an articulate geological and hydrogeological asset.

Keywords: Hydrogeochemistry; statistical analysis; Coreca; drinking and irrigation use; statistical elaboration.

PAPER ID: CEST2021_00180

Urban water bodies and recreational opportunities in Finland

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ABSTRACT

Urban water bodies provide recreational opportunities to residents such as swimming, boating, fishing and spending leisure time. The recreational opportunities offered by water bodies contributes to both physical and mental health. In Finland, there are almost unlimited possibilities to enjoy water bodies in urban areas by having 3.4 million hectares of inland water resources, e.g., lakes, ponds, and coastal wetland and 5.2 million hectares of marine waters. In this paper, we highlight the recreational values offered by these water areas in the urban context. We use water-based outdoor recreation statistics collected from the three provinces in Finland called Uusimaa, Pirkanmaa, and Pohjanmaa. As a result, we show that the demographic structure, access to the water areas are linked to the type of recreation activities such as swimming, fishing and boating. Thus, resulting in the well-being of people living in cities.

KEYWORDS: Urban Water bodies, Recreational Opportunity, Natural Resources, Water Resources.

PAPER ID: CEST2021_00094

Hydrological analysis and hydraulic simulation for Sperchios River Basin

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ABSTRACT

This research work deals with a flood risk assessment methodology for the ungauged Sperchios River basin, an area of 1003 km^2 located in Central Greece. This region is frequently exposed to floods, thus a floodplain evaluation is very important in order to take measures against the effects of floods. Initially, a hydrological analysis was conducted through the Hydrologic Modeling System (HEC-HMS) using the estimation of the runoff, based on the Natural Resources Conservation Service (NRCS) method and the appropriate curve numbers (CN) for the study area. The output of the hydrological analysis was a flood hydrograph, which was then used for hydraulic simulation through the River Analysis System (HEC-RAS) (2D), having the ability to produce the water profiles, velocity and inundation maps of the floodplain. The results of this work indicated that surface runoff is equal to 66% of the total rainfall and the flood hydrograph peaks at 1969 m^3/s, under normal soil moisture conditions. An increase of 22% in the surface runoff, leads to a peak of 2756 m^3/s (40% increase), under wet conditions. The adopted methodology contributes to the development of robust flood forecasting and early warning systems.

KEYWORDS: surface runoff, floodplain evaluation, HEC-HMS, HEC-RAS, Sperchios

PAPER ID: CEST2021_00092

Introducing UWAB 2.0. and exploring next steps for agent based modelling in domestic water demand.

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ABSTRACT

Domestic water consumption projections are needed to manage the urban water supply system in different spatiotemporal resolutions depending on the type of the supported decision. For instance, operational decisions require predictions of fine resolution (hourly or lower), while tactical and strategic decisions are satisfied with predictions of coarser resolutions (monthly or even annual). This work explores the development of the new version of the Urban Water Agents' Behaviour (UWAB) model, the UWAB 2.0. and its structural changes. These changes are expected to enable the linking of UWAB with machine learning techniques to enhance its projection capacity to support tactical and strategic decisions. UWAB is an agent based modelling tool, which simulates the water demand behaviour of urban households incorporating the effects of climate, water demand management policies and social network to water saving behaviour. This work will present the results of the structural changes of UWAB and the way forward for its development and pilot testing.

KEYWORDS: agent based modelling, water demand

PAPER ID: CEST2021_00115

Energy recovery from urea in decentralised wastewater streams

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ABSTRACT

This work presents the design of a new process that enables energy recovery from wastewater, based on the selective adsorption of urea from urine and its subsequent decomposition into hydrogen.

Removal of nitrogen compounds is at the core of wastewater treatment, as their uncontrolled discharge would lead to eutrophication and low quality of the water bodies. Currently, nitrogen-based contaminants are removed using energy-intensive biological processes that can represent more than 50% of the energy consumption of wastewater treatment plants [1]. Alternatively, decentralised treatment is a new approach where waste effluents are treated close to the generation point, where nutrients is at its highest concentration and the presence of other pollutants is minimized. In this regard, urine diversion toilets and urinals can be used to collect undiluted urine, which represents 80% of the nitrogen produced in households, in the form of urea ($(NH_2)_2CO$) [2]. Rather than just a contaminant, urea is a hydrogen-rich compound and a potential source of green energy.

Cost-effective adsorbents have been developed by modifying activated carbon with different oxidising agents to introduce oxygen functional groups that increased urea adsorption capacity by 25%. A correlation between the concentration of acid functional groups and the adsorption capacity was found, providing mechanistic insights into the adsorption of urea. After the adsorption step, the urea was desorbed through thermal treatment at 200°C with 90% efficiency, leading to urea decomposition into ammonia and carbon dioxide. Coupling the process with the in-situ catalytic ammonia decomposition demonstrates the production of hydrogen to be used as an energy fuel. This process opens the door to new treatment systems for nitrogen-based compounds that enable their valorisation as energy sources, promoting circularity of wastewater treatment. Preliminary energy analysis shows that, if a decentralised approach with this energy recovery system was deployed in a city of 150,000 people, 250 kg/day of hydrogen would be produced and the municipal wastewater treatment plant would save 2,500 kWh/day, which is equivalent to 20% of their energy consumption.

KEYWORDS: Wastewater valorisation, energy recovery, urea, adsorption, circular economy.

PAPER ID: CEST2021_00747

SESSION 31 - ENVIRONMENTAL HEALTH

Friday 3 September - afternoon

Evaluation of the human exposure to a broad spectrum of organic chemicals and the potential use of sewage sludge to prioritize hazardous substances

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ABSTRACT

Chemicals are part of our daily lives, and we are exposed to multiple chemicals through multiple pathways. Relevant scientific evidence contributing to regulation of hazardous chemicals requires a holistic approach to assess simultaneous exposure to multiple compounds. In this sense, recent advances in analytical chemistry are crucial to obtain a more complete view of human exposure to organic chemicals.

Human fetus is particularly susceptible to chemical exposures, with effects of such exposures not only appear during early postnatal and childhood periods, but could also influence health and disease later in life. An exploratory study to characterize the human chemical exposome was conducted in maternal blood and placenta samples, available from the BISC mother-child cohort (Barcelona Life Cohort Study, http://projectebisc.org). Ultimate HRMS-based approaches were applied including wide-scope target and suspect screening (for >2300 and >10000 chemicals, respectively). Dozens of chemicals were determined including pesticides, personal care products or industrial compounds, among others, in the range of ng·mL^{-1}. In parallel, sewage sludge from the wastewater treatment plants serving the residence

areas of the studied population was also screened to evaluate its potential use as a proxy of the human body and its application in early warning systems to prevent chemical threats.

PAPER ID: CEST2021_00201

Are emerging contaminants affecting drinking water microbial biofilms?

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ABSTRACT

The presence of biofilms in drinking water (DW) distribution systems is unavoidable as well as the presence of trace levels of different emerging contaminants (ECs). ECs constitute a potential risk for the "One Health" trilogy. In particular, the presence of antibiotics in the environment has been associated with antibiotic-resistance spread worldwide. However, the information about the pressure caused by non-antibiotic and non-pharmaceutical ECs remains scarce. This study aims to highlight the possible impact of different pharmaceutical and even some non-pharmaceutical ECs on the behavior of bacteria isolated from DW. Few recent works reported the impact of a continuous exposure to specific ECs on DW microbiota; however, this topic still remains unexplored by the scientific community. In order to provide more realistic knowledge about the continuous exposure of DW biofilms to ECs, *Acinetobacter calcoaceticus* isolated from DW, *was* used to form biofilms. These biofilms were exposed to several pharmaceutical (ibuprofen, ciprofloxacin, carbamazepine) and non-pharmaceutical (caffeine) ECs. The results demonstrated that the presence of these ECs may affect DW bacteria behavior, namely the ability to form biofilms and the tolerance to antibiotics. Additionally, this work demonstrates the possible impact of ECs on DW bacteria behavior and highlights that the impact of ECs on DW microbial community is dependent on the bacterial diversity, environmental conditions and also the time of exposure.

KEYWORDS: antimicrobial tolerance, biofilms, exposure conditions, micropollutants

PAPER ID: CEST2021_00275

QSight-based method for the detection and quantification of polar contaminants in drinking water

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ABSTRACT

An analytical method covering various difficult polar contaminats such as chlorate, bromate, bromide, glyphosate and AMPA was successfully developed utilizing direct injection and ion exchange columns. Linearity could be obtained for each compound, with a dynamic range of 2-3 magnitudes and regression coefficients (r2) $\geq$ 0.995. Furthermore, for some compounds levels as low as 10 ng/L could be reached demonstrating the extreme sensitivity of the QSight UPHLC-MS/MS. Moreover, it could be shown that by simple direct injection of drinking or surface water the sample preparation could be completely eliminated. The present work aims at illustrating the performance of a targeted LC-MS/MS method using a QSight triple quadrupole mass spectrometer for the quantification of several difficult polar contaminants in drinking water and meeting current EU regulatory limits.

KEYWORDS: Direct injection, Glyphosate, Polar contaminants, Drinking water

PAPER ID: CEST2021_00653

Investigation of the relationship between Hg speciation in soil and human health and ecological risk assessment

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ABSTRACT

Mercury (Hg) pollution in soils can have major effects on human health and ecological systems. Concentrations, toxicological behaviour and bioavailability of different Hg species, both in the environment and in biological systems differ greatly, and are significant in the estimation of both human health and ecological risk assessment. Herein the significance of appropriate selection of species in both human health and ecological risk assessments is considered.

KEYWORDS: mercury species - total mercury - human health risk assessment - ecological risk assessment- reference dose

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Indoor Built Environment and Human Comfort in Buildings with Complex Design

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ABSTRACT

In this paper, related with indoor built environment and human comfort, it is applied a numerical software in buildings with complex design. The methodology applies a numerical model which incorporates the building thermal behavior with the human thermal-physiology. The building model uses an energy and mass balance integral equations system solved by Runge–Kutta–Felberg method with error control. In this numerical study, it is analyzed a university building with complex design, in transient conditions and for the winter season. The thermal comfort, using the PMV index, and the air quality, using the carbon dioxide concentration, are evaluated. The building, with 319 compartments and with four floors, is equipped with Heating, Ventilating Air Conditioning system controlled through the PMV index. The results demonstrated that the indoor thermal conditions inside the building are non-uniform and it is important to use specified and adapted control system to guarantee acceptable thermal conditions.

KEYWORDS: Indoor built environment, Complex design buildings, Human comfort, Indoor air quality, Energy

PAPER ID: CEST2021_00687

Acute toxicity of polystyrene microplastics and cobalt assessed individually or in combination on "Amphibalanus amphitrite"

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ABSTRACT

Study was carried out to assess the ecotoxicity and interaction of polystyrene (PS) microspheres and trace element, cobalt (Co). Stage II nauplii of Amphibalanus amphitrite were exposed to environmentally relevant (250 and 1000 particles/ml) and future high (2000 particles/ml) concentrationss of 3µm PS microspheres in 3 different forms (unwashed, washed and aged). Series concentrations of Co were prepared, 24h LD50 was determined and 0.01, 0.1 and 1ppm Co concentrations were selected for use in individual and combined toxicity assays. It was found that microspheres of all types did not significantly affect the survival of nauplii (Mortality≤20%) at low concentrations. With increase in no. of particles in the medium (upto 2000 particles/ml), treatments consisting of unwashed and aged particles resulted in percentage mortality as high as 39% and 56% respectively however washed particles were still nontoxic. r. With regards to Co, mortality appeared to be a linear function of concentration.. When nauplii were exposed to a mixture of PS and Co, there was a shift in percentage mortality either towards low or high. Percentage mortality after combined exposure to Co at 0.01 ppm and unwashed/washed particles at 250 particles/ml was 13% and 37% greater than the mortality at same concentration of Co alone however with increase in no. of particles in the medium, a decrease in toxicity of cobalt was observed. Antagonistic effect of microplastics was more pronounced in the presence of aged particles and when present at 2000 particles/ml, toxicity of 1 ppm Co dropped down to half It is concluded that aging of microplastics, which is a real environment scenario, reduces the toxicity of cobalt even if present in higher concentrations in the environment.

KEYWORDS: Polystyrene, Aged, Cobalt, Co-toxicity, Barnacle

PAPER ID: CEST2021_00526

SESSION 32 - SPATIAL ENVIRONMENTAL PLANNING

Friday 3 September - afternoon

Creating the base for MSP; depicting the environmental status of Inner Ionian-Korinthiakos Gulf

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ABSTRACT

Marine Spatial Planning (MSP) reflects the need to plan and regulate all human uses taking place in the marine environment, under the scope of protecting marine ecosystems. MSP requires the identification of the specific ecological characteristics of the marine area to be managed, as well as the human uses taking place and the main pressures and impacts induced. The present work focused on Inner Ionian-Korinthiakos Gulf, situated in Western Greece, defining the status of the coastal and marine environment of the area in the framework of MSP. Existing information was collected, gathered in a geodatabase and mapped; biological and ecological distributions, areas of importance for particular species, communities or habitats; oceanographic and other physical environmental features (bathymetry, currents, sediments, seismicity), spatial and temporal information regarding human activities and pressures caused. The data collected was related to MSFD characteristics and pressures, based on Directive 2017/845, Annex III. The outputs included maps depicting the interrelation of the physicogeographical features with important biological and ecological characteristics as well as the current pressures in the Inner Ionian-Korinthiakos Gulf marine area.

KEYWORDS: Marine Policy, MSFD, Ecosystem Approach.

PAPER ID: CEST2021_00218

Rapidly growing cities and critical environmental issues: An evaluation model to support policy-making

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ABSTRACT

The use of multi-criteria analysis methods as a decision support tool plays a crucial role in defining spatial policies oriented towards environmental quality enhancement, social and cultural development, and economic feasibility. In order to support sustainable city governance processes, purpose of this research is to define an innovative model for the selection of urban regeneration projects. Innovative elements concern both the sequence of calculation algorithms, based on a rational and repeatable hierarchical scheme, and the selection of criteria and corresponding evaluation indicators, to be referred specifically to the analysis of investments for rapidly growing cities with strong environmental issues.

KEYWORDS: Urban Regeneration; Environmental Decision Making; Multicriteria Analysis.

PAPER ID: CEST2021_00538

Towards a Holistic Approach for Small Island Tourism Analysis: The case of Camiguin, Philippines.

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ABSTRACT

Tropical small islands are perceived paradise destinations for most tourists, however, small islands are critical biosystems with finite, fragile and vulnerable yet unique set of resources. These features are not highlighted as a defining character that captures small islands spatial challenges and context. Using the DPSIR (Driver-Pressure-State-Impact-Response) framework as an approach to analyze the small island tourism context, a more robust and integrated problem diagnosis was derived from the small island province of Camiguin. The problematic context of tourism activities is centered to the aspect of island sustainability geared towards the understanding of its different sectoral concerns including the socio-cultural, economic, environmental, infrastructural and institutional. Through the DPSIR framework direct and indirect concerns were linked on the problematic context or existing state of tourism activities with insightful relationships to recurring island problems on waste management, marginalization of local communities, food insecurity, unsustainable economic activities, threats in the biodiversity, etc. These problematic conditions were provided with targeted solutions involving a wide-spectrum of activities involving community empowerment and local conservation actions and larger municipal- and provincial-wide policy recommendation encompassing direct and indirect sustainable recommendations all obtained from the careful island tourism analysis guided through the DPSIR framework.

KEYWORDS: DPSIR Framework, Island tourism, sustainability, island analysis

PAPER ID: CEST2021_00170

The environmental benefits of small-scale timber frame dwellings for utilization of forested and rural remote areas in Greece

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ABSTRACT

Wood is the only renewable material produced by photosynthesis. Wood has the ability to preserve the stored carbon in its molecular structure as long as remain within a structure. Small-scalelightweight timber dwellings are gaining recognition in Europe after the dominance of concrete and steel since the second World War . Nevertheless, public is still sceptical on their environmental impacts, structural behavior and durability. In Greece, small-scale timber dwellings became popular at rural and forested areas for their touristic attraction, aesthetic superiority and compatibility to the natural landscape. Information from literature and industrial studies showed that the use of structural timber has beneficial environmental impacts as well as economical impacts. Specifically, compared to other common building materials, timber has competitive structural characteristics, due to its low weight to strength ratio, low embodied energy and allows an easy and fast construction with minimum disruption to the environment. Moreover, lightweight timber buildings may have a high potential of waste re-use and recycling, when designed for future ease of deconstruction. The successful waste management contributes to circular economy. Local economy benefits directly from the all the relevant applications of wood.

KEYWORDS: Timber frames, embodied energy, waste management, circular economy- forest utilization.

PAPER ID: CEST2021_00517

A topographical approach to survey environmental adaptation assessment on a mountain trail as a pathway to local prosperity

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ABSTRACT

Mountainous trails represent unique ways into the wild nature. No matter the difficulties or the hours of reaching the end point of a mountain trail; the joy of hiking to desirable and adventurous places makes the hikers the happiest persons. The need of a topographical approach to survey mountainous trail lead us to use TruePulse 360B – laser technology techniques and digitally mapping in order to select and analyze a trail in a forested area based on environmental adaptation assessment. Since ancient times mountain trails were pathways to local prosperity because they were used for commercial trades. In modern world mountain trails are used for hiking, recreational walks in nature, as an introduction way of new ages in the wild forests by persons in wheelchairs or disable people (deaf, blind, down-syndrome, etc). The aim of this paper is not only to provide a digital map for visiting and exploring the natural beauty near by the Wild Life Museum of various tourist teams especially disable ones; in order to manage the wild trails for the benefit and prosperity of the local community; but also to examine the environmental adaptation of this trail by taking into consideration the protection of the nature.

KEYWORDS: mountain trail, disable pathway, local prosperity, environmental adaptation assessment, topographical approach

PAPER ID: CEST2021_00528

Adaptation to Climate Change and Spatial Planning: The Case-Study of the Region of South Aegean

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ABSTRACT

Since the early 1990s, when climate change issues rose, the EU and its Member-States have introduced ambitious objectives and policies related to climate change adaptation, which directly affected its Member- States' climate policy framework. However, many policies concerning climate change adaptation have either direct spatial reference or significant spatial effects. Therefore, the analysis between the Regional Adaptation Action Plans and other types of regional-scaled plans, such as the Regional Spatial Planning Frameworks, is regarded to be valuable. This paper examines the compatibility and complementarity of objectives, measures and tools between the Regional Adaptation Action Plan and the Regional Spatial Planning Framework of South Aegean. The analysis performed revealed linkages between the RAAP and the RSPF of the South Aegean in terms of objectives, measures and tools.

KEYWORDS: Climate change, Adaptation, Spatial Planning, Regional scale

PAPER ID: CEST2021_00774

Do pro-environmental attitudes affect the adoption of flying cars?

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ABSTRACT

The decarbonization of the transportation sector requires the adoption of low-carbon power sources and technological progress in vehicles' energy efficiency. Flying cars constitute innovative transport modes that have exploited technological advancements such as electrification to provide a more sustainable urban and inter-urban landscape. Existing literature has focused on the technical characteristics, while few studies have investigated flying cars in terms of their environmental footprint. In tandem, research on the adoption of flying car and its relationship with their environmental aspects is still scarce. This paper aims at enhancing the current literature by investigating whether end-users environmental attitudes might affect their perception towards flying cars. To achieve this, a questionnaire survey was conducted gathering attitudes and perceptions regarding flying cars from 202 people. The collected data are used to estimate a regression model explaining the effect of their pro-environmental attitudes on their perception towards flying cars. Results indicate that flying cars' perceived environmental footprint and low income affect negatively the perception towars them, while females seem to be more positive with this concept.

KEYWORDS: flying cars, air taxis, environmental attitudes, environmental footprint

PAPER ID: CEST2021_00587

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Considering LSI in MSP in Greece: updates and challenges

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ABSTRACT

The LSI analysis should be understood as an important component in the preparation of MSPlans to be reached through consistency of policies and decision-making. In Greece, although LSI as a term is fully incorporated in MSP legislation, its consideration may be easily and completely disregarded, given the contradicting provisions introduced by L.4759. This paper suggests that consideration of LSI in MSP in Greece (which is a highly insular and coastal country), can be achieved if: interaction between MSPlans and TSPlans is (re)established by Law; LSI analysis is incorporated as binding step in the MSP; the so far sectorial orientation of MSP is suppressed in favor of a more place-based approach; governance schemes give priority to local administration and communities; international cooperation is encouraged; the Multi-Use concept is integrated in Greek MSP.

KEYWORDS: MSP, LSI, Law 4546, Law 4759, Greece

PAPER ID: CEST2021_00676

Environmental Sustainability Indicators applied to Tourism Sector in Sicily

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ABSTRACT

Tourism is an important source of revenue for the economy of a country because it brings money to the State which use it as a source to improve services, buildings, facilities and tourism destinations. Its importance extends to a variety of studies and researches aimed to a better and more sustainable development. The aim of this study is to analyze environmental impact caused by tourism, thanks to the use of indicators, which varies regarding the tourism destination they are linked with.

In particular, some environmental indicators on the city of Catania, in east of Sicily, are analyzed and their interaction could give a wide panorama of Sustainability in Catania and to identify all the advantages on sustainable tourism tools in Sicily.

KEYWORDS: Sustainability; environmental impacts; environmental indicators; development instruments.

PAPER ID: CEST2021_00328

SESSION 33 – INNOVATIVE ENVIRONMENTAL SOLUTIONS

Friday 3 September – afternoon

Quantifying and mapping urban trees' decay severity using thermal and spatial indices: implications for tree hazard assessment and management

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ABSTRACT

Wood decay, a crucial factor in tree stability, is an internal long-term interaction between fungi and tree that leads to the disruption of energy flow, temperature abnormalities on the tree's surface, and possible tree mortality, especially when the decay extent is close to the threshold of 33%. In this study, arboreal vegetation species' stability in two urban parks in the city of Mytilene, Greece, was evaluated, in accordance with the tree failure criterion, by measuring the trees' morphological traits along with their decay severity. Thermal indices were developed by analyzing tree trunks' temperature data, and strength loss equations associated with wood decay were applied for each tree. Temperature spatial dependence across each tree's trunk was estimated using Moran's I index, while statistically significant spatial clusters were assessed using local spatial autocorrelation statistics. Relationships between tree stability, thermal, and spatial indices, were established using linear and logistic regression models. Finally, the Getis-Ord Gi* statistic was used for the recognition of hazardous tree hotspots in the urban parks, and the kriging geostatistical procedure was applied for mapping their spatial extension. The results have shown that thermal and spatial indices can sufficiently explain decay severity, identify hazardous trees, and contribute to tree health assessment for specialized park management.

KEYWORDS: Urban tree stress, infrared thermography, geospatial analysis

PAPER ID: CEST2021_00325

A Preliminary Investigation On The Acceptance Of The Use Of Urine Based Fertilizers: A Comperative Survey With Farmers And Environmental Engineers

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ABSTRACT

Source separated human urine, a highly concentrated solution of nutrients, may be recycled directly or indirectly for further use as fertilizer. While environmental engineers (EnvE) recommend and set the fundamentals of this practice for valorizing a wastewater stream, farmers are the immediate group to apply urine-based fertilizers (UBF) for producing crops. A preliminary survey was conducted to assess/compare the acceptance of UBF by those two groups in Turkey focusing on awareness regarding urine as fertilizer, willingness to use natural/synthetic/urine-based fertilizers, acceptance towards three different groups of products (edible crops/industrial crops/green areas) grown using UBF, and concerns about this application. Overall, the results showed that acceptance towards UBF was considerable and in general comparable for both groups. The most obvious difference in acceptance was with synthetic fertilizers which received 92% acceptance from farmers as opposed to 26% from EnvE. It was clearly stated by the farmers that they actually do not prefer to use it however they have to as there is no current alternative for increasing the crop yield. Both groups had similar and high acceptance for indirect use of UBF for all product groups up to 88%, typically 60%. However, farmers had a greater acceptance for direct use in all categories of the group of products questioned, i.e., edible crops, industrial crops and green areas. While psychological reasons were indicated as the main drawback, over 90% accepted urine diversion.

KEYWORDS: source separated human urine, fertilizer, nutrient recovery/recycling, acceptance of farmers and environmental engineers as occupational groups, Ecological Sanitation (ECOSAN)

PAPER ID: CEST2021_00462

Planar Mixing Tool for Enhanced Performance of Covered Anaerobic Pond Systems

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ABSTRACT

Pond systems are the simplest and most widespread technology for the treatment of high-strength wastewater containing biodegradable suspended solids. When covered, they offer significant advantages such as odour control, intensification of the decomposition process, and the potential to capture methane as a bioenergy fuel. However, process performance is challenged by occurrence of unmixed (dead) zones, as well as the formation of floating and sinking layers lowering residence times, degradation rates, and biogas yields. Here we aimed at the integration of a novel mixing concept for covered anaerobic pond systems to overcome these problems. A lab-scale pond (V = 330 L) was manufactured from transparent PVC. The effect of the substrate's apparent viscosity (1, 100 and 1,000 mPa s; at 1 s^{-1}), hoist speed (6 and 12 cm/s) and three alternative mixing tool designs on the mixing process was evaluated in dye and conductivity tracer experiments. Results show that mixing time strongly increases with increasing substrate viscosity and could be reduced (factor 4) by doubling the hoist speed of the mixing system. The design of the mixing tool largely affects the flow conditions and needs to be adjusted to the viscosity of the substrate.

KEYWORDS: Biogas, mixing, wastewater, anaerobic digestion

PAPER ID: CEST2021_00502

The effect of incorporating biosolids on soil quality after cotton crop management

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ABSTRACT

A pilot sewage sludge (also known as "biosolids", BS) application of 7,000 kg/ha (dry weight) was performed in the area of Lamia prefecture, central Greece, in two fields cultivated with Cotton. BS was very rich in organic matter (75%) and had high concentrations of nutrients, with all heavy metals below the limits set for use in agricultural soils. Soil samplings before BS applications and after cotton cultivation for 1 and 2 years for the first and second pilot respectively, revealed the positive effect of BS use to soil quality. Soil organic matter increased from 0.9 and 0.8% to 3.8 and 3.3% respectively. Soil P content increased only to the pilot sampled one year after BS applications. BS increased significant the concentration of Mg, Mn and Fe at both pilots farms. Heavy metals in the soil was kept in acceptable levels at both pilots after BS use except Cr that exceeds the upper limits set by Common Ministerial Decision at both pilots. In conclusion, the results of the study underline the positive effect of BS in soil quality if we could control toxic heavy metals concentrations in the soils by analyzing and organizing proper application rates for each soil case separately.

KEYWORDS: Sewage Sludge, soil organic matter, heavy metals, soil quality

PAPER ID: CEST2021_00516

Synthesis and characterization of nanomagnetite for environmental applications

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ABSTRACT

Magnetite (Fe_3O_4) in nanoscale has been very attractive due to its unique properties which make it ideal for a wide range of applications. Nanomagnetite can be applied as drug delivery medium, as catalyst and as efficient adsorbent and reducing agent for water treatment. In this study, magnetite nanoparticles were synthesized by co-precipitation of ferrous and ferric iron salts with the addition of a base under microwave-assisted heating. This is a simple, low cost and quick method which results to uniform shape and size of nanomagnetite particles. The effect of heating time and the microwave power were evaluated for the properties of nanoparticles. The mineralogical composition of prepared nanoparticles was determined by X-Ray Diffraction (XRD). The performance of nanomagnetite for Cr(VI) removal from contaminated water streams was evaluated by conducting batch tests. Nanomagnetite exhibited good removal performance for chromates and could easily be separated and recovered under magnetic field.

KEYWORDS: magnetite; magnetic nanoparticles; microwave synthesis; chromium removal; adsorption.

PAPER ID: CEST2021_00146

Energy Communities: A Significant Factor to alleviate Energy Poverty

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ABSTRACT

At the end of the 20th century, one of the phenomena that affect humanity on a social, economic, political, and environmental level is the energy poverty, a concept that is still misunderstood. It is a distinct form of poverty associated with a range of adverse effects for people's health and wellbeing. Energy poverty is often described as the inability to keep homes adequately warm.

In the late of 20th and especially in the early of 21st century, the protection of the environment and the developing capacity of economy, through sustainable development, set the vision for the innovation of distribution networks and production of energy, through renewable energy sources.

To optimize energy production and to reduce production costs, the socio-technological system envisages optimal results through decentralized systems, and smart grid cities. It offers to consumers the power to be producers of the energy that they consume. The new concept of prosumer (the ability to be both consumer and producer) involves the production of the energy from renewable sources and its consumption in a social context. This new institution is called "energy community" and constitutes the key to transition to a decarbonized economy and society and it is considered as a significant step in tackling climate change.

The aim of this research is to evaluate the intervention of energy communities in the efficiency of the energy consumption sector and their social impact, based on the subjective indicators of energy poverty.

KEYWORDS: Sustainability, Energy Production, Energy Communities, Energy poverty, Prosumer

PAPER ID: CEST2021_00446

The Quality Properties of Tire Tread With Adding Filler of a Sunflower Oil and Pinecone Powder

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ABSTRACT

This study, aimed to be developed economical and environmentally friendly tires by modifying commercial tire tread using pinecone powder and sunflower oil. Different additives were used in the blend formulations: stearic acid as an accelerator and softener supplement, zinc oxide to increase the elasticity of the tread and provide abrasion and tear resistance, 40 MS was used to provide fluidity under high temperature and pressure. In the tread mixture, TMQ was preferred to resist aging, Ozone Wax to extend the life of the tire, and IPPD to provide flexibility under high temperature and pressure. Powder sulfur was used as a curing agent. 3 types of accelerators, DPG, CBS, and TMTD, were selected as chemical accelerators for curing time. Tire tread mixtures were prepared as a control formula and 7 different test mixture recipes. Rheological tests before vulcanization and physico-mechanical tests after vulcanization (tensile strength, elongation at break, tear strength, modulus 300%, hardness, abrasion, and density) were applied to all prepared mixtures. All tests were carried out in accordance with the relevant ASTM D standard test procedure. According to the test results, rheological and physic-mechanical properties showed significant changes depending on natural fillers.

KEYWORDS: Pinecone powder, vegetable oil, physico-mechanical properties, rheological properties, tire tread

PAPER ID: CEST2021_00344

Application of non-thermal Plasma as an Alternative for Purification of Bacterial Cellulose Membranes

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ABSTRACT

Innovation to mitigate environmental impact and alignment with the Sustainable Development Goals, encourages the cosmetic industry to explore new methodologies and materials. Biopolymers become attractive, such as bacterial cellulose that has biocompatibility, high crystallinity and wettability. During the production of cellulose, there is the purification process, which is essential for safety in the applicability, as it removes metabolites and bacterial cell debris. Currently, the most adopted methodology is the immersion of the membranes in NaOH solution, however, there is no concise methodology, causing, besides the generation of chemical residues, discrepancies between authors. In this sense, the proposed work aims to use cold plasma technology (NTP) to verify the action in the BC purification process. With the association of gases, after 15 minutes of treatment with NTP in membranes, no new membranes appeared when they were placed back in the culture medium. Attesting the potential of NTP in the BC purification process, optimizing time and avoiding the generation of aggressive chemical residues.

KEYWORDS: bacterial cellulose; cold plasma; non-thermal plasma; sodium hydroxide; purification

PAPER ID: CEST2021_00167

Use of bacterial cellulose produced by Kombucha drink for the manufacture of biotextiles for the benefit of sustainability

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ABSTRACT

Textile industry is one of the most complex sectors in relation to environmental degradation, both with regard to the materials used and the manufacturing and disposal processes. One way to mitigate negative environmental impacts is the use of microorganisms such as bacterial cellulose (BC) in the formation of biomaterials considered biodegradable. One of the ways to obtain bacterial cellulose is through the production of the probiotic drink Kombucha. Thus, BC production was carried out through the fermentation of teas belonging to the *Camellia sinensis* family and a sweetener, with the addition of a culture based on the symbiosis of bacteria and yeasts. Then, two methods of purification were used, the traditional method using NaOH solution (BC_NaOH) and the sterilization method using a non-thermal plasma reactor (BC_NTP). A control sample was also maintained, BC_Untreated was left in the medium without any treatment. Thus, the characterization of the surface was carried out to investigate the purification of the membranes and the possibility of using NTP in the Textile Industry. Finally, a discussion is also presented relating biotechnology production to the UN Sustainable Development Goals, in order to understand what goals can be achieved with this approach.

KEYWORDS: bacterial cellulose; kombucha; biotextile; eco-fashon; Sustainable Development Goals.

PAPER ID: CEST2021_00169

Bioeconomy value indicators in Sicily

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ABSTRACT

The emergence of the bioeconomy and the concept of sustainability in production processes have been essential for the protection of the environment and biodiversity, as well as for the implementation of processes for energy recovery, the creation of new jobs and increased competitiveness. Bioeconomy includes all sectors of the economy that use biological renewable resources of land and sea (such as crops, forests, fish, animals and micro- organisms, as well as biological residues and waste) to produce goods and services in an economically, socially and environmentally sustainable strategy. The objective of this paper is to quantify the performance of bioeconomy and sustainability of the agri-food chain in Sicily through the analysis of the main business, innovation and bioeconomy start-ups connected to Circular Economy, the overall waste treatment plants that permit material recovery; and the number of biological surfaces.

KEYWORDS: biomass energy; environmental impacts; bioeconomy indicators; development instruments.

PAPER ID: CEST2021_00753

SESSION 34 - ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY

Friday 3 September - afternoon

Condensate originating from household food waste as a substrate for Microbial Fuel Cells

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ABSTRACT

A microbial fuel cell (MFC) is a bioreactor that converts the chemical energy of the bonds of organic compounds to electrical energy, through the catalytic reactions of microorganisms. Under anaerobic conditions various substrates have been examined using MFC technology. This study examines the potential use of the liquid fraction of fermentable household waste (source-sorted food waste), which results from condensation of the vapors generated during drying, as a feed to the MFC. The main characteristics of this substrate are: 13 g COD/L, pH=3.5, conductivity=262 μS/cm. Condensate was fed to two single-chamber air cathode MFCs, using mullite and GoreTex as cathodic electrodes, respectively. The oxygen reduction catalyst was MnO_2 in both cases, while graphite granules were used as anodic electrodes. The units were operated in batch mode. Linear sweep voltammetry was carried out in order to conduct electrochemical characterization. The maximum power output was 0.52 $\mu W/m^3$ for the mullite cell and 0.28 $\mu W/m^3$ for the GoreTex cell, respectively. High COD removal efficiencies (>75%) were achieved for both cells.

KEYWORDS: Microbial Fuel Cell, Condensate, Household food waste, Wastewater treatment, Energy production

PAPER ID: CEST2021_00240

High FAME yield Biodiesel from microalgae through nanocatalytic transesterification process.

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ABSTRACT

Biodiesel production from microalgae is significantly important when reserves of petro-diesel are depleting, and utilization of vegetable oil-based fuel leads to food scarcity. The rapid growth and high lipid content of microalgae is an ideal feedstock for biodiesel production. The use of nanocatalyst is favorable due to its high activity, high stability, large ansd efficient surface to volume ratio, high resistance to saponification and reusable characteristics up to 5 times. The nanocatalyst has been prepared by wet impregnation method and compared with the base catalyst characterized by X-ray diffraction method, scanning electron microscopy, BET surface area analysis, and FT-IR. The study states the formation of nanocatalysed particle with the particle size of 50nm. The SEM study supports the formation of nanoparticle in the shape of flower. The catalyst found to possess the maximum basic strength and show the maximum activity towards the transesterification of microalgae. The main motive of this work is to produce biodiesel with higher FAME yield. The transesterification of microalgae oil using the nanocatalyst gives the FAME yield of 96% characterized by GC-MS at optimum parameters.

KEYWORDS: SEM- Scanning Electron Microscopy, FAME-Fatty acid methyl ester, BET-Brunauer-Emmett-Teller, FTIR- Fourier-Transform Infrared Spectroscopy, GC-MS- Gas chromatography mass spectroscopy.

PAPER ID: CEST2021_00448

Assessment of Carrot Juicing Pulp Hydrolysate fed MEC for Bio-Hydrogen production

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ABSTRACT

The thrust for alternative renewable energy carrier with the integration of solid waste management and biofuel production is considering Biohydrogen as one of the most attractive alternatives. The present study aims to assess the suitability of carrot juicing pulp hydrolysate (CJPH) fed membrane less single chambered Microbial Electrolysis Cell (MEC) for the bio-hydrogen production in batch mode under applied voltage of 0.8 V at 30 ± 2 °C. The anode enrichment for bioanode with mixed culture of microorganism was achieved on heat treated graphite rods. The maximum bio-hydrogen production was reported as 0.1 m^3 of $H_2/m^3/d$ at $E_{applied}$ = 0.8 V at HRT of 21 days. The maximum COD removal of 76.6 % was reported. These results demonstrated an energy-efficient approach for biohydrogen production from CJPH coupled with waste mitigation.

KEYWORDS: BioHydrogen, Microbial Electrolysis Cell, Juice Pulp Hydroselate, COD, Bioanode

PAPER ID: CEST2021_00509

Biodiesel Properties from *Chlorella sorokiniana* Bio-Oil Cultivated Heterotrophically with Industrial By-Products

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ABSTRACT

The fatty acid (FA) distribution of bio-oil derived from *Chlorella sorokiniana* and the biodiesel basic properties were examined. *C. sorokiniana* was cultivated heterotrophically in two growth media: a) glycerol and inorganic salts (GLIN) and b) glycerol and anaerobic digestrate (GLAD). The cultivation took place in 42 L bioreactors. The bio-oil was extracted from the biomass collected. Extraction was performed using a mixture of n-hexane and isopropanol in a 3:2 ratio. The fatty acid (FA) distribution was determined in a gas chromatograph by converting the bio-oil in biodiesel. The fatty acid distribution covered chain lengths from C10 to C26. The great proportion of the FA were of medium chain FA C16-C18 constituting about 85% and 53% of the total fatty acids of the GLIN and GLAD treatments respectively. Also, the distribution of saturated, monounsaturated and polyunsaturated FA differed. The basic properties of the biodiesel such as the density, the kinematic viscosity, the acid value, the cetane number, the iodine value and the heating value were within the range of the respective values from biodiesel obtained from seed oils and differences in the properties of the two treatments were explained in terms of differences in FA distribution.

KEYWORDS: biodiesel properties, *Chlorella sorokiniana*, heterotrophic, FA distribution

PAPER ID: CEST2021_00637

The effect of HRT in the successful bioaugmentation of CSTRs working under ammonia toxicity

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ABSTRACT

High levels of ammonia is a common inhibitory factor in anaerobic digestion (AD) resulting in low methane production and unbalance of the process. In the present study, the adjustment of the hydraulic retention time (HRT) and the bioaugmentation process (BP) are investigated to counter the negative effects of ammonia toxicity. Two lab scale continuously stirred tank reactors (CSTR) were operating with cattle manure at a low total ammonia nitrogen (TAN) concentration (1.8 g TAN/L). The reactors were working with 20 (R1) and 30 (R2) days HRT, respectively and ammonia toxicity conditions (6.1 g TAN/L) were achieved through the direct addition of ammonium chloride. In both reactors after the increase of TAN the average daily methane production was reduced by 37.04% in R1 and 38.52% in R2. The stepwise acclimatization of the microorganisms to high concentrations of TAN (6.5 g TAN/L) for the BP was performed in batch reactors. After the BP there was a recovery of the methane production in both reactors. In R2 the recovery was immediate, however, a delay of 20 days was observed in the recovery of R1. A likely explanation for the R1's delayed response is the slow reproduction rate of the introduced acclimatized population and the low HRT.

KEYWORDS: Anaerobic digestion, Inhibition, Ammonia, Meth378ane, Bioaugmentation

PAPER ID: CEST2021_00669

Untargeted screening analysis for mycosporines and mycosporine-like amino-acids in algae by mass spectrometry

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ABSTRACT

Mycosporines and mycosporine-like amino acids have been described as natural sunscreens and antioxidant compounds presenting a great potential for health and cosmetic applications. Herein, an untargeted screening approach for mycosporines and mycosporine-like amino acids (MAAs) was developed by the coupling of zwitterionic hydrophilic interaction liquid chromatography (HILIC) with multistage electrospray mass spectrometry MS^2/MS^3 using an Orbitrap analyzer and fragment ion search (FISh). This method was applied to study the mycosporine and MAA contents of five algae extracted using a 50% methanol solution and sonication. Candidate-MAAs were detected by mining eight characteristic fragment ions in their HILIC data-dependent MS^2 mass spectrum. Their exact masses were measured with 3 ppm mass accuracy and their structures were elucidated on the basis of the MS^3/MS^4 mass spectra. The method developed was validated with a targeted analysis using an extract of *Gymnogongrus devoniensis* which confirmed the detection of 14 MAAs reported in the literature. In addition, 23 previously unreported MAAs were detected and the structures could be assigned for seven of them. The developed method was applied to the analysis of four algae allowing the detection of MAAs, including some reported here for the first time.

KEYWORDS: Algae, Mycosporine-like amino-acids, High-resolution Mass Spectrometry, Fragment Ion Search, Untargeted Screening

PAPER ID: CEST2021_00166

The effect of catalysts MnO_2, activated carbon and fly ash on the performance of single-chamber Microbial Fuel Cells

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ABSTRACT

Microbial fuel cells (MFC) are bioelectrochemical systems that convert the chemical energy contained in waste to electricity, using bacteria as catalysts. In order to boost the power output of MFCs, various approaches are feasible. This study examines the effect of using MnO_2, activated carbon and fly ash as catalysts on the performance of three identical single-chamber MFCs. Ceramic (mullite) tubes run through the chamber providing structural support to the catalyst. Graphite granules were used as the anode electrode for all units. The cells operated in batch mode using glucose (1.5 g COD/L) as substrate. High COD removal efficiencies (>75%) were achieved for all units. The best performance in terms of power output was achieved when using MnO_2 catalyst (P_{max}=2.32 W/m^3).

KEYWORDS: Microbial Fuel Cell, Wastewater treatment, Electricity, Ceramic, Catalyst

PAPER ID: CEST2021_00293

Red Mud as a Secondary Source of Scarce Metals - Recovery using Red Microalgae

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ABSTRACT

Red mud is a by-product of the production of alumina from bauxite ore. Less than 2% of the red mud produced is currently being reused. The red mud contains a number of residual elements, some at a considerable concentration. The red microalga *Galdieria sulphuraria* was used to test the accumulation of scarce metals from red mud. Algal cells were cultured autotrophically and mixotrophically in a liquid medium with an alternative addition of glycerol as a source of carbon. Red mud was added into the growth medium as the acidic extract (in 10% HNO_3). The growth of the cultures was monitored. The content of single scarce metals in the red mud extract and the biomass, was determined using ICP-MS. The most abundant element in red mud was Fe followed by Na and Al (53%, 17% and 12% respectively). The most abundant lanthanides were Ce, Y and La. The growth of cultures grown in the presence of red mud was comparable with the control. The red alga *Galdieria sulphuraria* can grow in the presence of red mud and accumulate scarce metals from it. The accumulation is more effective under the mixotrophic regime, shoing Y as the most accumulated lanthanide.

KEYWORDS: red mud, scarce metals, rare earth elements, red algae, *Galdieria sulphuraria*

PAPER ID: CEST2021_00027

Hydrogen production in a microbial electrolysis cell: the influence of operational parameters

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ABSTRACT

In the present study two identical two-chamber microbial electrolysis cells (MECs), fed with an acetate synthetic medium, were used for hydrogen production, using different anodic materials, i.e. commercial carbon fiber paper (CP) and graphite granules (GG). The effects of the applied voltage (i.e. 0.7 and 0.9 V) and of the acclimation procedure (direct potentiostatic operation as MEC or galvanostatic as microbial fuel cell, MFC) were assessed and the performance of both MECs was compared in terms of their biochemical and electrochemical characteristics.

KEYWORDS: Microbial Electrolysis Cell (MEC), hydrogen, applied voltage, anode.

PAPER ID: CEST2021_00256

Evaluation of the potential of four microalgal-bacterial symbiotic association on wastewater treatment and lipid accumulation

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ABSTRACT

Microalgae-bacteria symbiotic systems have demonstrated greater benefits over the pure culture of microalgae. The existence of certain bacteria will increase the quality of sewage purification and also reduce the associated high capital cost for maintaining the pure culture of microalgae. In this study, the potential of four microalgal-bacterial symbiotic associations to accumulate lipid besides growth rate, biomass concentration, and to eliminate nutrients from secondary treated municipal wastewater was evaluated. The two microalgae strains, namely, *Tetraselmis indica*, *Chlorella protothecoide* in combination with *Pseudomonus* sp. and *Bacillus pumilus* were observed. *Chlorella protothecoide-Pseudomonas sp*. system achieved the highest lipid productivity of 37.93 ± 2.53 mg $L^{-1}d^{-1}$ with lipid content 25.67 ± 0.95 % after ten days of cultivation. The chlorophyll-a content of *Chlorella protothecoide* + *Pseudomonas sp.* has 32% higher than the pure *Chlorella protothecoide* culture in wastewater. On the 10th day, *Chlorella protothecoide-Pseudomonas sp*. system removed 83.59 %, 86.76%, and 81.35% of chemical oxygen demand (COD), total dissolved nitrogen (TDN), and total dissolved phosphorus (TDP), respectively. *Chlorella protothecoide* + *Pseudomonas sp*. could coexist as a consortium has the potential to be utilized in biofuel technology.

KEYWORDS: Microalgae–bacteria consortia, Secondary treated wastewater, Chlorophyll-a

PAPER ID: CEST2021_00513

Evaluation of viable anode material for bioelectricity production in Microbial Fuel Cell

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ABSTRACT

Microbial Fuel Cell (MFC) technology is based on bioelectrochemical system, extract power from organic load of the wastes to produce bio-electricity. The present study have evaluated the effect of the different electrode materials in two sets of mediator-less H- type double chambered MFC operated at 30 ± 2 °C in a batch mode. In MFC_{GG}, graphite rods (G) and in MFC_{CBG} carbon brush (CB) and graphite rod (G) were used as anode and cathode electrode respectively. The both MFC were fed with distillery spent wash as a substrate with HRT of 21 days. The maximum COD removal of 61.07 % and 67.17 %; open circuit voltage (OCV) of 565 and 735 mV were achieved in MFC_{GG} and MFC_{CBG} respectively. The peak power densities of 3.19 W/m^2 and 5.4 W/m^2 were recorded in MFC_{GG} and MFC_{CBG}. These results suggest the efficacy of carbon brush anode in MFC_{CBG} compared to graphite rod as an anode material in MFC for bioelectricity production.

KEYWORDS: BioElectricity, Microbial Fuel Cell, Distillery Spent Wash, Open Circuit Voltage (OCV), Anode material

PAPER ID: CEST2021_00512

SESSION 35 - LIFE CYCLE ANALYSIS – LCA

Friday 3 September - afternoon

17th International Conference on Environmental Science and Technology

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Life-Cycle-Oriented Framework for Seaport Infrastructure Maintenance and Climate Change Adaptation

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ABSTRACT

Life-cycle considerations are a prerequisite for rational seaport engineering design and planning since they actually retain seaports' resilience and operational effectiveness. However, the current climate crisis poses threats to the resilience of existing seaport infrastructure, leading to functional degradation and structural failures. Life-cycle-oriented approaches have been proposed to tackle these issues since they constitute an important element for seaport rehabilitation schemes. This paper uses the case study of Evdilos Port in Ikaria Island, Greece to investigate alternative configuration scenarios for the seaport windward breakwater, damaged during a severe storm event in 2018. Multi-criteria decision aid (MCDA) analysis was performed for the examined configurations to select the optimal solution regarding the rehabilitation of the damaged section. The present research seeks to enhance seaport sustainability, particularly while implementing maintenance and rehabilitation practices via the incorporation of life-cycle-oriented design approaches.

KEYWORDS: Life Cycle, Seaport Infrastructure, Seaport Rehabilitation, Seaport Resilience, Seaport Sustainability

PAPER ID: CEST2021_00124

Sustainable water management in industry using Industrial Water Footprint

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ABSTRACT

Large quantities of water are consumed directly or indirectly by production and distribution plants. Industries are rapidly required to comply with the principles of sustainable development through United Nations Sustainable Development Goals (UN SDGs), focusing on sustainable water management, such as SDG 6 (clean water and sanitation), 12 (responsible consumption and production), 13 (climate action) and 14 (life below water) Industrial Water Footprint (IWF) is an important tool for estimating and analyzing water consumption, thus enabling the industry to move to a more sustainable direction. Operational WF focuses on the WF resulting from industrial processes i.e. manufacturing & packaging while supply chain WF represents the WF of the raw materials and products used in the production.

The aim of this paper is to present and compare the operational and supply chain WF of different industrial branches, showcasing its applicability as an environmental pressure indicator. Selected industrial branches, worldwide and also in Greece, where significant water quantities are needed for production will be analyzed, given that water consumption is not only an economic parameter but also a tool to determine process performance within the branch.

Through WF assessment, increased water consumption spots and water recycling potential can be identified, resulting to process or management alternatives, with significant economic and environmental impacts on the production and/or consumer behavior.

KEYWORDS: Water management, Water footprint, Industrial processes, Supply Chain, Environmental pressure indicator

PAPER ID: CEST2021_00139

Applying Product Social Impact Assessment (PSIA) to services: the case study of a higher education and research institution

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ABSTRACT

Applying the Product Social Impact Assessment (PSIA) methodology to evaluate the social performance of a service such as that provided by a higher education and research institution is not straightforward. This is mainly due to the lack of materiality of the system, which makes it unfeasible to define a typica life cycle with its conventional stages. This investigation proposes to consider three elements in the social assessment: i) the university, primarily focusing on the wellbeing of its workers and users (students); ii) the material products and infrastructures consumed by the university, focusing on local and global companies; iii) the intrinsic value of the function, focusing on society as a stakeholder. The UF proposed is the completion of 1 academic year, which leads to the accomplishment of a university degree. This preliminary study highlights the difficulty in finding specific and generic indicators proposed in PSIA for the analysis of the social behavior of this system.

KEYWORDS: PSIA, Social LCA, university.

PAPER ID: CEST2021_00796

Quantifying the social benefits of the fair-trade designation of coffee using Social Hotspot Database

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ABSTRACT

Quantifying sustainability is a difficult but necessary task to improve our environmental, economic, and social surroundings. This paper describes an investigation into the use of the Social Hotspot Database (SHDB) to determine the true value of fair-trade certification. The analysis has been carried out on two coffee systems produced in Colombia and consumed in Spain: i) a low-cost generic (GC) and ii) a high-quality organic fair trade certified (FTC). Risk levels in the SHDB for the cultivation sector in Colombia were adjusted to reflect compliance with fair-trade criteria. Surprisingly, the results showed that the social risks per functional unit (FU) (1 kg) of the FTC were significantly higher than FTC. This incongruence is caused by the fact that the lower risk values associated with the fair-trade designation are largely offset by its significantly higher economic cost. This is so even though these costs are dedicated to mitigating the risks that are then penalized by the same expenditure (e.g., low salaries, poverty). A solution to this artifact may be to conceive the fair-trade coffee as a multifunctional system and apply an economic allocation approach to evaluate separately its functions as beverage and as a contributor to social wellbeing.

KEYWORDS: PSIA, Social LCA, SHDB, Colombia, coffee

PAPER ID: CEST2021_00797

Environmental performance of two WEEE sorting centers operating in Greece

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ABSTRACT

The Life ReWeee Project aims to prevent the creation of Waste Electrical and Electronic Equipment (WEEE), by collecting, shorting and preparing them for reuse or treatment. For this project, two WEEE sorting centers (SCs) were established and operating in the wider region of Attica and Central Macedonia. In SCs the collected WEEE will be transferred, stored and sorted after three control stages. The examined WEEE will be driven either for repair and reuse or recycling. Within the framework of the present LCA study, a total number of 6 types of WEEE will be examined, as decided according to the input flows data of the SCs. The LCA would pay particular attention to the potential environmental impacts of the repair and reuse of WEEE, in comparison with buying new products.

KEYWORDS: WEEE; Reuse; Refurbish.

PAPER ID: CEST2021_00839

Life cycle assessment of microalgal membrane photobioreactors

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ABSTRACT

The exploration of new biomass sources for energy purposes is increasing. Cultivation of algal biomass for biofuels production through photobioreactor represents an attractive and useful way to obtain clean energy, also thanks to the contribution that the system makes on the reduction of climate change through the recovery and reuse of CO_2. However, to prove the complete sustainability of a system the application of a holistic assessment, like Life Cycle Assessment (LCA) methodology, is necessary. To date LCA is applied through different methodologies, which make evaluations and systems difficult to compare and evaluate. Furthermore only few studies are present in the scientific literature that highlight the parameters used for the evaluation of membrane photobioreactors (mPBR). The research presents and discusses the state-of-the-art of the adopted LCA methodologies to assess mPBR, pointing out strengths and weaknesses. Knowledge gap, uncertainties and recommendations are highlighted. Furthermore, a case study LCA application on an advanced mPBR for the CO_2 capture and biomass production is presented. The study provides important information to the different scientists involved in the microalgae production sector in a holistic and proactive view in order to maximize its environmental sustainability.

KEYWORDS: sustainability, biofuels, microalgae, climate change, life cycle assessment

PAPER ID: CEST2021_00591

Using multiregional environmentally extended input-output assessment to quantify the carbon footprint of peach production

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ABSTRACT

The main objective of this investigation is to analyse the validity of multiregional input-output methodology to evaluate the environmental performance of peach production using a life cycle approach. The analysis is based on a detailed sectorial economic foreground inventory applicable to the region of Murcia (Southern Spain), following the principles of ISO 14040 and incorporating the methodological decisions of Environdec Product Category Rule for fruits and nuts. Total climate change emissions for 1 kg of peaches were calculated at 1.2 kg CO_2 eq, 39.2 % of which correspond to economic activity in the sectors directly affected by the expenses and a further 60.8 % to indirect emissions from induced effects. Most of the total carbon footprint (63 %) is generated by the core stage, primarily crop production and refrigerated storage, both activities being characterized by their high economic intensity and environmental factors.

KEYWORDS: MRIO-EE, LCA, stone fruit, agriculture sector, value chain, cost inventory.

PAPER ID: CEST2021_00794

Suitable Practices Of Design And Repairment For Reducing The Environmental Impact Of Smartphones

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ABSTRACT

Nowadays, smartphones are one of the most common devices in developed countries, as most citizens are owners of at least one. However, smartphone's averagelifetime is reported to be between 2 and 3 years by many studies, and the environmental impact of manufacturing, using and disposing of these products may grow to be a global issue in the years to come. This calls for a reformulation of our relationship with these devices, both from the user and design perspective, that allow us to extend their lives. With that purpose in mind, we first needto take a look at how this new way of thinking can greatly improve the sustainability of smartphones. This work shows how a change on new different kind of behaviors and habits can be a potential new path for diminishing the environmental impact of smartphones. It also reveals howeasily, when faced with a component malfunction,consumers tend to replace their smartphone against the alternative of repairing them and what cost this has from aGWP perspective for the case of battery and/or display malfunctions. Finally, it estimates an average lifetime for every component and an average extended lifetime for every phone repaired.

KEYWORDS: Smartphone, Life Cycle Assessment, environment, behavior, electronics

PAPER ID: CEST2021_00379

Environmental LCA and Carbon Footprint of Cauliflower as Produced in Southeast Spain

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ABSTRACT

Southern Spain has an optimal climate for growing fruits and vegetables. Over 39,534 ha are currently dedicated to the production of cauliflower and broccoli in Spain, 33% of which correspond to the Region of Murcia. This type of intensive agriculture causes environmental impacts which must be quantified and minimized as much as possible. This study details the Life Cycle Assessment (LCA) of cauliflower production with a cradle-to-farm-gate approach using precise and updated primary data from local producers. Foreground inventory data was collected for the nursery and on-field stages, including energy use, consumption, application and diffusion of fertilizers and pesticides, machinery and transport to the packaging center. Ecoinvent v3.6 datasets were adapted to the characteristics of the system for background inventory and the EF 3.0 method was used for evaluation. The carbon footprint of 1 kg of cauliflower was estimated at 91.2 g CO_2eq. Impact values for the same functional unit in other categories were as follows: Photochemical ozone formation 3.33E-04 kg NMVOC eq., Acidification 3.41E-04 mol H+ eq., Freshwater eutrophication 2.27E-05 kg P eq. The mitigation practices in cauliflower production should focus on energy use during irrigation and reduced use of pesticides.]

KEYWORDS: Sustainable agriculture, cauliflower, vegetables, carbon footprint, pesticides.

PAPER ID: CEST2021_00564

Environmental life cycle assessment of nectarine as producedin Southeast Spain

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ABSTRACT

The aim of this work is to evaluate the environmental performance of fruit production using Life Cycle Assessment considering the case study of nectarines produced in the Murcia Region (Southeast Spain). The investigation was carried out according to ISO 14040/14044 using a cradle to grave approach that included three stages: upstream (inputs production and crop establishment), core (agricultural phase, product processing and storage) and downstream (distribution, usephase and waste management). Modelling was carried outusing Simapro v.9.1, using the EF 3.0 assessment method and considering 1 kg of fresh fruit as the functional unit. Foreground inventory data was obtained from a 405 ha plotestablished and run by a local company. Climate change emissions were calculated at 0.76 kg CO_2 eq per functionalunit. The life cycle stage called downstream is the one thatgenerates the most impacts with 46.9 %, followed by 41.2

% in upstream stage and 11.9 % in core stage. The inputs production is the substage leaders in 3 of 5 impact categories; 38.1 % in climate change, 35.3 % in acidification and 32.6 % in eutrophication. The substage ofdistribution lead with 48.5 % of photochemical ozoneformation due to diesel consumed by refrigerated transport.The substage agriculture phase is the principal contributorsin water use (depriv) with 77 % due to crop fertigation. Thepossibilities for implementing mitigation strategies are broad and cover the main substages of the life cycle.

KEYWORDS: LCA, carbon footprint, climate change, stone fruit, supply chain.

PAPER ID: CEST2021_00798

SESSION 36 - AGROFORESTRY, FOREST AND AGRICULTURAL SUSTAINABILITY

Friday 3 September - afternoon

Litter decomposition across a post-fire chronosequence in Mediterranean pine forests

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ABSTRACT

Litter decomposition is a key component of the global carbon cycle, and a process of great importance for the function of forest ecosystems. The rate of litter decomposition shows significant variation both between different forest types and within forests of different successional stage. Considering that global change is expected to shift (directly) the abiotic conditions experienced by trees in a stand as well as (indirectly) the structure of stands, a sound understanding of how litter decomposition varies within forests of the same dominant species and environmental conditions but of different structure is important. To explore this question, we applied the litterbag method within the permanent forest plot monitoring network established on the island of Lesvos. We selected four *Pinus brutia* dominated plots under similar environmental conditions, across a fire chronosequence ranging from 15 to 90 years. Twenty-four litterbags were buried in each plot and sequentially removed after specific time periods. The percentage of the initial remaining mass was used as a response variable and modeled with a negative exponential and an asymptotic curve. Our findings show that the rate of litter decomposition increases with time since fire and standing biomass of the plot, highlighting the importance of maintaining mature forests in Mediterranean ecoregions.

KEYWORDS: decomposition, *Pinus brutia*, C-cycle, stand structure

PAPER ID: CEST2021_00060

Cross-border trade: certification schemes for recycling derived organic fertiliser (RDF)

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ABSTRACT

The project ReNu2Farm (Nutrient Recycling – from pilot production to farms and fields, funded by the EU Interreg North-West Europe Program) focuses on closing nutrient cycles to substitute mineral fertiliser and to contribute to a sustainable agriculture by supporting demand-oriented application of recycling derived nutrients.

The implementation of EU Fertiliser Product Regulation (EU 2019/1009) is a big step to close nutrient cycles and to strengthen the circular economy use of high-quality recycling-derived fertiliser products (RDF's) as a CE marked product on the free market of the EU. As this adapted EU regulation is still not in force and also not covering all innovative RDFs or components of it, the current situation is still hampering the European transborder market introduction of RDFs and some of its components. For more market uptake of RDFs and its components, quality assurances for the production, processes and the end-product needs to get uptaken normatively. Additionally, contamination limits (impurities and heavy metals) but also nutrient content and plant availability must be defined for more transparency for RDF users (Egan & Power 2020). Beside the European CE marking, the fertilizer producer can still choose to comply with national standards and sell the product to other EU countries on the basis of mutual recognition. Voluntary certification schemes are supportive to proof compliance for sale and marketing.

ReNu2Farm highlights the benefits of RDF and proposes criteria for RDFS and designated fertiliser components to ease trade within the European single market. At the example of the RDF STRUBIAS, the legal status is portrayed, that is supposed to enhance consumer's trust and market uptake. This should help to build up trust in recycled fertilisers and prospectively help to substitute mineral fertiliser by RDF.

KEYWORDS: EU Fertiliser Product Regulation, Nutrient Circles, Circular Economy, Certification Scheme, European single market

PAPER ID: CEST2021_00063

Effect of Castanea sativa plantation age on soil bacterial communities

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ABSTRACT

Soil microbial communities are involved in key processes of forest ecosystems that include decomposition of organic matter, cycling of nutrients or formation of structure. The composition and diversity of these communities depend on a large number of factors such as humidity, pH, nutrient levels, C content, or the type of vegetation cover. Despite the high forest area of the Iberian Peninsula, the bacterial communities of these soils are still poorly studied and characterized. This work is carried out in the interior of the region of Galicia (NO of the Spain) where the main plantations of Castanea sativa are found in this region. The objective of this work was to study the effect of the plantation age on the microbial communities that develop in these soils. For this, soil samples were taken in plantations of two different ages: young plantations (10-15 years) and centennial plantations. Soil samples were collected at 50 cm and the different visually identifiable horizons were separated. The bacterial communities present in the organic horizon were characterized by massive sequencing of the 16SrDNA ribosomal gene. The results will be discussed in terms of bacterial diversity, composition and functionality (focusing on bacterial groups potentially involved in N or C cycling).

KEYWORDS: soil, bacteria, age, Castanea sativa, nutrients

PAPER ID: CEST2021_00304

Investigation of the establishment and dynamics of black pine in the fir zone of Tymphristos mountain under climate change

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ABSTRACT

The establishment and dynamics of black pine in comparison to fir on the Tymphristos mountain, Greece, was investigated based on their growth behavior and the ecological factors governing the area. Specifically, from a black pine stand, derived from reforestations and which presently contains also fir individuals, tree-ring cores were obtained up to the pith from both species. Subsequently, the tree-rings width was measured, followed by the analysis of radial growth in relation to site conditions and vegetation zone. The results show the incapacity of black pine to compete fir due to the local bioclimatic conditions which partly explains the absence of the species in the area. However, this condition may be altered by the transition to a drier bioclimatic type due to the evolution of climate change.

KEYWORDS: dendroecology, forest ecology, tree-rings, reforestations, climate change

PAPER ID: CEST2021_00570

Reclaimed water reuse in agriculture: a review on potentials and drawbacks

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ABSTRACT

Water has always been the limiting factor of agricultural production in the Mediterranean basin, with its continuously increasing demand driven by climate-induced factors. In the Mediterranean the agricultural sector is the prime water consumer as it requires more than 70% of the total water demand. Reclaimed water may represent a viable solution to face the problem of water scarcity, increasing the availability of fresh water sources, while supporting local economies. Reclaimed water needs to be of adequate microbiological and chemical quality in order to be safely reused. Based on a literature review presented in this article, the use of reclaimed water does not affect the quality of the agricultural products. However, more research should be conducted to thoroughly evaluate whether the quality of reclaimed water can undermine the quality of crops particularly with respect to emerging contaminants. A major challenge that needs to be overcome is public acceptance by the end users and particularly the farmers.

KEYWORDS: agriculture, water scarcity, circular economy, water management, pollution

PAPER ID: CEST2021_00851

Prescribed fire combined with guided herbivory can control shrub development in an Iberian heathland

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ABSTRACT

The high amount of biomass fuel accumulated in Mediterranean areas due to land abandonment, combined with the effects of climate change, results in high severity fires that strongly affect local environment and social communities. Traditional fire practices and livestock grazing can be efficient tools to manage fuel loads and reduce wildfire impacts. This work is within the Open2preserve project, aimed at the evaluation of prescribed fire use combined with guided herbivory for the control of shrub growth and flammable biomass accumulation in an Iberian heathland dominated by *Erica* spp.

The low intensity prescribed fire led to a strong reduction in the phytovolume of the whole studied area. An increase in the understory biomass in the non-grazed area was found in the first and second year of the experiment compared to the grazed area. A significant effect of grazing was observed in the phytovolume of *Chamaespartium tridentatum* in both years of the experiment. Moreover, although not significant, an increase in the phytovolume of *Daboecia* spp was observed with time in the non-grazed areas. Similarly, *Agrosti curtisii* appeared only in the non-grazed treatment and showed a tendency to increase with time.

KEYWORDS: *Erica* sp., *Chamaespartium* sp., grazing, horse, cattle

PAPER ID: CEST2021_00783

Agroforestry innovation networks (AFINET): Knowledge Transfer and Innovation

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ABSTRACT

Agroforestry is recognised as climate-smart agriculture, being a powerful tool for climate change mitigation and adaptation. Considering knowledge transfer a capital challenge to overcome the needed transition towards this for the European Commission, the AFINET (AgroForestry Innovation NETworks) project intended to boost agroforestry through a multi-actor approach by defining challenges and providing solutions for end-users. Knowledge transfer is key to maximize dissemination, being innovation networks an instrument that allows the source of knowledge to reach end-users straightforwardly. As part of AFINET, a list of agroforestry innovations was elaborated according to the challenges and bottlenecks raised by end-users enrolled in the project. To obtain the list, regional groups of local stakeholders (RAINS) were created in the nine covered countries involving over 1400 participants. Regional Innovation Network (RAIN) meetings were organized with innovations as focus, providing finally 96 innovations grouped in topics; i) technical challenge, ii) economical challenge, iii) communication/education challenge and iv) policy and governance challenge. Education for consumers, CAP as a major agricultural and forest land use driver, but mainly technical innovations linked to design and farming systems and economic challenges were highlighted by actors on the importance of woody perennials use in agricultural lands or performance from forestlands in Europe.

KEYWORDS: Climate change, Agriculture, Circular Economy, Bioeconomy, Stakeholders.

PAPER ID: CEST2021_00784

Forest Fire Sustainability: Numerical Simulation of a Pine Tree Thermal Response and the Thermal Radiative Phenomenon

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ABSTRACT

This paper presents a numerical simulation of a pine tree thermal response and the thermal radiative phenomenon, in order to evaluate the forest fire sustainability. The three-dimensional pine tree model is made by 2289 cylindrical elements, with 1.8 m height, to represent its trunk, branches and leaves. The tree thermal response numerical models are based on energy and mass balance integral equations. The tree systems consider the phenomena of conduction, convection, transpiration and radiation. The tree is placed nearby the fire front. The view factors, Mean Radiant Temperature, surface temperature of both bodies are analyzed on transient regime. In accordance with the obtained results in trees, with lower dimensions, is important not to expose during long time to the radiative phenomenon and after a short time period the steady state regime is obtained.

KEYWORDS: Numerical models, Forest fire, Tree thermal response, Mean Radiant Temperature, View factors

PAPER ID: CEST2021_00686

Validation of surveillance applications and low-cost drone for mapping and exploitation of forest areas in urban environment

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ABSTRACT

The municipalities of big cities utilize public green areas within the urban fabric, in order to create a small-scale natural environment for the community. The methods and the instruments for surveying and implementing topographic projects differ in quality, accuracy, time and cost. The purpose of the present research is to compare three different surveying methods according to these factors, and to test the adequacy of the results for highlighting best available techniques in forest urban areas. The results of measurements derived from a total station and unmanned aircraft were compared. Measurement errors were combined with the time required to complete the survey and the cost of each instrument and associated software for data processing. Based on the results, the time and cost of each application has shown that low-cost methods give sufficient results that can be used for the design and implementation of forest urbanization studies. The prospects for utilizing these methods of measuring and surveying urban forested areas are multiple and constantly improving with the development of technology.

KEYWORDS: Surveying, Low-cost methods, Forest Urban Environment, spatial planning, UAV

PAPER ID: CEST2021_00103

Topographical map of infrastructures in forest areas and site inspections for nature development and protection, produced by using a low-cost Unmanned Aircraft Vehicles - evaluation case

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ABSTRACT

Site inspections of the road network and the infrastructures in forest areas are crucial for development and protection of natural environment from several disasters such as forest fires. A digital topographical map can be an administrative tool to the Civil Protection and to Forest Offices for infrastructure inspection. The road network is usually inspected twice a year before the fire protection period by the forest service authorities, in order to record any abnormalities such as landslides and soil erosions and to secure the movement of the fire fighting vehicles. These inspections have major cost and working hours for the services' personnel. Due to the long length of the road-network the inspections are not carried out adequately and the implementation of repairs is delayed. This paper demonstrates the evaluation of a low-cost UAVs for the production of maps in order to implement photogrammetry analysis for observation of the functionality of road network. A case-study in the university forest of Taxiarchis - Chalkidiki, Greece is presented. Drone flights have taken place in the study area and orthophotos have been analyzed. The method is being compared with the regular in-situ methods in terms of cost and quality. Low-cost and fast inspection could ensure the damage repair and the safe movement of ground fire-firefighting vehicles.

KEYWORDS: Topographical mapping, infrastructures, forest areas, UAV, natural development, hazards protection.

PAPER ID: CEST2021_00238

SESSION 37 - HYDROLOGY AND WATER RESOURCES

Friday 3 September - afternoon

Risk Evaluation of Community-Based Water Systems from Nonpoint-Source Pollution in Eastern Visayas, Philippines

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ABSTRACT

This study evaluated the risk posed by nonpoint-source (NPS) pollution to the 266 community-based water systems (CBWS) in Eastern Visayas, Philippines. Geographic Information System (GIS) techniques, together with Multi-Criteria Decision Analysis (MCDA) was used to develop a Nonpoint-Source Pollution Potential Index (NSPPI) to identify and classify the potential locations of water systems that are at risk from NPS. In developing the NSPPI, this study used three features that contribute to NPS pollution (taken from the original Agricultural Pollution Potential Index (APPI) model) as follows: Runoff Potential Index, Sediment Yield Potential Index, and Nutrient Yield Potential Index. Results showed that 22% (n=59) of the CBWS is at high risk of NPS pollution, 42% (n=111) is categorized as moderate, and 36% (n=96) as low. Using NSPPI as a primary risk evaluation of CBWS from NPS pollution is a cost-effective screening tool in identifying priority sites for environmental management intervention.

KEYWORDS: Non-point-source pollution, community-based water system, water management, Philippines

PAPER ID: CEST2021_00231

Enhancing citizen engagement in water resources management

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ABSTRACT

The world is currently facing serious water challenges that require an unprecedented global response. The present study proposes a multidisciplinary and dynamic approach to enhance citizen involvement in water resources management. It was conducted in Ave river, a medium-large sized river located in the Northwest region of Portugal, and the target groups were the inhabitants of Guimarães' parishes crossed by Ave river (45.000 inhabitants), particularly students (aged 6 to 18), the green volunteers of each parish, and parish council mayors. For a year, the ecological quality and the biodiversity of Ave river was monitored at 11 sampling sites, and mitigation and restoration measures to be done with the citizens were promoted. Additionally, more than 120 environmental education theoretical and practical actions were carried out to empower target groups with tools to track freshwater quality, to debate opinions, and to standardize procedures among parishes (e.g., clean-up and rehabilitation actions). Actions also included discussions with citizens, researchers, local authorities, and governmental entities about citizens' concerns, as well as proposing measures that reconnect citizens with local rivers. Citizens' engagement in water resources management has fostered good environmental practices and has increased society's awareness of green policies.

KEYWORDS: Water Resources, Sustainability, Society, Water Policy, Community-based monitoring

PAPER ID: CEST2021_00245

A Water-Based Approach for Addressing RES Integration Challenges in Insular Energy Systems

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ABSTRACT

High shares of RES-based power capacity in island electricity grids often imply significant energy curtailments of non-dispatchable power generation, which in turn limits islands' capacity to leverage RES environmental and economic benefits. The presence of energy storage systems and/or grid interconnections can improve this situation, but at the same time add considerable costs in terms of capital expenditure. We argue that exploitation of already existing assets, at the demand side, offers the opportunity for low-cost demand-based schemes, providing power systems with increased flexibility which, in turn, can support increased RES penetration. This study demonstrates the application of a demand side management strategy for exploiting the high deferability of load demand of a set of water pumping stations, in an isolated grid on a Greek island. The strategy, given a sufficient implementation scale, seeks to reduce limitations, with regards to wind energy contribution in RES-saturated grids, under an energy consumption minimization function, fulfilling at the same time constraints related to water management.

KEYWORDS: Isolated Grids, Demand Side Management, Water-Energy Nexus, RES Integration, Sector Coupling

PAPER ID: CEST2021_00662

Intercomparison of satellite and ground-based precipitation in the area of Cyprus

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ABSTRACT

Cyprus has an excellent location for studying meteorology, climatology of atmospheric aerosols and aerosol-cloud-precipitation interaction. Aerosol-cloud-precipitation dynamics in the region of Cyprus are responsible for the country's precipitation budget. This study uses observations from the NASA's Global Precipitation Measurement (GPM) Mission and from the two ground-based radars of the Department of Meteorology (DoM) to measure the distribution of precipitation over Cyprus. The DPR (Dual-frequency Precipitation Radar) aboard of GPM is used in order to derive precipitation rate at the ground with a spatial resolution of 5-25km for 120km wide swath. The ground-based radar stations provide raw information with a spatial resolution of 0.1° and a radius of 150km. The two datasets are interpolated on a universal grid in order to enable the calibration of the raw data and their validation with the GPM data. The results will contribute to the development of an automated method for the estimation of the precipitation budget over the area of Cyprus and thus, drought monitoring in the region of the eastern Mediterranean.

The presented work is under the EXCELSIOR project that received funding from the European Union [H2020-WIDESPREAD-04-2017: Teaming Phase2] project under grant agreement no. 857510, and from the Republic of Cyprus.

KEYWORDS: remote sensing, precipitation, radar, GPM, eastern Mediterranean

PAPER ID: CEST2021_00202

The Water Tariff Structure in the New Convergence Regulatory Scheme

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ABSTRACT

The most recent innovation in the regulation of the Italian Urban Water Management is the introduction of the Convergence Regulatory Scheme. The new tariff preparation method introduced by the Italian Regulatory Authority for Energy, Networks, and Environment (ARERA) aims to simplify the mechanism for identifying the water tariff for those managements characterized by enduring critical issues regarding investment planning and management of the Urban Water Management. The application of the Convergence scheme provides for the estimate of parametric costs to be considered in the construction of the water tariff, considering different cases depending on the management information available. But the same convergence mechanism also provides obligations for the Managers, including the structuring of tariff classes in compliance with the provisions of the ARERA resolutions. The initial point for defining the user's tariff structure is the Manager's Revenue Constraint, estimated based on a reference benchmark. This study proposes a mathematical programming model that allows, in compliance with the constraints dictated by the ARERA resolutions, to define the tariff structure for users in the application of the Convergence Regulatory Scheme, thus supporting in the complex decision process all those Operators that present serious problems in the management of the water service.

KEYWORDS: Urban Water Management, Economic Evaluation of Projects, Optimizing Tools, Water Tariff, Decision Making

PAPER ID: CEST2021_00510

Chemical And Isotopic Characterization of The Thermal Fluids In The South-western Margin of the Loutros-Feres-Soufli Tertiary Basin in Northern Greece. Case Study: Geothermal Area of Aristino

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ABSTRACT

In this work we examine the hydrochemical and isotopic characteristics of the thermal fluids in the Aristino geothermal area in the southwestern margin of the Loutros-Feres-Soufli Tertiary basin (LFS), which is located west of Evros river in Northeastern Greece, in order to identify their possible origin and the expected procedures responsible for the alteration of the initial composition of them. The studied fluids are characterized by high Cl^- and Br^- contents, which indicate a higher or lower marine contribution. Furthermore, the elevated B and Li^+ values and the low Mg^{2+} values respectively, are related to high temperatures indicative of water-rock interaction procedures. Additionally, we observe an enrichment of $\delta^{18}O$ values, which is another indicator of water-rock interaction that occurs in areas with high thermal potential. Finally, we attempt to evaluate the deep reservoir temperatures with the application geothermometers. Their values reflect an equilibrium process with the probable existence of a deep hydrothermal system of middle to high enthalpy.

KEYWORDS: geothermal system, water geochemistry, O-H isotopes, geothermometry

PAPER ID: CEST2021_00604

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Chemical And Isotopic Characterization Of The Thermal Fluids Emerging From Nestos River Delta Basin in North Greece

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ABSTRACT

In this work we study the isotopic and hydrochemical properties of waters emerging from Nestos river delta basin (Erasmio, Eratio and Myrodato), which is forming the continental margin of the broader graben type basin of Prinos that includes the Nestos delta and the offshore extension between Thassos island and the main land around Kavala bay. Our goal is the identification of the procedures that are related to the waters' composition as well as their origin. Some of our samples are characterized by low Cl^- which excludes the marine contribution while the others present high Cl^- and Br^- which indicate marine participation. This assumption is, also, confirmed by the $\delta^{18}O$ and $\delta^{34}S$ isotopic values. Finally, we use isotopic geothermometers for the evaluation of reservoir temperature and we conclude to the existence of deep geothermal field of low to middle enthalpy, except from one sample which has middle to high enthalpy.

KEYWORDS: geothermal system, water geochemistry, O-H-S isotopes, geothermometry

PAPER ID: CEST2021_00605

Towards a sustainable water resources management in post-lignite era: the case of Western Macedonia, Greece

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ABSTRACT

In 2018, Public Power Corporation (PPC) employed 15,000 employees in the energy sector, mainly in lignite production, providing electricity to 6,900,000 customers in Greece. The total confirmed lignite reserves amount to 5 billion tons mostly resourced (1.8 billion tons) in the Western Macedonia Region (WMR, Ptolemaida, Amynteo and Florina) followed by Drama, Eastern Macedonia (900 tons) and Megalopolis in the Peloponnese (223 million tons) (PPC 2020). Given recent decisions regarding a European Green Deal for the European Union (EU) and its citizens and the Greek government's National Energy and Climate Plan (NECP) for climate and energy issues, setting out a detailed roadmap regarding the attainment of specific energy and climate objectives by 2030, it appears that lignite has no future and Greece has to be prepared for the post-mining era. Especially in the water sector, authorities must face the significant impacts of both, mining operations and Coal-fired power plants on water quantity and quality. Mining operations can have severe impacts on water supplies, involving contamination of nearby rivers, lakes and aquifers with metals and acids, while the use of water in the power plants to cool the condenser units, have major effects on water quality. Within the scope of this study, we assessed both the Just Transition Development Plan of lignite areas in Greece and the River Basin Management Plan (RBMP) of Western Macedonia River Basin District (GR09) and we recorded the status of the EU Water Framework Directive (WFD) implementation in this field. We also studied the complexity in resolving the conflicts between the Development Plan, water resources management and environmental protection. Finally, given the environmental and economic issues in water management broached by WFD we investigated possible changes and additions to both the Development Plan and the RBMP 09 in order to meet WFD objectives. Building a comprehensive sustainability strategy requires the assessment of long-term impacts of mining activities before and after the mine closures on the environmental, economic and social parameters and promote future protection of earth's resources.

KEYWORDS: post lignite era, water resources management, Water Framework Directive, Energy, coal

PAPER ID: CEST2021_00303

SESSION 38 - GAS EMISSIONS CONTROL AND UTILIZATION

Friday 3 September - afternoon

Green sonochemical route for the synthesis of MOFs for the electrochemical reduction of CO_2

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ABSTRACT

A zinc-based MOF has been prepared by utilizing adipic acid as an aliphatic ditopic linker via both solvothermal and sonochemical methods. The ultrasound irradiation has reduced the reaction time and has led to smaller particle size. The samples were evaluated for their catalytic efficiency by the electrochemical reduction of CO_2, with carbon monoxide and hydrogen being the sole products. At lower potentials (-1.5 V to -1.7 V) the ultrasound sample achieved up to 10 % better faradaic efficiency towards CO (FE_{CO}). At more negative potentials (-1.8 V to -1.9 V) the FE_{CO} of the two samples start to equalize to a maximum of around 58 %.

KEYWORDS: Carbon Dioxide, Electrocatalysis, Reduction, Metal-Organic Frameworks, Sonochemistry

PAPER ID: CEST2021_00348

Life cycle assessment of various combustion-based electricity generation technologies with carbon capture and storage: A review

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ABSTRACT

With the continuous advancement of the industrialization process, climate change continues to intensify. Traditional electricity production consumes a lot of energy and fuel and is accompanied by huge amounts of greenhouse gas emissions. Although the rapid development of renewable energy electricity generation technologies (e.g. solar, water, wind, geothermal, tidal) plays an increasing role and proportion in the energy generation portfolio, it is still difficult to meet the increasing electricity demand. Traditional fossil fuels electricity generation (mainly coal and natural gas) still dominates in the short term. Carbon dioxide capture and storage (CCS) is a set of integrated technologies that can capture CO_2 from large industrial CO_2 emission sources such as power plants, oil refineries, cement plants, and steel plants. Then, CO_2 is transported to the storage site and injected into underground. CCS technology has the flexibility, compatibility, and huge potential for the emission reduction in combination with the current energy infrastructure. The life cycle assessment (LCA) is usually used to quantify the various potential environmental impacts of the CCS system and seek the improvement measures to reduce the environmental issues. However, the existing methodologies of LCA research still have some deficiencies.

This work reviewed the related studies in the past 10 years and found that CCS can effectively reduce the global warming issues, and also increase other environmental impacts (e.g. acidification and eutrophication). When comparing the life cycle environmental benefits of different combustion power generation systems, more standards need to be included to eliminate differences caused by conditional assumptions, system boundaries, and evaluation methods. In addition, the present CCS development barriers and challenges were discussed detailedly. The research perspective needs to shift from the application of CCS at the level of a single power plant to the impact evaluation during the large-scale deployment, and also from a single discipline to interdisciplinary research. This paper also provides effective information for the large-scale implementation of CCS through the comprehensive LCA studies.

KEYWORDS: Carbon capture and storage, Life cycle assessment, Environmental impacts, Large-scale deployment

PAPER ID: CEST2021_00644

CO_2 absorption into 4-diethylamino-2-butanol solution in a membrane contactor under wetting or non-wetting conditions

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ABSTRACT

Natural gas produces a large amount of carbon emissions in the process of mining and processing, on the one hand from the energy use of processing facilities, on the other hand from the way that natural gas is extracted. The adoption of appropriate carbon capture technology is of urgency. The membrane absorption method has recently been attracted much attention and studied by the majority of researchers worldwide. Because it overcomes many shortcomings compared with the conventional absorber, and has the advantages of large gas-liquid contact area and small size. In this paper, a hollow fiber membrane contactor (HFMC) is used to simulate the decarburization process by using 4-diethylamino-2-butanol (DEAB) solution. As a new type of alcohol amine solvent, DEAB solvent has excellent absorption and regeneration performance, and also has the characteristics of low energy consumption and high energy efficiency, which exhibits a strong development potential in the field of gas absorption.

In this work, a mathematical model of the gas and liquid reaction and transport in HFMC under wetting and non-wetting conditions was established. In this model, the countercurrent process of the absorbent and natural gas is adopted, and four solvents (i.e., DEAB, monoethanolamine (MEA), diethanolamine (DEA) and triethanolamine (TEA)) are used to absorb CO_2 from natural gas containing 10 vol.% CO_2 and 90 vol.% CH_4. Moreover, the effect of membrane wettability on the CO_2 removal performance by different absorbents are studied. The results show that the wetting of the membrane pores greatly reduced the absorption efficiency under the same conditions. The decarburization efficiency under the non-wetting mode is 342% of the fully wetting case. Increasing the flow rate and concentration of the absorbent can improve the decarburization performance. The increase in the inner diameter of HFMC also significantly improved the decarburization capacity within a certain range. The inlet temperature and gas flow rate had an adverse effect on the CO_2 removal.

KEYWORDS: Membrane contactor; Natural gas; Carbon dioxide capture; 4-diethylamino-2-butanol; Absorption

PAPER ID: CEST2021_00697

A comparative analysis upon the utilization of exhaust gas cleaning systems, LNG fuels or conventional fuels as the most viable options to comply with the new IMO Low Sulfur Cap Regulations

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ABSTRACT

Since the decrease of the global sulfur limit from 3.5% to 0,5% by the International Maritime Organization on 1-1-2020, the ship-owners and carriers are obliged to elect between the three available options in order to comply with the present regulatory amendments. The first available option is the utilization of exhaust gas cleaning systems, also called "scrubbers". By the use of these filters, the vessels are able to burn high sulfur fuels while the sulfur surplus and other dangerous chemicals are evaporated by spraying alkaline water via an open loop, closed loop or hybrid systems. The other option is the use of LNG as fuel, a viable option connected with the constant expansion of the global LNG supply infrastructure network. This network is yet in a developing status, as the majority of the LNG vessels are primarily coastal vessels operated in European waters and many supply ports worldwide have not yet developed full-scale LNG supply facilities and proper equipment is not yet installed. The final option is the utilization of conventional fuels, low on sulfur emissions, such as MGO and ULSFO. The major issue is the availability and the cost of those fuels, with the refiners being unable to forecast if they should produce more low-sulfur fuels to meet potentially higher demand. By the comparative analysis of those three options, pursuant to distinct indicators, their viability will be evaluated and a thorough proposal for their utilization will be provided.

KEYWORDS: IMO 2020 Low Sulfur Cap, Scrubbers, LNG fuel, MGO, ULSFO

PAPER ID: CEST2021_00854

Low temperature conversion of methanol to higher hydrocarbons and hydrogen using a non-thermal plasma

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ABSTRACT

In recent years, the emission of volatile organic compounds (VOCs) from chemical manufacturing plants, agricultural practises, and indoor sources has attracted public concern, as these emissions have a negative effect on both human health and the environment. VOCs are precursor for the formation of ground level ozone, organic aerosols and photochemical smog. Some of the VOCs are toxic and carcinogenic, while others can cause unpleasant odour that are detrimental to human health. Long-term exposure to VOCs has been linked to a variety of human diseases, including cancer, cardiovascular disease, lung and respiratory diseases. As a result, reducing VOC emissions has become a major concern and a hot research subject around the world. Non-thermal plasma (NTP) is an attractive and emerging technology for removal of odorous volatile organic compounds (VOCs) such as methanol from ambient air. In this study, a dielectric barrier discharge (DBD) reactor has been developed for the conversion of methanol into higher hydrocarbons, hydrogen and other products. The influence of specific input energy (SIE= 1.7 -8.5 kJ/L), methanol concentration (260-350 ppm) and residence time (1.2-3.3 s) on the performance of the plasma DBD reactor has been investigated in pure and humidified nitrogen. The results indicated that the removal efficiency of methanol increased with increasing SIE and residence time. The removal efficiency of methanol decreased with increasing methanol inlet concentration. The humidified nitrogen plasma shows the best performance in terms of removal efficiency and energy efficiency of the decomposition process. The maximum removal efficiency of 96.2% can be achieved at 8.5 kJ/L and a residence time of 3.3 s in humidified nitrogen plasma. Furthermore, water addition at 10% relative humidity improved the conversion of methanol, H_2 yield, CO_2 and CH_4 selectivity. These results reveal that humidified nitrogen plasma provides an alternative approach for improving the performance of DBD reactor for the removal of VOC emissions from ambient air.

KEYWORDS: Non-thermal plasmas, Dielectric barrier discharge, Volatile organic compounds, Methanol, Removal efficiency

PAPER ID: CEST2021_00746

A New Method for Emission Control System Malfunction Detection During the Periodic Technical Inspection

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ABSTRACT

The paper shows a new method for detecting emission control system malfunction during periodic technical inspection (PTI). The on-board diagnostic (OBD) test results were collected and processed during the PTI of vehicles in Croatia in 2020. The study included petrol and diesel passenger cars that passed the tailpipe test and for which an OBD test had also been performed. In 11.5% of the tested cars, at least one stored diagnostic trouble code (DTC) was found. Due to the significant number of vehicles with identified DTCs, a new and more efficient method for the detection of potentially defective vehicles has been suggested. The introduction of the OBD test mandatory for all vehicles equipped with a European on-board diagnostic (EOBD) system is proposed. In addition to the existing OBD data, it is recommended to introduce the number of DTCs as mandatory, and such data should be relevant for passing the roadworthiness test.

KEYWORDS: On-board diagnostic (OBD); Diagnostic trouble code (DTC); Periodic technical inspection (PTI); Emission control; Emission standard

PAPER ID: CEST2021_00421

CO_2 Utilization for Preparation of Carbon Nanostructures

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ABSTRACT

The CO_2 conversion to valuable materials is a challenging way to manage pollution problems. In the present work, CO_2 was used as a feedstock to synthesize solid carbon nanostructures by employing a simple magnesiothermic reduction reaction under constant gas flow in a tube furnace. It was shown that the CO_2 reduction at 675 ^oC led to the simultaneous formation of different nanocarbon morphologies including graphene, tubular and spherical carbon nanostructures. The synthesized material was characterized using XRD analysis, Raman spectroscopy, SEM and TEM microscopies which demonstrated its good crystallinity and morphological diversity. Electrochemical tests were performed to evaluate specific capacitance and cycling stability of the prepared sample. The calculated values of ~ 325 F/g at scan rate 0.1 V/s revealed that the obtained nanostructures can be used as effective functional material for supercapactior applications.

KEYWORDS: CO_2 conversion, nanocarbons, metallothermic reduction, Mg

PAPER ID: CEST2021_00765

SESSION 39 - DISASTER RISK REDUCTION AND MANAGEMENT

Friday 3 September - afternoon

An Agent-Based Modelling approach to assess risk in Cyber-Physical Systems (CPS)

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ABSTRACT

The classic approach to risk assessment in civil engineering infrastructure (incl. water systems) often takes an incomplete view of the socio-technical system and its cyber-physical extensions, thus confining the ability to properly quantify the level of risk. To tackle this limitation and enhance the water sector's preparedness, this work proposes the use of Agent-Based Modelling (ABM) to explore and derive alternative routes to quantify risk. ABM approaches carry the capacity to describe systems of complex adaptive nature that characterize behavioural rules (e.g., selection of target), socio-technical systems (e.g., water systems including human stakeholders), and their "real-world" interaction. This work takes advantage of those capabilities, to quantify risks through a generic, case independent approach where the cyber-physical attackers are treated as independent, autonomous agents (e.g. hackers, saboteurs) that follow various behavioural rules to decide on their targets and plan their attacks, and hence interact with an external environment simulating the critical nodes of water critical infrastructure (e.g. storage tanks, pumping stations). The ABM simulations can be used to provide the data sets required to derive probabilities for the cyber-physical events that allow the quantification of the risk in accordance with the classic approach to risk in infrastructure planning and natural hazards.

KEYWORDS: Agent-Based Modelling, Water Security, Risk Management, Cyber-Physical Systems, CPRISK

PAPER ID: CEST2021_00194

Guimarães 2030: A new governance ecosystem

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ABSTRACT

Nowadays there is near consensus that cities have an important role to play in the pursuit of global climate protection and Sustainability. However, local strategies for sustainable development require a holistic and systemic approach, enabling multiscale involvement dynamics from a variety of stakeholders. Because Sustainability objectives are multifaceted, they often do not align with local governments' typical organizational structures, which compartmentalize expertise around core service functions. This paper intents to analyze the Governance Ecosystem Guimarães 2030 highlighting on the practical implementation of the quintuple helix model at local level. Available Information allowed characterizing Guimarães' Governance model as well as understanding how it evolved overtime. Projects were selected for each of the five-helix showcasing the continuous circulation of knowledge that is contributing for local sustainable development.

KEYWORDS: Governance, Sustainability, Knowledge, Helix model, Transformation

PAPER ID: CEST2021_00267

A comparative study of alkali activated slag cement concretes with carbonates and silicate activators.

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ABSTRACT

Alkali-activated cements are increasingly gaining interest as viable alternatives to Portland cement, because they are considerably reducing CO_2 emissions compared to traditional Portland cements while maintaining or exceeding performance requirements commonly specified for construction applications. Experience of this type of cement shows that the results are very sensitive to mixing procedures and curing conditions. This article thus studies concretes with Na_2CO_3 activated ground granulated blast furnace slag (GGBS) cement mixes and mixes of on Na_2CO_3 plus Na_2SiO_3 activated GGBS under different mixing and curing regimes. After studying different mixing procedures of the ingredients and their effects on the compressive strength, the most suitable mixing procedures were adopted for a series of mechanical and durability related tests using different curing conditions. The results showed that providing the carbonate in solution rather than powder form, resulted in higher strengths. Curing conditions at ambient temperature and high humidity regimes were most successful in maintaining strength development in time. All mixes had adequate strengths for structural concrete but those with Na_2SiO_3 developed the highest strengths at all ages and curing conditions.

KEYWORDS: concrete sustainability; alkali-activated cements; sodium carbonate; ground granulated blast furnace slag; industrial waste management

PAPER ID: CEST2021_00301

Coastal Inundation Integrated Modelling

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ABSTRACT

The present paper provides an integrated framework for modelling of coastal inundation, aiming to help coastal communities understand their risks and consequently to prevent the adverse effects to society. The proposed framework involves the implementation and coupling of a suite of sea state hindcast data, numerical wave and hydrodynamic models and empirical formulas. The validity of any model is demonstrated by its success in reproducing recorded events and to this end, the coastal zone of Rethymno in the Island of Crete, Greece is examined to demonstrate the proposed framework's performance to capture historical coastal flood events.

KEYWORDS: coastal inundation, flooding, storm surge, wave overtopping, numerical modelling

PAPER ID: CEST2021_00751

Optimal Productive Structure for Sustainable Development: Environmental Extended Input-Output Analysis

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ABSTRACT

The research aims to apply an integrated methodology for optimizing the productive structure of an economy with a view to sustainable development for the Greek economy. The main purpose of the research project is to constitute at the theoretical and applied level a model of synthesis of all economic, environmental, and social designs to optimize the results they create. The analytical approach at the sectoral level and the implementation of input-output analysis ensure effective planning to achieve an adequate level of development and effective response to modern environmental challenges. The objective of the restricted optimization model is to maximize the economy's growth rate (economic pillar) under air emissions restrictions (environment pillar). The impact of the optimal structure on the workers' skills and the demand for different occupations (pillar society) will be used to assess the results. The optimization model will be resolved using Evolutionary Optimization Algorithms, which are suitable for multimodal, non-curved, intensely nonlinear, with also nonlinear rather than convex limitations problems.

KEYWORDS: Sustainable Development, Input-Output Analysis, Optimization, Economic Structure, Greece

PAPER ID: CEST2021_00042

The Implementation of Risk Management processes as a contributing factor to the minimization of shipping disasters through the study of previous shipping accidents

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ABSTRACT

Environmental disasters can maliciously affect property, human lives and even entire ecosystems. The magnitude and extent of such a disaster can lead to uncertainty about who is liable and how the restoration of the environmental damage will be achieved. The implementation of Risk Management processes enables us to combine our available information and resources and learn how to avoid such problems in the future. In shipping industry, oil spills from tanker vessels constitute the most severe threat to local and global ecosystem. When an oil spill happens, it usually spreads rapidly and is affected by weather and sea currents. Without prompt treatment it can cause huge disasters in the local aquatic ecosystem and human property altogether. This paper will assess the famous accident of Exxon Valdez based on Risk Assessment Methods and more specifically with the method of Root Cause Analysis to identify and measure the effect of each contributing factor to each accident and with Failure Mode Effect Analysis to identify the best solutions to minimize such risks in the future.

KEYWORDS: Oil Spills, Risk Management Methods, Maritime Accidents, Root Cause Analysis, Failure Mode Effect Analysis.

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Daily Forest Fire Prediction modeling and Forest Fire Information System (FFIS)

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ABSTRACT

Forest fires in recent years are becoming increasingly devastating for ecosystems, human lives and infrastructures as they follow the climate change impact. In this context the fire monitoring and risk prediction is crucial to support Civil Protection Agencies in charge of the protection of natural ecosystems against fires. Embracing the advancements in remote sensing the fire monitoring task is more and more contributed from automated systems that exploit satellite sensors data, while in the fire risk prediction field, machine learning tends to become the most applied methodology. In this short manuscript we briefly present the development of a daily wildfire risk prediction model based on machine learning techniques and a monitoring system (Forest Fire Information System) for active fires and burn scar mapping that exploits MODIS and VIIRS remote sensing data.

KEYWORDS: Fire monitoring, wildfire predictive modeling

PAPER ID: CEST2021_00773

The development of a Forest Canopy Density (FCD) model in Akamas National Forest Park in Cyprus, using Landsat-8 and Sentinel-2 satellite data

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ABSTRACT

The canopy of trees plays a very important role in forest ecosystems and acts as a regulator, affecting the microclimate and the soil conditions. The density of the forest canopy is associated to the forest development and it can be used as an indicator of forest degradation. Additionally, forest density is one of the most important parameters, used in the design and implementation of programs for forest restoration, especially in cases of areas affected by fires. The main objective of this study is to determine the disturbance that occurred in the canopy density of the Akamas National Forest Park in Cyprus after the fire that occurred on November 13rd, 2019. For the purposes of this study, the Forest Canopy Density model (FCD model) was estimated using the Landsat-8 satellite data. Moreover, this study aimed to evaluate the FCD using Sentinel-2 data. The results from the two satellite sensors were validated and compared with each other. The results obtained from Sentinel-2 seem to be very promising and the calculation of the canopy density through this study is achieved in a better resolution, in contrast to the analysis available by the Landsat-8 satellite.

KEYWORDS: Forest Canopy Density, FCD model, Earth observation, Sentinel-2, Landsat-8.

PAPER ID: CEST2021_00224

Assessing the risks of climate change for cultural heritage – The CLIMASCAPE project

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ABSTRACT

The protection of cultural heritage sites from the climate change effects is a central priority for protecting the cultural capital of Greece, and the sustainability of the related touristic flows. This paper describes the conceptual framework of the CLIMASCAPE project which aims to develop a methodology to be rolled out as a multi-criteria system for the evaluation of exposure, sensitivity, adaptive capacity and eventually vulnerability of archaeological areas to climate change. Eight UNESCO archaeological sites in Greece are selected as case studies namely; Olympia, Delphi, Delos, Sanctuary of Asklepios, Mystras, Apollo Epicurius, Philippoi and Heraion of Samos. Climate model projections are used to identify possible climate change related risks such as heatwaves, floods, droughts, fires and sea level rise and associate them with each of the eight selected study areas. A methodological framework for assessing the vulnerability and its components is also presented along with examples of possible data that are useful for the quantitative estimation of the above. The preliminary finding of the project suggest that differentiated adaptation plans for each site based on (a) the specific projections regarding the impacts of climate change and (b) the specific characteristics of each site are needed.

KEYWORDS: Cultural heritage, Climate change, Adaptation, Tourism

PAPER ID: CEST2021_00767

SESSION 40 - WATER AND WASTEWATER TREATMENT AND REUSE

Friday 3 September - afternoon

Pilot-scale membrane bioreactor for wastewater treatment using innovative encapsulated self-forming dynamic membrane

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ABSTRACT

The use of membrane bioreactors (MBR) is a promising technique for wastewater treatment that manages to respect the restrictive limits imposed by regulations. However, during the filtration process membranes are subject to fouling which requires additional costs for cleaning and replacing the modules. This phenomenon severely limits the widespread of this technology on a real scale. Thanks to many scientific studies, it has been possible to put into practice various fouling mitigation strategies which, at the same time, manage to increase the treatment efficiencies of the system, such as the application of electrochemical processes associated with MBR reactors (e-MBR).The introduction of low-cost self-forming dynamic membranes (SFDM), to replace the conventional ones, has made MBR technology even more promising. However, the large size of the pores limits their application since the effluents obtained at the beginning of the process are not of good quality. In the present study the performance of an innovative patented hybrid reactor, which combines encapsulated self-forming dynamic membranes (ESFDM) with an electro-MBR, was studied. The experiment, conducted at a pilot scale using real wastewater from a full-scale wastewater treatment plant, evaluated the efficiency of pollutant removal and fouling formation as a function of the applied current density.

KEYWORDS: Electrochemical processes, Current density, Membrane fouling, Dynamic membrane, Sustainable development

PAPER ID: CEST2021_00278

Wastewater Treatment and Membrane Fouling Control Using an Algae-Activated Sludge Self-Forming Dynamic Membrane Bioreactor (AAS-SFDMBR)

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ABSTRACT

Self-forming dynamic membrane bioreactors (SFDMBRs), which utilize formed biomass layer and large pore-size mesh/ support materials instead of conventional membrane materials, have been studied for wastewater treatment applications. The consortium of algae and activated sludge bacteria has also been recently shown to improve pollutant removal and fouling rate reduction in membrane bioreactors (MBR). This study presents a novel Algae-Activated Sludge SFDMBR (AAS-SFDMBR), with combined activated sludge and *Chlorella vulgaris* as biomass, for wastewater treatment. Pollutant removal efficiency and membrane fouling alleviation by the AAS-SFDMBR were compared to those of a previously reported Algae-Activated Sludge Membrane Bioreactor (AAS-MBR), which utilized a hollow-fiber ultrafiltration membrane. COD removal by the AAS-SFDMBR was only slightly lower than that obtained in the AAS-MBR. NH_4^+-N removal efficiency was increased by 10.83% in the AAS-SFDMBR. Concentration of membrane fouling pre-cursors in the AAS-SFDMBR mixed liquor, particularly those of the protein fractions of bound Extracellular Polymeric Substances (EPS) and Soluble Microbial Products (SMP), were significantly reduced in the AAS-SFDMBR. Consequently, the fouling rate in the AAS-SFDMBR was lower by 71.25% than that in the AAS-MBR. This study demonstrated the potential of SFDMBR, with algae-activated sludge biomass, as low-cost alternative to conventional MBRs.

KEYWORDS: Fouling mitigation, Self-Forming Dynamic Membrane, Microalgae, Nutrient removal

PAPER ID: CEST2021_00283

Seafood wastes as an attractive biosorbent: Chitin-based shrimp shells

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ABSTRACT

In recent years, water quality deteriorated with Zn (II) ions has started to take place among the important environmental problems. Zn (II) is a primary type of toxic and bioaccumulative pollutant commonly found in industrial wastewater. Biosorption is the most practical method in the treatment of water contaminated with Zn (II). Researchers have evaluated the biosorption efficiency with various innovative adsorbents in the aquatic environment recently. In this study, the biosorption capacity of chitin based shrimp shell waste (Cht-SSW) was investigated in Zn (II) containing wastewater. Initial findings showed that Cht-SSW is an effective biosorbent due to high porosity and functional groups. Within the scope of the study, the effects of Cht-SSW dose, contact time, pH and temperature on the treatment efficiency of Zn (II) were evaluated by batch mode experiments. The surface morphology and functional groups of Cht-SSW used in the study were determined using FT-IR and SEM. The isotherms and kinetics confirmed that Cht-SSW has high value of adsorption capacity. Experimental results point out Cht-SSW is a biosorbent that eco-friendly, economical, easily available and efficiently (4e) on the removal of Zn (II) from aqueous solution.

KEYWORDS: Biosorption, Chitin, Seafood waste, Shrimp shell, Zinc ion

PAPER ID: CEST2021_00415

Alternative wastewater treatment process with algae (AlgA) – general mathematical model and dynamic simulation

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ABSTRACT

Conventional wastewater treatment systems are based on processes including the steps of pre-/ primary, secondary and finally the sludge treatment. In this study a treatment step with algae as an alternative secondary treatment is supposed to improve the biological nutrient removal efficiency. In comparison with conventional technologies, less is known about the internal functioning of microalgae wastewater treatment systems. To integrate an algal system into a conventional wastewater treatment process, a mathematical model based on Activated Sludge Models (ASM) can help to understand the influences of algae on the general system of a wastewater treatment plant. The main outcome of the present study is to apply a dynamic model for a conventional wastewater treatment plant including an integrated microalgae-bacteria model to remove the nutrients nitrogen and phosphorus. The AlgA system is simulated in SIMBA# (software for modelling and dynamic simulation in wastewater technology) considering the annual variation of environmental influences in Central Europe.

KEYWORDS: microalgae-bacteria model; alternative wastewater treatment; dynamic simulation

PAPER ID: CEST2021_00431

Irrigation with reclaimed water containing Diclofenac and Lamotrigine induces stress reactions in Lettuce (Lactuca sativa)

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ABSTRACT

Pharmaceuticals as contaminants in treated wastewater can become a serious problem for food safety when they are used for agricultural irrigation. These organic contaminants can be taken up by plants and trigger abiotic stress responses which can eventually affect plant growth and development. When crops are irrigated with treated wastewater they can take up environmentally persistent pharmaceuticals, like diclofenac and lamotrigine. In a greenhouse study the uptake and translocation of the two pharmaceuticals in lettuce (Lactuca sativa) was quantified. Furthermore, molecular and physiological changes triggered by the pharmaca were scrutinized. Plants were cultivated under controlled conditions and treated independently with diclofenac (20 µg L 1) and lamotrigine (60 µg L-1) for 48 h. While translocation of both compounds into the aerial parts of the plants was low under the conditions applied, the expression of stress related genes increased under some of the treatments, especially with diclofenac. An oxidative burst in roots and especially in leaves occurred after treatment with lamotrigine. This could be responsible for the significantly changed gene expression pattern in both tissues. Our results showed for the first time that pharmaceuticals like lamotrigine or diclofenac might act as signals for physiological alterations in crops, affecting the expression of stress related genes and possibly causing a repressed physiological status of the plant. Hence irrigation of crops with reclaimed water containing pharmaceuticals should be critically investigated with respect to plant health and performance, and potential risks for consumers.

KEYWORDS: irrigation, diclofenac, lamotrigine, plant uptake, Lettuce

PAPER ID: CEST2021_00019

Functionalized iron oxide nanocomposite ultrafiltration membranes for water-in-oil emulsion separation

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ABSTRACT

Removal of emulsified water in oil (w/o) emulsions are the most challenging compared to free water and dissolved water emulsions. Emulsified w/o cannot be removed by conventional techniques such as settling tanks, oil skimmers, floatation and magnetic technologies. Membrane technology is a highly efficient, energy saving, and pollutant free alternative. In this work, iron oxide-oleylamine nanoparticles have been synthesized and embedded into polylactic acid (PLA) to make a hydrophobic-super-oleophilic ultrafiltration membrane. The concentration of the nanoparticles was varied from 0.5 to 3% of the polymer. Scanning electron microscopy (SEM), Energy dispersive X-ray spectroscopy (EDS), thermal gravimetric analysis (TGA), and Fourier-transform infrared radiation (FTIR) were utilized to confirm both the attachment of the oleylamine on the iron oxide and the loading of the prepared nanoparticles into the PLA membrane. The water contact angle was found to increase steadily as the concentration of the nanocomposites increased. This was associated with the hydrophobicity of the membranes, allowing the oil to penetrate through the membrane. Moisture removal in surfactant-stabilized w/o emulsions reached up to 80% in the composite membranes, compared to only 52% in the pristine PLA. The maximum permeability was found to be at 2% loading, where 885 $L/m^2.h/bar$ was reported, compared to 500 $L/m^2.h/bar$ in the PLA. The abundance of iron-oxide, and the biodegradability of PLA prove the capability of the prepared membranes to be a viable and environmentally friendly alternative for w/o separation.

KEYWORDS: Super-hydrophobic; water in oil; iron oxide; ultrafiltration; chemical synthesis.

PAPER ID: CEST2021_00186

Aqueous wastewater treatment with aluminum oxide, silica, and alginite

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ABSTRACT

The adsorption of different types of dyes and stains over inorganic adsorbent materials such as silica, and aluminum oxide (basic and acidic) as well as over a mineral with an organic component, alginite, has been studied, with the idea of treatment of remnant dye solutions and solution wastes from small and educational laboratories. To recycle the adsorbents, they were heated to 600 °C where the adsorbates are combusted. The inorganic sorbents were compared to activated carbon derived from coffee grounds (ACCG) in their adsorption behavior. Acidic alumina was found to be an effective adsorbent material for azo dyes and anionic dyes/stains, but also for textile dyes, with very high adsorption capacity. The adsorption capacity of alginate and silica was found to be almost the same for cationic dyes, while the adsorption capacity of ACCG is the least.

KEYWORDS: Adsorption, Adsorbent, Alginite, Dyes, Decolorization

PAPER ID: CEST2021_00799

Kinetics study of the MO adsorption and photocatalytic degradation using an effectively engineered HF photocatalyst

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ABSTRACT

In this study, copper decorated photocatalysts (Degussa P25), were shaped in the form of ceramic hollow fibers (HFs) and their photocatalytic properties were investigated using Methyl Orange (MO), a prototype anionic pollutant. The abatement of the dye was tested in dark and under UV irradiation by means of batch experiments and a possible mechanism was proposed for the MO photodegradation.

The photocatalysts were subjected to a series of MO adsorption experiments at variable initial concentrations, while the adsorption data were interpreted using different models. In general, the data analysis implied favorable MO physisorption on photocatalyst under the conditions used in this work. Furthermore, the adsorption kinetics of the photocatalysts was studied using pseudo-first and pseudo-second order kinetic equations, as well as Bangham, Elovich and Weber-Morris kinetic models. For further elucidation of the photocatalytic mechanism, experiments were performed with either O_2 or inert gas sparged MO solutions. It was concluded that the MO degradation rate followed the Langmuir-Hinshelwood (L-H) model.

In order to explore the stability of the derived ceramic HFs, their photocatalytic efficiency was investigated in successive cycles of batch photocatalytic experiments. Finally, a simple regeneration process revealed that the efficient photocatalysts could be reused without severe deactivation of their performance.

KEYWORDS: Adsorption; Photocatalysis; Kinetics study; Batch reactor; MO degradation

PAPER ID: CEST2021_00244

Photocatalytic elimination of water pollutants using innovative titania thin film heterostructures embedding carbon quantum dots

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ABSTRACT

Titanium dioxide based photocatalysis is a well-established advanced oxidation process (AOP) that recently has expanded its borders comprising advanced reduction processes (ARPs) as well. To enhance the photocatalytic activity, titania heterostructures embedding semiconductors, or clays, or plasmonic metals can be proposed as very promising solutions. In this study, carbon quantum dots (C-QDs) prepared hydrothermally, were successfully combined with titania (TiO_2). The photocatalytic activity of the C-QDs/TiO_2 heterostructures was successfully tested in the photocatalytic reduction of 4-nitrophenol (PNP) and hexavalent chromium (Cr^{+6}) pollutants. Moreover, the composite thin films were also effectively used in photocatalytic degradation of characteristic dye contaminants, thus confirming their high potential for photoinduced oxidation reactions. The mechanisms of the photocatalytic reactions were studied using appropriate scavengers and it was demonstrated that electrons (e^-) are at the origin of the photocatalytic reduction of Cr^{+6} and 4-NP, while holes (h^+) are the main active species for the photocatalytic oxidation reactions.

KEYWORDS: Photocatalysis, carbon quantum dots/TiO_2 composites, Organic-inorganic pollutants degradation

PAPER ID: CEST2021_00255

Application of catalytic hydrodehalogenation for the removal of brominated flame retardants

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ABSTRACT

The aim of this work is to evaluate the feasibility of aqueous-phase catalytic hydrodehalogenation (HDH) for the fast and environmentally-friendly degradation of the flame retardant tetrabromobisphenol A (TBBPA). TBBPA is a pollutant of emerging concern characterized by a strong persistence that has been associated with negative effects on both the environment and human health. The complete degradation of TBBPA during the HDH reaction ($[TBBPA]_0 = 1$ mg L^{-1}) was achieved in short reaction times (5 min) under ambient conditions using 1 g L^{-1} of a commercial Pd/Al_2O_3 (1% wt.) catalyst. Remarkably, bisphenol A, a known endocrine disruptor, was generated along reaction once TBBPA was completely debrominated. However, its complete removal was achieved by further hydrogenation. Although TBBPA suffered a strong adsorption on the catalyst surface, both adsorbed and free molecules reacted completely, and bromine balance was closed (>95%). HDH of TBBPA followed a pseudo-first order kinetic and a kinetic constant value of 1.03 min^{-1} was obtained. Furthermore, the effect of the temperature was evaluated between 15 and 35 ºC, obtaining higher degradation rates when the temperature increased. A resulting apparent activation energy of 36 kJ mol^{-1} was calculated. Notably, the catalyst showed a notable stability after three consecutive HDH runs.

KEYWORDS: catalytic hydrodehalogenation; water treatment; Pd supported catalyst; brominated flame retardant; TBBA

PAPER ID: CEST2021_00762

Synthesis of Fe_3O_4/Carbon Quantum Dots Hybrid for Efficient Removal of Congo Red Dye from Aqueous Solution

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ABSTRACT

During the past decades, the release of toxic pollutants into aquatic environment has continuously increased due to rapid industrialization and civilization. The presence of organic dyes, such as Congo Red (CR), can be dangerous to both human and aquatic life. Therefore, their removal is an imperative need. Many technologies have been developed for water treatment. Among them, adsorption is the most popular due to its simplicity and low cost. Aim of this work is to synthesize an Fe_3O_4/carbon quantum dots (C-QDs) adsorbent and evaluate its performance in the removal of CR dye from aqueous solutions. More specifically, adsorbent Fe_3O_4/C-QDs was successfully synthesized via a solvothermal method, using ferrocene ($C_{10}H_{10}Fe$) and hydrogen peroxide (H_2O_2) as starting materials. The process took place in a Teflon-lined autoclave at 200 °C for 18 h in the presence of acetone. A series of Fe_3O_4/C-QDs hybrids were synthesized by adding different amounts of H_2O_2 aqueous solution, in order to investigate their physicochemical properties. The obtained Fe_3O_4/C-QDs hybrid materials were characterized using XRD, TEM, micro-Raman, FT-IR, and N_2 adsorption/desorption measurements. Lastly, the adsorption capacity of the Fe_3O_4/C-QDs toward CR was investigated using a UV-Vis spectrophotometer.

KEYWORDS: Fe_3O_4, carbon quantum dots, water treatment, Congo Red

PAPER ID: CEST2021_00251

Removal of phosphate ions and Pb (II) from synthetic water matrices using "green" synthesized zero valent iron

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ABSTRACT

In this paper, phosphates and lead were chosen as the priority pollutant, because their increased concentrations in water can be caused by the release of various untreated effluents and thus can cause serious damage to the environment. Nano zero valent iron synthesized by leaves, In addition to being considered an environmentally friendly method, it is a stable and efficient material. The influence of process conditions was examined by applying a statistical model of the new generation - definitive screening design, which played a significant role in the optimization of the entire experiment. The influence of 4 process parameters on the efficiency of lead removal was examined: initial phosphate concentration (from 1 mgL^{-1} to 9 mgL^{-1}) initial lead concentration (from 1 mgL^{-1} to 9 mgL^{-1}), dose of nZVI (from 2 mL to 16 mL) and pH value (from 2 to 10). Under optimal conditions, the dose of nZVI 9 mL, 8.76 mgL^{-1} , phosphate concentration 2 $mgL^{-1}$and pH value 3 the removal efficiency is 99.41%. Based on the verification and confidence interval, the adopted model was found to be appropriate and to describe well the process of removing phosphate in the presence of lead from the synthetic aqueous matrix.

KEYWORDS: oak-nZVI, Lead, Phosphorus, statistical model

PAPER ID: CEST2021_00778

SESSION 41 - ENVIRONMENTAL HEALTH

Saturday 4 September – morning

Particulate Matter impacts on public health in a Mediterranean coastal city, Patras, Greece

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ABSTRACT

It is of great consensus among the scientific community that particulate matter (less than 10 μm or 2.5 μm in diameter, hereafter PM_{10} and $PM_{2.5}$, respectively) has become a significant threat for human health in modern urban agglomerations. Taking into consideration the intensification of urbanization, given that in 2030 more than 60% of the world's population is expected to live in cities, urban morbidity and mortality due to adverse impacts of PMs is very likely to increase. This is the case of a Mediterranean coastal city, Patras, which is Greece's third-largest city and the regional capital of Western Greece, in the northern Peloponnese.

The goal of this study is to examine the effects of PMs on the cardiopulmonary mortality within the framework of the AirQ+ model, developed by the World Health Organization. We focus on the Relative Risk (RR) of cardiopulmonary mortality attributed to PM_{10} and $PM_{2.5}$ concentrations. The datasets used in the analysis concern daily means of PM concentrations acquired from the network of the Laboratory of Atmospheric Physics, Department of Physics, University of Patras, covering background, urban city center and north/south urban areas of Patras, within the period 2017-2019.

KEYWORDS: Particulate Matter (PM_{10}, $PM_{2.5}$), Cardiovascular and Respiratory Mortality, Patras, Greece

PAPER ID: CEST2021_00205

Do the weather conditions drive the spread of COVID-19? The Case of Greece

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ABSTRACT

The new global pandemic of COVID-19 declared on March 11, 2020, by the World Health Organization, has already caused unprecedented health and socio-economic impacts, worldwide. The second wave of the COVID-19 pandemic has been sweeping the Unites States of America and Europe since late September 2020. The northern countries of Europe (Germany, France, Austria, Finland, Sweden) faced this second wave of the pandemic earlier in September 2020 against other southern countries, such as Greece, where there was a significant increase in cases in late October 2020.

To understand the spread of COVID-19 in Greece, from the environmental perspective, we try to examine the effect of air temperature, humidity and wind on the emergence of COVID-19. More specifically, we concern whether warm and wet conditions have a positive effect by decreasing the number of COVID-19 cases, while on the contrary, cold and dry conditions are associated with increasing cases. We apply Pearson correlation analysis and Generalized Linear Models taking as dependent variable the confirmed admissions in intensive care units (ICU) of COVID-19 from the National Public Health Organization and the corresponding air temperature, humidity and wind speed from the Hellenic National Meteorological Service, as independent variables. The analysis concerns Athens and Thessaloniki, the two largest cities in Greece.

KEYWORDS: COVID-19 pandemic, meteorological conditions, Generalized Linear Models, Greece

PAPER ID: CEST2021_00213

Analysis of fungal bioaerosols in Athens: a pilot study.

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ABSTRACT

This pilot study is the first attempt to describe the bioaerosol composition found in Athens' urban air by DNA barcoding. There are currently limitations in establishing a direct link between fungal exposure and health effects due to shortcomings of existing sampling and analysis methods, among other reasons. New sampling technologies and molecular techniques can achieve a better understanding of this link.

We collected airborne samples using Rutgers Electrostatic Passive Sampler (REPS). We studied the taxonomy, diversity, and frequency of captured airborne fungal particles by extracting and purifying fungal DNA present in samples and then sequencing it. Four sampling campaigns were conducted in 2019 and one in 2020 at the National Observatory of Athens meteorological and environmental station of Thisseion. Five samples plus two controls were used each time. Sequence analyses are now routine in systematics, taxonomy, and fungi ecology, with the nuclear ribosomal operon being the most frequently targeted genetic region. The variable spacers ITS1 and ITS2, jointly or separately, are often species-specific. Thus, the internal transcribed spacer (ITS) region was our primary choice for molecular identification of fungi. We detected 13 classes of two phyla (Ascomycota and Basidiomycota) and approximately 133.000 OTUs. The dominant classes (>10.000 OTUs) were *Dothideomycetes, Malasseziomycetes, Leotiomycetes*, and *Microbotryomycetes*.

KEYWORDS: Fungi, bioaerosols, Athens, DNA barcoding, taxonomy

PAPER ID: CEST2021_00514

CEST 2021

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Application of the PALM4U Model Coupled to WRF/Chem Model to Evaluate Wind Comfort and Air Pollution Impacts for Urban Scenarios

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ABSTRACT

Air pollution and wind comfort are both important indicators of quality of life in urban environments. This study examines the influence of a tree area (Green Park) on the wind patterns and air pollution concentrations over a downtown urban area (1 km x 1 km) in Madrid (Spain) with the CFD PALM4U model (5 m spatial resolution) coupled with the WRF/Chem mesoscale chemical model. Two numerical experiments have been performed: a) with trees (BAU) and b) without trees (NOTREE) to investigate the impacts of trees on the wind patterns and air pollution concentrations. Nitrogen dioxide and ozone concentrations in the BAU scenario were compared with the values at the pollution monitoring station in the area to validate the simulations. The impacts (BAU-NOTREE) indicate that the pedestrian wind comfort and NO_2 concentrations is greatly affected by the trees far away of the Green Park area. In some specific locations in the area the NO_2 concentrations are found to increase up to 10% and in other locations, reductions of up to 20% are found. This results demonstrate the efficiency of using sophisticated CFD numerical models, such as PALM4U, for conducting air quality and micro-climate simulations in urban areas.

KEYWORDS: PALM4U, CFD, wind and urban pollution

PAPER ID: CEST2021_00668

Assessment of radon concentration in a residential building – a case study

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ABSTRACT

It is known that the highest contribution to the yearly radiation dose for population derives from natural radioactivity. About 50% of that is estimated to be caused by exposure to radon (Rn) and its products. Human exposure to indoor Rn is currently considered as a relevant research topic, because of the associated epidemiological aspects. This paper assessed Rn concentrations in the basement of a building in Kosice city, Slovakia. The continuously monitoring of indoor radon levels was performed over a period of 16 days, during a reconstruction of the basement. The measured concentrations ranged in a wide interval from 5 to 113 Bq/m^3 with the average value of 24.3 Bq/m^3. The WHO limit value of 100 Bq/m^3 was exceeded only in a short period during two weekend days when the basement was closed and there was no activity and only limited air exchange. This could point to the potentially higher radon concentrations under normal operation of the building and thus to the increased radiological risk due to radon accumulation in the basement.

KEYWORDS: radioactivity, indoor air quality, radon, ventilation

PAPER ID: CEST2021_00043

Environmental attitudes in times of a pandemic

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ABSTRACT

The COVID-19 pandemic has undoubtedly had severe impacts on health care and economies everywhere in the world. This disaster, however, provided us with a unique opportunity: the privilege to watch nature healing due to the restriction measures applied on a global scale. Even though the positive environmental effects proved temporary, could this period serve as an example of what sustainable human behavior is? Has this disaster brought people closer to understanding the effects of their choices? Do people realize the connection between natural processes and the pandemic? Can people actually learn and adapt to a new normal? The present study aims to test the hypothesis that individual environmental beliefs and COVID-19 perceptions influence environmental attitudes and behavior. For this purpose, an on-line questionnaire survey was conducted, within the academic community of the Aristotle University of Thessaloniki, Greece, investigating the relationship between the effect of the pandemic on individual environmental behavior and attitudes. The results of this study hope to contribute to the efforts of the global community to effectively answer these questions, in order to gain a clear view on how to respond to future climate and other environmental challenges, which are, in a broader sense, pandemics as well.

KEYWORDS: COVID-19, environmental behavior, environmental attitudes, sustainability

PAPER ID: CEST2021_00200

Increased use of antiseptics due to COVID19: a case study in Greece - anticipated effects on the marine environment

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ABSTRACT

COVID19 pandemic started in China in 2019, when a coronavirus appeared that spread globally, causing severe health problems and increasing mortality. At that time, as there were no effective pharmaceuticals for treatment and no vaccines for protection, the only available means were preventive measures: antiseptics and masks. There has been a dramatic increase in their use, for human protection. However, the final receiver of all substances contained in antiseptics is the marine environent, where adverse effects could appear, degrading its quality, affecting marine organisms, and eventually, human. This paper reports the first study in Greece regarding the quantities of antiseptics used before and after COVID19 outbreak, in order to estimate their increase, while in parallel, an investigation of ingredients of antiseptics and their possible toxic effects was performed, in order to provide a primary picture of anticipated future effects of their increased use on the marine environment.

KEYWORDS: COVID19, antiseptics, ingredients, toxicity, marine environmental effect

PAPER ID: CEST2021_00837

Clean water – Healthy city. Using of WBE for monitoring of the consumption of illicit drugs in the city Prague

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ABSTRACT

The results of the three years long project named *Municipal wastewater as a diagnostic medium of the capital city of Prague* are presented. The post informs about regular, almost two-year long monitoring of municipal wastewater at selected sampling points of the Prague sewerage network. In addition to selected illicit drugs and some pharmaceuticals (e.g. methamphetamine, MDMA, THC, cocaine, fentanyl), nicotine and its metabolites and the ethanol metabolite ethyl sulphate were monitored in municipal wastewater. 24-hour composite samples each fourth day (the first year) or eighth day (the second year) were collected. There were obvious differences in consumption of individual drugs in different parts of the city. For the purposes of the project, analytical methods standardly used in the laboratory for the determination of monitored substances were extended. The project included a Socio-economic study of spatial distribution of the population and identification of risk areas in terms of population lifestyle.

KEYWORDS: wastewater-based epidemiology, illicit drugs, nicotine, alcohol, monitoring

PAPER ID: CEST2021_00473

Training Opportunities for Estonian Elite Athletes in the COVID-19 situation

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ABSTRACT

COVID-19 pandemic influences different aspects of society, especially sports. The aim of research was to assess the changes in training conditions and aspects of training of Estonian elite athletes in the COVID-19 situation and get feedback of athletes` assessment about pandemic impact of the on Estonian sports. 102 Estonian athletes (♀ = 58; 24.68 ±8.55y) filled in the electronic self-rate questionnaire. The training of Estonian elite athletes in the COVID-19 situation continued but changed. Athletes were mostly disturbed by the cancellation of competitions (70.6%) and change in training conditions (62.1%). Instead of usual training places, forests, gardens, city streets, homes, as well as public bathing places (rivers, lakes) were used. The strongest negative impact of the pandemic according to athletes' opinions was on their economic situation. The majority of respondents (90.8%) ware positive and thought that (1) the pandemic has little effect or (2) who were able to adapt to a new situation and stay motivated still come out of the situation even stronger. Governments and sport organizations should consider financial support for affected athletes in current situation, and also initiate prevention strategies for the future.

KEYWORDS: COVID-19, elite athletes, training conditions

PAPER ID: CEST2021_00651

SESSION 42 - CIRCULAR ECONOMY AND INDUSTRIAL SYMBIOSIS

Saturday 4 September - morning

The Circular Economy Shift for Business Models: Creating value from waste in the Peach Canning industry

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ABSTRACT

With the Circular Economy (CE) concept emerging, the reorganization of the supply chain (SC) and the reengineering of its processes is highlighted. In Greece, industrialized agriculture and more specifically the peach canning industry can be an important factor for the economy within and outside the country's borders, with the total yearly exports worth at around 400 million euros. However, an important source of waste is not utilized in the optimal way; the kernel is often mistaken as a useless by-product or at best as biomass. This paper focuses on the optimization of this supply chain achieved through CE applications, by separating the seed from the kernel's wooden exterior and utilizing it to create new products that will provide added value for the SC, while the wooden exterior serves as biomass feedstock. The resulting products studied include (i) the peach oil which can be consumed as is or in cosmetics and (ii) natural medicine. The above mentioned are investigated and valued, in order to shift the peach canning industry's business model, thus reinventing the sector. Finally, the new optimized SC framework is presented under the prism of CE, which can be applied for other processed stone fruits.

KEYWORDS: Circular Economy, Sustainability, Peach Canning, peach kernel utilization, peach waste management

PAPER ID: CEST2021_00085

Quantification of feedstocks and outputs for a regional Bioeconomy using the AD Biorefinery concept.

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ABSTRACT

Greenhouse gas emissions (GHG's) from agriculture in Northern Ireland account for over 27% of regional emissions, as opposed to 7% for the UK overall, leaving the region with challenges in meeting climate abatement targets. The development of a sustainable regional Bioeconomy has been identified as a key requirement for regional sustainability. Previous research carried out as part of the Northern Ireland Biogas Research Action Plan, had quantified the feedstock available for Anerobic Digestion (AD) in Northern Ireland, and estimated potential biogas and biomethane yields. This research builds upon and extends that work by applying the AD biorefinery concept to include both biological and thermochemical feedstocks and utilisation pathways. The research has quantified the potential feedstocks for AD coupled with gasification and has explored utilisation pathways for the outputs of the processes, including AD digestate to gasification and applications of biochar. The utilisation pathways have been evaluated for their potential in meeting GHG reduction targets and suitability indicators have been applied to a range of scenarios and a scenario analysis model developed. The limitations of this research have been identified and recommendations have been made for future research priorities.

KEYWORDS: Bioeconomy, anaerobic digestion, gasification, biogas, syngas, biochar.

PAPER ID: CEST2021_00247

Shipyards and Ship breaking: Opportunities for utilization of steel under the prism of Circular Economy

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ABSTRACT

Among the activities that constitute the process of dismantling a ship is the obligation of proper management of hazardous materials. As almost the entire ship can be recycled, reused or even resold, the ship dismantling industry can also be considered a "green" industry. The steel used by the maritime industry complies with the quality standards of shipbuilding, presents high durability and is a valuable raw material for reuse by the industrial sector. Following the Circular Economy principles, the ship's steel parts that haven't lost their material value, might re-entry the supply chain and be reclaimed as raw material by the steel industry after being processed. In the present work, a Circular Economy model based on the operation of a hybrid shipyard is proposed. Taking advantage of the facilities and the equipment of a moderate shipyard, it is proposed to include the dismantling activities of specific vessels, focusing on the abandoned ones. The advantages that result with the operation of this hybrid plant include: the reduction of the environmental footprint of ship breaking, assurance of steel tracking in the industry, saving of natural resources and energy, the use of recycled raw materials adopting circular economy practices, cost reduction and more.

KEYWORDS: Ship breaking, Steel, Circular Economy, Industry, Shipyard

PAPER ID: CEST2021_00289

Evaluation of Pressure-Driven Membrane Processes for Nutrients Recovery from Dilute Effluents

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ABSTRACT

Results are presented from an ongoing R&D project, aiming at full utilization of dairy-industry effluents. Development of a membrane-based method is pursued, for treatment of digestate (after fermentation yielding bio-gas) to recover nutrients (N-NH_4, P-PO_4) and water for reuse/recycling or safe disposal. The performance is investigated herein of four commercial nanofiltration/ultra-low-pressure reverse osmosis membranes, employed in dead-end filtration mode, for nutrients recovery from solutions simulating the liquid digestate/effluent of an anaerobic membrane-bioreactor (AnMBR). Best-performing membranes, regarding nutrients' rejection, were assessed within a sufficiently broad range of all key process parameters, including trans-membrane pressure and feed-composition. Further testing took place in a cross-flow set-up, simulating real operating conditions. For ~80% permeate recovery, the concentrate was significantly enriched in nutrients; i.e. compared to feed-solution, N-NH_4 was concentrated twice, whereas P-PO_4 was concentrated by 3- to 4-times. Research with real AnMBR effluent is on-going, for process improvements/optimization, mainly focusing on composition of concentrate/nutrients (for use in liquid fertilizers), membrane-fouling mitigation and quality of permeate/water for possible reuse.

KEYWORDS: nanofiltration, ultra-low-pressure reverse osmosis, dairy industry effluents, anaerobic digestate, ammonium and phosphorous recovery

PAPER ID: CEST2021_00354

Implementing Circular Economy in Wineries: The Case of Greece

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ABSTRACT

Grape is considered one of the largest fruit crops in the world, since its 2017 production, the vast majority of which was used in winemaking, reached 74 MT globally and 24 MT in the EU. The main target of this paper is to highlight the urgent need for transforming the linear model into a circular one in the case of agriculture, and especially in wine production. According to the International Organization of Vine and Wine, Greece held 1.3% of the total European wine production in 2018 (300,031 tons of wine), while at the same time it was ranked in the twelfth place in terms of wine production on a global scale. Therefore, it is of great significance to implement the circular economy model in Greek wineries. After an extensive literature review, this paper aims to examine whether a circular economy could be implemented in wineries adequately. Last but not least, it presents some of the valuable products that can be obtained from grape marc not only in the food industry but also in cosmetics, phyto-pharmaceutic sector, and in the animal feeding or bio-fertilizers.

KEYWORDS: circular economy, winery, wine industry, agriculture, wine waste management

PAPER ID: CEST2021_00534

Biobased Lubricants within a Circular Economy Concept: Utilization of Spent Coffee Grounds as an Alternative Sustainable Feedstock

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ABSTRACT

The economy is gradually transitioning to a circular model that extends resources, reduces waste and requires a great deal of creative thinking. Both established and emerging global economies view waste as a bioresource for our next generation energy, chemicals, or platform molecules and materials. Due to the substantial quantities of food-type waste generated each year worldwide, there is a global social and economic need to re-use, re-cycle and/or re-cover these "losses" under sustainable approaches. Nowadays a growing recognition evolves that the twin problems of waste management and resource depletion can be solved together through the utilization of food waste as a resource, using green and sustainable technologies that can play a significant part in the forthcoming bio-economy era. Coffee is one of the most popular beverages with the consumption continuously increasing and generating huge amounts of solid residues in return. This solid waste after the extraction of the coffee beverage is known as Spent Coffee Grounds (SCG). SCG valorization may be directed towards the production of high added value commodities such as lubricants. The biobased lubricants market has been grown substantially the years before, making it one of the promising bio-sectors with multiple applications. Further evolution of this segment shall be based on the concept that biolubricant don't just have to be environmentally acceptable but also have to fulfill the targets of the new sustainable development agenda that dictates the protection of natural resources through the increasing exploitation of waste materials under industrial symbiosis notions. In this work the capabilities of materializing SCG as a source for biolubricants is explored, the possible pathways and the product's quality are analyzed while the overall sustainability of the process is discussed.

KEYWORDS: biolubricants, waste valorization, food waste, sustainability, bio-commodities

PAPER ID: CEST2021_00545

The Lombard Dairy Industry in the Perspective of Circular Economy: Degree of Application and Improvement Potentials

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ABSTRACT

Circular Economy is an economic concept, aiming at increasing resource efficiency, recirculating resource streams and minimizing waste of an industrial process. Thereby, ideally, environmental impacts can be decreased while the profitability of the considered process is improved. This concept is growing increasingly popular among the scientific community. Yet, due to the immense variety of potential applications, it can be difficult to assess the degree of application in a particular industrial sector at a given time. For this contribution, a survey is conducted among producers of dairy products, in Lombardy, Italy. The aim of the survey is to investigate the current degree of application of Circular Economy among these producers considering waste recovery, by-product valorization, and renewable energy production. Furthermore, the producers' perception of Circular Economy is tested, and their interest in an intensified implementation inquired. Considering the most relevant resource streams (i.e., by-products, water, energy, and solid waste), more detailed questions are added, focusing on internal management and recovery strategies.

KEYWORDS: cheese production, sustainability, resource efficiency, by-product valorization, waste recovery

PAPER ID: CEST2021_00215

Comparison of the effectiveness of three outranking multicriteria methods as analytical tools for the efficiency assessment of biorefineries/waste-to-energy technologies

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ABSTRACT

Circular Economy is at the heart of the EU Green Deal and Waste Management has been focusing on material and energy recovery. Waste-to-energy (WtE) technologies are focused in increasing the resources recovery as they allow the utilization of wastes that cannot be incorporated in other recovery schemes. Rigorous methodologies for the evaluation of the different WtE technologies are necessary for the efficient comparison of the available options. Several thermodynamic assessment methodologies have been presented in the literature, such as the 3T method and the R1 formula, whose calculations for the evaluation of WtE technologies are effective for conventional energy surplus cases. Nonetheless, in scenarios where the focus is on the production of materials and there is an energy deficit, these methods have some limitations. In this study, we utilize Multi-Criteria Decision Analysis (MCDA) methodologies for the assessment of WtE plants by integrating the 3T method parameters in three different outranking methodologies, i.e., PROMETHEE, TOPSIS, and ELECTRE, in order to provide an integrated assessment and create rankings of preference. The differences in the assessment results are observed and possible reasons for the variations are identified, alongside for consideration on future research to enhance the robustness of the proposed methodological developments.

KEYWORDS: Waste-to-Energy, Energy Efficiency, Waste Management, MCDA

PAPER ID: CEST2021_00540

SESSION 43 - WASTEWATER-BASED EPIDEMIOLOGY TO MONITOR COVID-19 OUTBREAK: PRESENT AND FUTURE DIAGNOSTIC METHODS TO BE IN YOUR RADAR

Saturday 4 September - morning

SARS-Cov-2 in wastewater: a seven-month period of monitoring infection dynamic in Athens

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ABSTRACT

Since December 2019, COVID-19 has spread rapidly all over the world with considerable morbidity and mortality. SARS-CoV-2 infections are accompanied by the shedding of virus in feces of both symptomatic and asymptomatic individuals, indicating that Wastewater-based Epidemiology (WBE) is an appropriate chemical tool to monitor the number of infections and disease prevalence in a community level.

In the current study, SARS-CoV-2 load was measured in influent wastewater from Athens from November 2020 until May 2021. PEG precipitation and Water DNA/RNA Magnetic Bead kit were selected as the concentration and extraction method, respectively.

The study timeline is divided in three different phases based on the levels of viral load. On 7th of November 2020, Greek government announced the second strict total lockdown after March 2020. Viral load was stable during December and the first days of January, indicating the effectiveness of lockdown and restrictions. After the announcement of the third lockdown (20th of February) the viral load reached peak levels especially during April (more than 100,000 copies/L from 17th to 20th of April). On May 14th, the end of lockdown was announced, while the number of vaccinations had been increased and the viral load was significantly decreased to approximately 37,000 copies/L.

KEYWORDS: Wastewater-based epidemiology, SARS-CoV-2, COVID-19, infection, wastewater surveillance

PAPER ID: CEST2021_00842

Monitoring illicit stimulant drug use in Cyprus during the COVID-19 lockdown by UPLC-MS/MS

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ABSTRACT

The occurrence and spread of the novel corona virus SARS-CoV-2 at the end of 2019, has led WHO to announce the outbreak of a pandemic. Restriction measures were taken from authorities globally, in order to impede its spread. In Cyprus, a strict lockdown period was implemented on the 24th March of 2020 and lasted until the end of April, with many restrictions still remaining. During the COVID-19 crisis, Wastewater Based Epidemiology (WBE) or otherwise environmental surveillance, has been proven to be a useful tool, enabling the investigation of various aspects of the pandemic. This work focuses on the impact of the lockdown restrictions implemented in Cyprus on the consumption of illicit, stimulant drugs, employing the WBE approach. Influent wastewater samples collected during the lockdown period were analysed to estimate amphetamine, methamphetamine, MDMA and cocaine consumption during this period. A similar sampling campaign was conducted one year earlier, during April of 2019, and the results were compared.

The first campaign was conducted between 3-9 of April 2019 and the second, between 21-27 of April 2020, during the strict lockdown period. Daily composite 24-hour samples of influent wastewater were collected from two WWTPs of the country, LIM and AGN, serving one big city and a touristic area, respectively. All samples were spiked with a mixture of internal standards. After solid phase extraction, the samples were analysed for amphetamine, methamphetamine, MDMA and benzoylecgonine, using an ACQUITY TQD UPLC-MS/MS system (Waters Corp, USA), with a triple quadrupole mass spectrometer operating in positive ionization mode. The analysis and method validation procedures were based on the European Network of SCORE (Sewage analysis CORe group Europe), SCORE-Protocol of Action for the analysis of illicit drugs.

For amphetamine, methamphetamine and MDMA, the concentrations of the parent compounds were used for the determination of the consumption of each drug. For cocaine, its main metabolite's concetration, benzoylecgonine, was used. Back-calculations, requiring the polulation served from a specific WWTP, influent daily flows and a correction factor, CF, that accounts for excretion rates and the molar mass ratio of the parent/metabolite, were applied to convert the concentrations of each drug in the influent samples to consumption of the drug, in mg/day/1000 inhabitants. The CF values, adopted

from the most recent literature, were 2.77, 2.44, 4.4 and 3.59 for amphetamine, methamphetamine, MDMA and cocaine, respectively.

The analysis showed that amphetamine use was not affected from the imposed lockdown at both areas studied. At the LIM site, the average consumption of this drug during the 2019 campaign was 13.4 mg/day/1000 inhabitants, while during the lockdown sampling, the corresponding value was 9.5 mg/day/1000 inhabitants. The amphetamine consumption estimated at the AGN site was slightly lower than that at the LIM site, during both campaigns. Average methamphetamine consumption was found to decrease significantly at the LIM site during the lockdown, dropping from 136.5 during 2019, to 35.2 mg/day/1000 inhabitants during the lockdown. At the AGN site no significant change was observed, where the mean consumption during 2019 and lockdown were 51.0 and 46.0 mg/day/1000 inhabitants, respectively. The lockdown led to a remarkable decrease of the MDMA consumption at both sites: At the LIM site, where the average MDMA consumption was 60.1 mg/day/1000 inhabitants during the 2019 campaign, was found to be 5 times lower. The initial MDMA mean consumption of 17.3 mg/day/1000 inhabitants at the AGN site dropped below the method's LOQ. The lockdown strongly impacted the use of cocaine, as well. At the LIM site, where the consumption during 2019 was 977.9 mg/day/1000 inhabitants, a more than 6 times decrease was observed. Similarly, at the AGN site, a significant decrease, from 433.0 to 118.0 mg/day/1000 inhabitants was observed.

KEYWORDS: Wastewater based epidemiology, illicit drugs, wastewater, COVID19, UPLC-MS/MS

PAPER ID: CEST2021_00360

Monitoring of SARS-CoV-2, noroviruses and adenoviruses in wastewater in the Czech Republic

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ABSTRACT

Monitoring SARS-CoV-2 presence in wastewater has been carried out since April 2020, when the new disease COVID-19 began to spread rapidly in the Czech Republic. The aim of this study was to detect viruses in order to evaluate the possibility of using wastewater analysis as one of the tools for the establishment of an early warning system. As a complement to SARS-CoV-2 RNA detection, noroviruses and adenoviruses were detected, as well. In the first round of monitoring, which took place from April to June 2020, a total of 122 samples of untreated wastewater were collected from 35 WWTPs of different size within the Czech Republic. Viral RNA was concentrated from wastewater and RT-PCR was used to detect RNA of viruses. SARS-CoV-2 RNA was found in 15 % of all samples, noroviruses in 43 % and adenoviruses in 95 %. It was confirmed that even low amounts of SARS-CoV-2 RNA in wastewater might be detected. Our data indicate that wastewater analysis may be a suitable tool for the establishment of early warning system. However, for unambiguous interpretation of data, it is necessary to evaluate other factors that might significantly influence the concentration of viral RNA in wastewater.

KEYWORDS: SARS-CoV-2, wastewater, PCR, WWTP, WBE, adenoviruses, noroviruses

PAPER ID: CEST2021_00408

SESSION 44 - MARINE ENVIRONMENT AND COASTAL MANAGEMENT

Saturday 4 September - morning

Numerical Modelling of Wave Reflection from Port Structures for Reliable Forecasting of Berth Downtime

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ABSTRACT

Forecast of wave agitation inside port basins and consequent downtime of berth positions are of utmost importance to make a port “smarter” by efficiently managing its infrastructure. Within Accu-Waves project (http://accuwaves.eu), a decision-making tool is being developed to provide forecast data on prevailing sea states in the vicinity of port entrances and inside harbour basins. The said tool will be based on cooperating hydrodynamic models that derive data from global scale, open sea forecasts. The implementation of the project includes development and application of a hydrodynamic circulation model, a spectral wave propagation model and a phase-resolving wave model for port basins. The latter is based on the hyperbolic mild-slope (HMS) equations, capable of simulating wave propagation and reflection. In order to achieve higher levels of simulation accuracy in the vicinity of waterfront structures, we need to robustly model the reflection of incipient waves from such structures (e.g., quay walls). In the present paper, this need is met through the incorporation of an additional, case-specific eddy viscosity coefficient to the governing mild-slope equations (of the phase-resolving wave model). This coefficient accounts for the energy dissipation on port structures’ fronts and its value is decided based on the corresponding reflection coefficient. A basic set of incident wave scenarios are simulated, required in investigating the numerics of reflection by the corresponding eddy viscosity coefficients in the wave model. Our pilot investigation refers to numerical experiments for several cases of waves approaching an either fully or partially reflective vertical quay wall. The proposed methodology could enhance similar HMS models; its results should be valuable for port operators.

KEYWORDS: port downtime, wave reflection, quay walls, numerical modelling, smart ports

PAPER ID: CEST2021_00163

Marine biofilms development: the importance of hydrodynamic conditions and their impacts

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ABSTRACT

Biofouling is an ongoing concern in aquatic environments and marine applications, leading to environmental impacts, contamination of aquaculture facilities, surface corrosion, decrease of hydrodynamic performance in ships and significant economic losses. Cyanobacteria are early marine surface colonizers and the most common fouling organisms on marine immersed surfaces. There is scarce information about marine biofilm reactors and their hydrodynamic characterization, which may enable them to mimic real environmental conditions. In this work, computational fluid dynamics was used to determine the shear rate field on coupons that were placed inside the wells of agitated 12-well microtiter plates. Biofilm formation by different filamentous cyanobacterial strains was assessed at two different shear rates (4 s^{-1} and 40 s^{-1}) which can be found in natural ecosystems and using two different surfaces (glass and perspex). Biofilm formation was higher under low shear conditions and the hydrodynamic effect was more noticeable during biofilm maturation than during initial cell adhesion. This study highlights the use of 12-well microtiter plates as a high-throughput platform to mimic the hydrodynamics on aquatic environments and a promising approach to evaluate different surfaces or even compounds for biofouling control.

KEYWORDS: marine biofouling, cyanobacterial biofilms, hydrodynamic conditions

PAPER ID: CEST2021_00284

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Electronic Navigational Charts Portrayal and S-100 Standard based Services for Environmentally Sensitive Sea Areas

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ABSTRACT

Data and information on the condition and variability of the marine environment are crucial for understanding changes that result from human activity, including the effects of human-induced climate change. Large quantities of marine related data are collected and stored globally for a wide variety of purposes and by diverse groups of both public and private entities, facilitating the development of Marine Spatial Data Infrastructures (MSDI), that enable a broad range of societal benefits. Nevertheless, in recent years search and rescue operations have been increased for maritime accidents and environmental degradation incidents. For the prevention of such events, advanced electronic navigational chart systems could be used by both vessels onboard and the operations centres for risk-based coordination and access to accurate data for the prevailing conditions around the increased risk area. The capability of the new IHO S-100 standard for electronic navigational charts to support Marine Information Overlays (MIOs) enriches the provided information, as it includes both static and dynamic information such as vessel traffic, tides, currents, weather conditions as well as precise coordinates of sensitive marine protected areas. New applications and services utilising data based on the S-100 series of standards are at the forefront of the IMO's e-Navigation strategy realisation, for the interactive coordination of shore-based stations with vessels, providing automated transmission of enriched data and enhanced portrayal on electronic navigational chart systems for risk-based voyage planning and environmental protection decision-making.

KEYWORDS: Electronic Navigational Charts (ENC); Portrayal; IHO S-100; Environmentally Sensitive Sea Areas (ESSA); Marine Spatial Data Infrastructure (MSDI); Marine Protected Areas (S-122)

PAPER ID: CEST2021_00639

Implementation of Maritime Spatial Planning (MSP) in Cyprus focusing on the European MSPs' good practices.

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ABSTRACT

The implementation of Maritime Spatial Planning (MSP) in each European country aims to bring together different public authorities and stakeholders to sustainably organize and map marine and coastal resources. The first step for the development of MSP was achieved successfully for Cyprus, through the implementation of the first cross-border project, "THAL-CHOR." Following the "THAL-CHOR" project, its successor project entitled "THAL-CHOR 2", is expected to evaluate the increased needs for the management and monitoring of the maritime space, the design and implementation of relevant policies focusing on the European MSPs' good practices and to set up the draft maritime spatial plan for the marine waters of Cyprus. The implementation was achieved by combining the principles of maritime spatial planning with issues of wider maritime governance, politics and economics while taking into account good practices by international organizations and individual states. For the study of MSP, all data from THAL-CHOR project were combined with the updated data resulting from the implementation of "THAL-CHOR 2". The project is based on the institutional framework to analyze and organize human activities at sea and coastal space to achieve the synthesis of social, economic, environmental, and cultural objectives of the Republic. The aim is to submit different MSP scenarios to be a policy proposal that will promote sustainable development in the marine area and the coastal zones, pursuing the harmonious coexistence of activities and uses, applying an approach based on principles of sustainability.

KEYWORDS: THAL-CHOR 2, activities, coastal, Maritime Spatial Planning (MSP), European Good Practices

PAPER ID: CEST2021_00292

Disinfection byproducts and related compounds in the coastal zone: a preliminary compilation

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ABSTRACT

Disinfection byproducts (DBPs) are formed whenever disinfectant ingredients contact organic matter. Due to widespread increase in production and use of disinfectants and antiseptics, the presence of their ingredients in coastal environments is increasing. However, very limited scientific literature is available in regard to the occurrence of DBPs and related compounds in the coastal zone and in particularly in seawater. In this context, the aim of this preliminary complilation is to outline the main up-to-date findings and raise awareness on their increasing occurrence in coastal environments. Sampling and analysis of marine samples in the USA, Spain, China, Taiwan, Malaisia, Korea, Kuwait and Hong-Kong revealed the presence of several categories of DBPs and related compounds in coastal environments, with the highest levels being detected in urban areas, probably related to the nearby wastewater treatment plants. The investigations considered in this preliminary compilation, report the detection of DBPs and related compounds as well as the formation of toxic brominated and iodinated DBPs in high levels due to chlorination of wastewater, especially after use of seawater for flushing in toilets. New DBP groups have also been detected, namely halogenated phenolic DBPs and halopyrroles.

KEYWORDS: DBPs, synthetic antimicrobials, personal care products, seawater, coastal environment

PAPER ID: CEST2021_00834

Marine litter monitoring: the case study of Paros island

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ABSTRACT

Marine litter have been characterized as one of the main threats for societies, while among them, plastics have been found in various marine ecosystems. A monitoring project on marine litter, based on beach visual-surveys started in 2019, on Paros Island in the Aegean Sea, under the Clean Blue Paros initiative. Four main sandy beaches with different characteristics were primarily selected for seasonal sampling. Among the findings, Plastics were the most abundant litter category, covering 80.45% of the total items, followed by Food Waste and Textiles (7.3% and 5.2%, respectively). Among the beaches, only 3 items covered more than half of the total, namely cigarette butts and filters, ropes and small plastic bags. In a primary analysis, significant differences were found in the mean values of collected items between the two sampling years (2019 and 2020) in Martselo beach ($p < 0.05$, ANOVA test). In an effort to locally connect marine litter with their sources, a scoring matrix technique was applied for each beach, highlighting beach visitors as the primary input source, followed by fishing-related activities. On-going monitoring and additional awareness actions have been implemented to further support the overall effort of plastic pollution mitigation in the island.

KEYWORDS: marine litter, Paros island, plastics

PAPER ID: CEST2021_00488

SESSION 45 - WATER AND WASTEWATER TREATMENT AND REUSE

Saturday 4 September – morning

Development of Advanced Electrokinetic Separation for Sulfur-Containing Hot Spring Discharge with High Acidity

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ABSTRACT

Hot springs at the Beituo district, Taiwan are well-known for containing a significant amount of white or blue sulphur. With strong acidity and high conductivity, the used hot springs water did not meet the effluent water quality standards of the sewerage system. Discharging without appropriate treatment has adversely deteriorated the water quality of nearby Huang Gang rivers and agricultural irrigation ditch. Electrokinetic separation, an advanced water treatment technology with the concept of "circularity of resources", can separate and concentrate ions from water through an electric field. In this study, we investigated the feasibility of ions removal and neutralization from hot spring water by two different stacks of Electrokinetic separation. Stack A can successfully remove and recover ions from hot spring discharge with the concentrate of sulfate <72 mg/L in 30 min and promote pH to 3.5 in 60 min while Stack B with bipolar membrane has better performance for neutralization. With the obtained results, we evaluated the productivity and energy consumption of each system. Lastly, we compared the process performance of two electrokinetic separation systems from the aspects of engineering and economy.

KEYWORDS: Ion exchange resins, Electrodeionization, Conductivity, Neutralization, Circular economy.

PAPER ID: CEST2021_00449

Incorporation of negatively charged MWCNT-fGO self-assembled nanomaterials into PLA polymeric membranes for wastewater treatment

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ABSTRACT

The incorporation of nanomaterials in membrane's matrix aims mainly to improve the properties of the membranes such as hydrophilicity, mechanical strength, thermal stability, water flux. Multi-walled carbon nanotubes (MWCNT) and functionalized graphene oxide (fGO) have recently attracted attention, as they have proved to have potential in various applications. In this study, self-assembled MWCNT-fGO nanocomposite was synthesized and used as a filler in environmentally-friendly polylactic acid (PLA) membranes. The membranes were fabricated following the phase inversion method with different concentrations of MWCNT-fGO (2, 4, 6 and 8 wt.%). In addition, the membranes were tested for the removal of heavy metal ions from wastewater. The results showed that a considerable removal can be achieved using the composite membranes. For instance, the highest Cu2+, Ni2+ and Zn2+ removal (e.g., 89%, 35%, and 39%, respectively) was observed in the 8 wt.% MWCNT-fGO PLA membrane. This was achieved at water flux of 850 L·m-2·h-1 (LMH). On the other hand, the pristine PLA membrane water flux was around 450 LMH and was capable of achieving 82, 25, and 30% rejections for Cu2+, Ni2+ and Zn2+, respectively. These results showed the potential of the MWCNT-fGO PLA membranes application in treating heavy-metal containing wastewater.

KEYWORDS: Membrane filtration; wastewater treatment; carbon nanotubes; graphene oxide; self-assembly.

PAPER ID: CEST2021_00754

Investigating the effect of different NaCl concentrations as draw solution used to concentrate synthetic municipal wastewater in a Forward Osmosis system

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ABSTRACT

The main bottleneck towards resource and energy valorization of municipal wastewater is the low strength of sewage; characterized by low organic matter and nutrient concentrations. In this study, a bench scale Forward Osmosis (FO) system with a cellulose triacetate membrane (CTA) was used as a pre-treatment system in order to concentrate synthetic municipal wastewater. Increasing concentrations of sodium chloride (NaCl) (0.6, 1.2, 1.7, 2.7 and 3 M) were tested as draw solution (DS), achieving a concentration factor ranging from 1.4 to 4.4. Afterwards, the different concentrated effluents of the FO were anaerobically treated. Based on the results, the most concentrated sewage with the higher water recovery rates yielded higher methane production. The concentration of 1.2 M NaCl (similar concentration to the brine produced in seawater desalination) proves to be the most attractive solution. High water flux (J_w) can be achieved by utilizing the by-product of the reverse osmosis (RO) system as draw solution and closing the loop on the management of two non-conventional water sources.

KEYWORDS: Forward osmosis, synthetic municipal wastewater, water flux, NaCl, draw solution

PAPER ID: CEST2021_00272

Activated carbon-polyethyleneimine-alginate composite fiber for scavenging pharmaceuticals with different charges from aqueous solutions

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ABSTRACT

Activated carbon (AC) is a potential adsorbent for water purification, though it is difficult to separate after use. To solve this problem, for the first time, the ternary composite fiber (ACPEIA) of AC, polyethyleneimine (PEI), and alginate (A) was fabricated as a multifunctional adsorbent for scavenging pharmaceuticals with different charges from the aqueous environment. The hydroxyl functional group of AC was bonded with the aldehyde group of glutaraldehyde through nucleophilic addition resulting in adduct containing free aldehyde moiety for the action of cross-linker. The aldehyde functionalized AC was crosslinked with the amino group of PEI and the hydroxyl group of A resulting in ACPEIA. The carboxyl group of ACPEIA was further crosslinked with calcium ion through ionotropic gelation to give a stable fiber. The fiber demonstrated as a scavenger for removal of model contaminants with different charges such as 1-naphthol (NPT) as neutral, diclofenac (DCF) as anionic, and amitriptyline (AMT) as cationic pharmaceuticals at pH 6.5. The fiber revealed a maximum adsorption capacity of 814 μmol g^{-1} for NPT, 450 μmol g^{-1} for DCF, and 410 μmol g^{-1} for AMT. FTIR and XPS spectra of the fiber before and after sorption supported the adsorption mechanism like electrostatic interaction.

KEYWORDS: Activated carbon, Polyethyleneimine, Alginate, Pharmaceuticals, Adsorption

PAPER ID: CEST2021_00381

Start-up of full-scale UASB-vertical flow constructed wetland for domestic wastewater treatment

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ABSTRACT

This work examined the start-up of a full-scale upflow anaerobic sludge blanket (UASB) - vertical flow constructed wetland (CW) for domestic wastewater treatment. The UASB reactors were inoculated with sludge originating from an industrial anaerobic reactor and the start-up period due to the slow growth rate of anaerobic sludge and the low temperatures (<18°C) during this period, expanded the start-up phase to 3 months. After the start-up period, two different operational configurations were studied on the vertical flow constructed wetlands with the application, or not, of internal recirculation between the saturated and unsaturated CW beds. During the 1st period of relatively stable operation, the UASB-CW system (with CWs recirculation mode) treated 32.3±2.5 m^3d^{-1} of domestic wastewater achieving up to 92±5% of COD removal. During the 2nd period of operation, the system operated without recirculation between the 2 different types of vertical flow wetlands and under an influent flow of 65±4.0 m^3d^{-1} of domestic wastewater and achieved up to 96±1% of COD removal.

KEYWORDS: UASB, constructed wetlands, domestic wastewater treatment

PAPER ID: CEST2021_00829

SESSION 46 - AIR POLLUTION

Saturday 4 September - morning

Investigation of BVOC levels in a coastal urban environment: The Piraeus Port in Greece

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ABSTRACT

Biogenic volatile organic compounds (BVOC) constitute organic species of high reactivity, influencing thus the composition of the atmosphere through participation in various reactions leading to the formation of secondary pollutants. Despite their well established origin from vegetation, focus is given recently on the role of the anthropogenic emission sources. Monoterpenes, which are under investigation in the current work, have been measured in environments affected by traffic, shipping, biomass burning and industrial activities. Monitoring of monoterpenes (α-pinene and limonene) during 2019 was implemented at the recently established Atmospheric Pollution Monitoring Station of the Municipality of Keratsini-Drapetsona located close to the Piraeus Port in Greece. An automatic gas chromatograph with flame ionization detector on 30 minutes time resolution was used to measure a wide range of non methane hydrocarbons (NMHCs) from 6 to 12 carbon atoms. The seasonal variability of α-pinene and limonene demonstrated slightly higher values during summer and winter respectively. The correlations with other pollutants of anthropogenic origin indicated the impact of non-natural emission sources on their levels. Their potential to form ozone and aerosol was estimated and compared with already published data obtained at the urban background environment of Athens.

KEYWORDS: BVOC, monoterpenes, urban environment, harbor, Greece

PAPER ID: CEST2021_00463

Non-Road Mobile Machinery Emission Inventory in forestry – first results for Croatia

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ABSTRACT

Most countries do not have an emission inventory for non-road mobile machinery. Existing inventories are usually based on assumptions, with little available data, due to various factors: a large number of machinery type, a large variety of internal combustion engines installed in non-road mobile machinery, lack of activity data etc. In this paper, an emission inventory for machinery used in forestry in Croatia is developed. Since there is no available data on the machinery, a survey was conducted. Data on fuel consumption based on fuel type and machinery type were gathered. The data were processed and, using weight factors provided by the Croatian Bureau of Statistics, shown on a national level. The results are shown for two main fuel types, gasoline and diesel fuel. The resulting emission inventory is compared to emissions from road vehicles in Croatia by emission type per gigajoule of energy spent. Results show that most emissions come from tractors, forwarders and construction work machines and indicate that the proportion of emissions of non-road mobile machinery used in forestry, compared to road transport, is considerably larger than their respective proportion of energy consumption (up to 41 times).

KEYWORDS: non-road mobile machinery, emission inventory, forestry, Croatia

PAPER ID: CEST2021_00470

Evaluation of the effects of the Covid-19 restrictions measures on the air quality as a tool to implement prevention strategies

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ABSTRACT

The World Health Organization (WHO) at the end of January 2020 declared a Public Health Emergency of International Concern (PHEIC). At the end of March 2020, the epidemic turned into the pandemic. The consequent stringent lockdown measures adopted to mitigate the spread of the virus generated huge economic impacts, along with clear environmental consequences. The study analyses the effects on the air quality of the restrictions measures imposed to limit the spread of the virus, with the aim to investigate their effectiveness. The experimental studies are presented with reference to the territory of the Campania Region (Italy). The concentrations of the main atmospheric pollutants (eg. PM10, PM2.5, NO_2, CO, C_6H_6, O_3, SO_2) were analysed and compared in different lockdown scenarios, imposed by the policy-makers in relation to the progress of the pandemic. The influence of sociological, meteorological and geographical aspects was taken into account in the impact analysis. The results show a significant reductions of the concentrations of the monitored pollutants in the first complete lockdown and a correlation of trends in air quality with the recovery of some economic activities. The research contributes to the air quality control by suggesting weak spots and possible strategy to ensure high quality standards.

KEYWORDS: air quality, covid, policymakers, impact, pollutants

PAPER ID: CEST2021_00576

Assessment of particulate pollution in a medium sized Greek city - the effect of biomass burning and COVID-19 lockdown

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ABSTRACT

Airborne particulate matter (PM) with an aerodynamic diameter of 10μm or less has severe negative effects on human health. In many European urban environments, small residential heating appliances contribute significantly to the degradation of air quality by generating a substantial quantity of PM. In the present work, trends of PM_1, $PM_{2.5}$ and PM_{10} have been evaluated in a medium – sized European city, Ioannina, NW Greece. We analyze the most recent available surface concentration observations for the period 2014 – March 2021. The analysis showed that even if there is a strict legislation at EU and national level, PM emissions from residential combustion processes contribute significantly to air pollution during wintertime in Ioannina. Local topography, local-scale meteorological conditions and local sources impose a local plan of action to monitor air pollution. The analysis highlights the need for coordinated actions in local and national scale.

KEYWORDS: $PM_{2.5}/PM_{10}$, $PM_1/PM_{2.5}$, urban air quality, biomass burning

PAPER ID: CEST2021_00588

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An integrated and comprehensive tool to assess urban mobility strategies

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ABSTRACT

Transport planning is a challenging topic to be addressed in urban areas in order to create sustainable cities, due to the adverse health effects, noise and congestions generated by the transport sector. Therefore, policymakers require technical tools that allow to take regulatory transport decisions, considering environmental and health impacts. This work presents the development of an integrated and comprehensive tool to assess urban mobility strategies called MAITec. The methodology includes the implementation and application of specialized software to estimate health impact by transport emissions. The tool was implemented in a university district in Mexico. Results indicate that in the base scenario, people are exposed to high pollutant concentrations in some sectors of the distric, where traffic pollution claims approximately 9 lives every two years. MAITec was implemented in a free online platform and shared with local governments for its application.

KEYWORDS: sustainable mobility, health impact, air pollution

PAPER ID: CEST2021_00660

Performance Evaluation of a Portable and Cost-effective Atmospheric Particulate Matter Monitor

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ABSTRACT

Low-cost particulate matter (PM) sensors offer high potentials in air quality monitoring. Their performance, however, strongly depends upon the materials used, their design and on the sampling and operational conditions. In this work we evaluate the performance of the latest Alphasense PM sensors under real-life outdoor and indoor conditions. Our observations highlight differences in the accuracy of these sensors, especially when sampling aerosol particles that have different properties from those used for calibration and under real-life conditions, but also high potentials for improvements.

KEYWORDS: Low-cost PM sensors; Air quality; Indoor/Outdoor exposure

PAPER ID: CEST2021_00411

SESSION 47 - MICROPLASTICS IN THE ENVIRONMENT

Saturday 4 September - afternoon

Benthic megalitter detection using unmanned surface vehicle (USV) and Automatic Target Detection: A case study in the Port of Thessaloniki, Thermaikos Gulf

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ABSTRACT

In the port of Thessaloniki, Greece, benthic megalitter detection was achieved using an Unmanned Surface Vehicle (USV) equipped with a compact high resolution sidescan sonar (SSS) and a single beam echsosounder (SBES). The benthic megalitter survey was organized in two separate phases. Firstly, a systematic hydroacoustic survey using the SBES and SSS managed to outline and map all the acoustic anomalies. The second phase followed using the ROV hovered over these acoustic anomalies and the sites were identified on the video camera. An Automated Target Detection procedure, based on acoustic texture analysis and Independent Component Analysis (ICA), was applied for the automated detection of acoustic anomalies. The ground truth survey attested that the anomalies represent megalitter (metallic items, car tires, wires, e.t.c.). The developed procedure had promising results towards fast detection of the benthic megalitter in coastal areas.

KEYWORDS: Benthic megalitter, USV, Side scan sonar, ROV, Independent Component Analysis (ICA).

PAPER ID: CEST2021_00599

Tackling single-use plastic items in the Mediterranean

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ABSTRACT

Overall, plastics are estimated to account for around 95% of the waste in the open sea, on the seabed and on beaches across the Mediterranean. In the Mediterranean, it is estimated an annual plastic leakage of 229,000 tonnes, made up of 94% macroplastics and 6% microplastics [1]. The scope of this paper is to support the development of policy measures and guidelines to reduce/prevent the negative impacts associated with Single Use Plastics (SUP), by presenting information on the production, consumption, end of life management and impacts associated with selected SUP items across the Mediterranean region at present and illustrating the potential effects of different policy measures to reduce these impacts in the Mediterranean context. The research and analysis presented focuses on key SUPs in four Mediterranean countries, namely: beverage bottles, inc. caps and lids; food containers (bowls, clamshells, trays); straws; and cigarette filters in Greece, Egypt, Morocco and Montenegro. The design of policy measures to eliminate or reduce the consumption of problematic single use plastics must, inter alia, take into account the necessity for the item in question, and, where relevant, the availability of alternative products and systems to switch to [2]. The overall recommendations to consider for the policy guidelines, cover: improving waste collection/ separation – particularly along coastal areas and waterways; the use of bans and levies of SUP products to maximise effect; ensuring implementation of Deposit-Refund Systems (DRS) for beverage containers to support increased recycling rates, reduced littering of deposit-bearing containers, a reliable supply of high-quality recycled material, reduced greenhouse gas emissions and air pollutants; and increased employment.

KEYWORDS: Single-Use Plastics, Marine Littering, Deposit-Refund System, recycling, microplastics

PAPER ID: CEST2021_00519

"Plastisphere - the holistic approach and numerical description of microplastics surfaces"

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ABSTRACT

The aim of this research is to discuss the current state-of-art, basic data and the methodology for the quantitative and qualitative physical and chemical characterization of the marine microplastics (MMs; polymer debris < 5 mm) and the Plastisphere. In particular, the surface of synthetic materials is crucial as determines the type of biofilm which growths on the substrate. The main hypothesis of this paper, based on the preliminary research, is that the Plastisphere is not one biotope but the variety of diversified ecological niches. As the amount of MMs growths constantly and rapidly in the environment, the understanding of their behavior and ecological impact is one of the main challenges of the Anthropocene Era. It is crucial to perform the basic research of a Plastisphere from the point of view of its chemical and physical properties. The qualitative and quantitative characterization of the surface will be presented. This is an entirely new and important area of research combining the biological, chemical and physical approach. Although the Plastisphere is already extensively studied by microbiologist observing the biofilm and by material scientists interested in the weathering of polymer materials, there is no correlation between those approaches. The aim of this project is to construct the bridge between the physical and chemical description of the Plastisphere and its microbiological and ecological significance. Various algorithms, based on the profilometry and SEM pictures analysis, will be proposed to describe in detail the morphology of naturally weathered polymers. This holistic approach is necessary to better understand the eighth continent and its variety of niches. Finally, one can underline the importance of this emerging research area considering for instance the amount of antibiotic-resistant bacteria already found on a Plastisphere. The variety of samples measured includes: MMs filtered from pelagial waters, sea birds casts, primary sources materials, weathered fragments of littoral wastes, ghost nets, to name just a few. The results from those techniques: IR spectroscopy in ATR and reflectance mode, Raman spectroscopy (line 532 nm or one in the range 400-700 nm if needed), SEM-EDX, profilometry have been numerically modelled basing on the image analysis. Thanks to the spectra characterization, the risk of overestimation due to the inorganic debris visible in optical microscopy and erroneously classified as MMs, is limited and some preliminary qualitative description of weathering proposed. All in all, this approach addresses the interdisciplinary global problem of marine microplastics pollution providing the advanced physical and chemical characterization tools for the description of biological samples. The project addresses the current and globally important problem of plastics in the environment and tackle it from the unique and needed perspective - basic studies of physical and chemical properties.

KEYWORDS: Microplastics; Plastisphere; Roughness; Quantitative Characterization of Structures; Numerical Description, SEM Imaging

PAPER ID: CEST2021_00031

Citizens' awareness and education for tackling microplastic contamination in freshwater ecosystems

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ABSTRACT

Microplastics (MPs) are ubiquitous and persistent contaminants, particularly in river sediments reaching high abundances with potential to impair ecosystem functions and services of great importance to humankind. Thus, monitoring programmes and public awareness are pivotal to implement mitigation and remediation strategies. This study evaluated the abundance of MPs in freshwater sediments and in benthic macroinvertebrates collected at four sites with different anthropogenic pressures of Costa/Couros river (Guimarães - Portugal), in order to alert, raise awareness and educate local citizens for (micro)plastic pollution. Results showed higher levels of MPs in the sediments of sites with more anthopogenic preassure. High number of MPs was also observed inside macroinvertebrates' gut from all sites, particularly in low weight organisms indicating malnutrition and digestive disorders. Such results were incorporated into public awareness campaigns to increase the citizens' knowledge and understanding about MPs prevalence and threats to the environment, human health and the economy, as well as spread individual measures and actions that can reduce MP contamination in aquatic ecosystems. This educational study also promoted the artistic creation in public spaces to raise awareness about plastic pollution.

KEYWORDS: Microplastic; Sediments; Aquatic organisms; Citizens' awareness; Environmental education

PAPER ID: CEST2021_00253

Affordable multi-spectral imaging system for the identification and classification of microplastics from the environment.

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ABSTRACT

Studies on microplastic pollution commonly use expensive spectroscopic methods such as FTIR spectroscopy or Raman spectroscopy. Alternatively, studies could also employ cheaper methods such as optical microscopes, which are prone to errors. Here, we present an inexpensive and simple multi-spectral imaging system that is based on photoluminescence spectroscopy. The main components are a RGB camera, two light sources that have a wavelength of 365 nm and 405 nm and a set of bandpass filters (with a central wavelength ranging from 380 nm to 440 nm). Our study shows that the spectra acquired with both light sources are sufficient to distinguish plastics from natural materials and identify different plastic types. Considering the simplicity of the proposed system, this could be combined with methods to extract microplastics from the environment.

KEYWORDS: Microplastics, photoluminescence, spectroscopy, multi-spectral imaging system, affordable system

PAPER ID: CEST2021_00188

Characterization and toxicity assessment of industrial microplastics made of Bakelite

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ABSTRACT

Microplastic research has focused mainly on particles made of polymers from ordinary consumer plastic products while industrial plastics has been largely overlooked. However, industrial plastics as Bakelite can be of a great importance due to their extensive use and unknown impact on the environment. Hence the aim of the study was to characterize Bakelite microplastics and to evaluate their toxicity in term of particles and its leachate. According to laser diffraction analysis, the mean number particles size distribution was 7.64 ± 3.48 µm with $1.5 \cdot 10^6$ particles/mg. The specific surface area was 249 cm^2/g indicating low porosity. Bakelite microplastics were introduced into freshwater medium and the toxicity was evaluated. They did not affect specific growth rate and chlorophyll content, but significantly affected the root growth of duckweed. Further investigation showed that Bakelite microplastics do not cause mechanical effect on roots, but the leached chemicals were responsible for increased toxicity.

KEYWORDS: microplastics, duckweed, ecotoxicity, aquatic ecosystem

PAPER ID: CEST2021_00044

Extent and distribution of microplastic contamination in the benthic sediment of Turag river in Bangladesh

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ABSTRACT

Microplastics are ubiquitous in the aquatic environment. However, a limited number of studies have been conducted on the quantification of accumulated microplastics in benthic sediments of freshwater bodies, which pose threat to the health of benthic communities through food chain contamination. The research aims to quantify, categorize, and determine the distribution pattern of microplastic residues in the benthic sediment along the stretch of an alluvial river (adjacent to public and private establishments such as markets, mosques, universities etc.) on the northern part of Dhaka city. A two-step mechanism made up of size-fractionation and density separation was carried out for microplastic extraction. Extracted microplastics were classified based on size, type and density. The mean abundance was 559.03 ± 10.71 items per 500 g. ANOVA indicated a significant variability with respect to location, size and interaction between the two. Correlating size and microplastic number revealed the presence of a higher number of microplastic in smaller size fractions. Contamination was the highest in the sample beside a market (1311 items) and the lowest beside a university (236 items). Discoveries from this study help to reduce the scarcity of knowledge on microplastic contamination in the context of a freshwater body in the study area.

KEYWORDS: Microplastics, River, Benthic sediment, Extraction, Categorization

PAPER ID: CEST2021_00484

Morphological analysis approach to detect microfiber contamination in Mytilus galloprovincialis

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ABSTRACT

Microplastic pollution is a widespread threat for marine fauna. Mussels are good candidates for assessment of microplastic exposure in the environment because of their wide geographical and spatial distribution and their filtration system. In this work the 65% of analysed mussels assessed the presence of microfibres in their tissue, with an amount ranged from 0.0 to 4.3 MF/ g ww. This result confirm that mussels could be used as biomonitors of surrounding environment pollution.

KEYWORDS: microplastic, mussel, microfiber, *Mytilus galloprovincialis* , morphological analysis

PAPER ID: CEST2021_00666

Microplastics in marine biota of North Aegean Sea: Summarizing and comparing preliminary findings

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ABSTRACT

Rising scientific literature and legislation measures have highlighted the concern on plastic pollution and the issue of microplastics. In the context of this study, 3 marine species of commercial interest (bogues, Mediterranean mussels, blue crabs) were examined, concerning microplastics' presence and characteristics. The abundance of the ingested items ranged between 1.22 and 3.30 items/individual. In total, 172 items were extracted from the samples, while only three items were categorised as mesoplastics. The most frequent size for all three species was particles smaller than 200 μm, while fragment was the most frequent type of microplastic (58.48%). In total, 12 colours were recorded, with blue being the most frequent one. Within the sampling areas, significant differences were determined ($p < 0.05$, Kruskal-Wallis test). Specifically, samples collected at Lesvos were significantly different from those collected at Thermaikos Gulf ($p < 0.05$, Dunn's Multiple Comparison test), while no difference existed among the samples of the different species originating from Thermaikos Gulf. This study contributes to fill the gap of knowledge regarding microplastic contamination of the North Aegean marine biota. In addition, this effort records for the first time the presence of microplastics in blue crabs at the North Aegean region.

KEYWORDS: microplastics, Aegean Sea, marine biota

PAPER ID: CEST2021_00401

SESSION 48 - CIRCULAR ECONOMY AND INDUSTRIAL SYMBIOSIS

Saturday 4 September - afternoon

Bioleaching of valuable elements from red mud using autochthonous biomass

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ABSTRACT

Red mud (RM) is the main residue produced by the alkaline extraction of aluminum from bauxite, and it contains valuable metals (e.g., iron, aluminum, titanium, silicon). Aim of this research was to investigate the biologically induced leaching of valuable elements from RM using autochthonous biomass, in order to simultaneously reduce RM polluting potential and extract metals for their subsequent recovery. Such approach is challenging, since high alkalinity and pH, as well as the absence of sulphides, constrain the use of traditional bio-hydrometallurgical techniques. Bioleaching tests were performed at different temperatures (22°C, 28°C) and solid to liquid ratios (S/L: 2%, 5%), using a leaching medium containing glucose, yeast extract and ethanol. The best results were achieved at 28°C and S/L ratio of 5%: pH rapidly dropped from 9.7 to 6.25 and remained constant till the end of the test. Metal concentrations in the liquid phase were 2%-Fe, 8%-Al and 1%-Ti. As expected, iron was less available to leaching at such pH, as it was mostly present as hematite in RM. Abiotic contribution to metals leaching was negligible. Results are promising, and further investigations are needed to favor pH drop to lower values, with a consequent increase in metals bioleaching.

KEYWORDS: bioleaching, circular economy, metals recovery, red mud.

PAPER ID: CEST2021_00308

Carbon Capture Utilization Potential in Malaysia

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ABSTRACT

Under the Paris agreement, Malaysia has set its target of reducing greenhouse gas emissions by 45% by 2030 (35% of which is on an unconditional basis), having 2005 as the base year. Carbon capture and utilization, together with an increased use of renewable energy sources, will be one of the main pillars of the national policy towards achieving this goal. Malaysia produces on an annual basis more than 100 million tons of biomass and is the second largest palm oil producer in the world. Thus, the focus of this study is the biogenic sources of carbon dioxide, and more specifically biomass power plants and palm oil mill effluent-based biogas power plants, operating at different scales across the country. Our objective is to map the existing carbon sources as well as the potential carbon receivers as many as possible (in both regions, East and West Malaysia), estimate the annual amount of produced carbon dioxide and identify the most economically viable business models for the development of symbiotic schemes based on the capture and reuse of carbon dioxide.

KEYWORDS: Industrial Symbiosis, Carbon Capture Utilization, Malaysia, Biogenic Sources

PAPER ID: CEST2021_00582

Solid Waste Reuse in the Balkan-Mediterranean Region

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ABSTRACT

The wide implementation of circular economy and industrial symbiosis in the Balkan and Mediterranean region lags behind most of the other European countries. The economic crisis has had a significant impact to the local businesses, eliminating new investments. Regarding specifically solid waste, which is the type with the highest increase in terms of annual generation over the last decade, the situation is aggravated by the lack of national or regional strategies. In this paper, taking into consideration the results of the implementation of SWAN research project, which led to the design and development of a digital solid waste reuse platform for the Balkans, our objectives are: (a) to compare the current state of solid waste management in four different countries (Albania, Bulgaria, Cyprus, Greece), (b) analyse the opinions of various directly involved actors on solid waste management issues and on their familiarisation with new concepts such as circular economy and urban/industrial symbiosis; and (c) compare the feasible business models in all four countries, in terms of their quantitative and qualitative characteristics.

KEYWORDS: Industrial Symbiosis, Solid Waste, Balkan Region, Business Models

PAPER ID: CEST2021_00583

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Symbiotic actions for CO_2 capture and utilization in Cyprus

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ABSTRACT

CO_2 capture and utilisation (CCU) is one of the main pillars of EU strategy towards the reduction of the greenhouse gases. The development of symbiotic actions between CO_2-emitting industries and potential receivers not only contributes to the above advantages but also has the possibility of creating new high value added products. This article presents a methodology and the corresponding tool for the identification and assessment of potential collaboration between companies that emit CO_2 (sources) and industries that may reuse CO_2 (receivers), demonstrated in the island of Cyprus. The methodology used is based on technical and geographical criteria. Thus, for each potential industrial symbiotic scheme, the technical characteristics of a potential source (such us the required mass flow and the acceptable level of purity of CO_2) and the characteristics of a potential receiver such us the permitted technology readiness level of its existing technology are identified and assessed.

KEYWORDS: Industrial Symbiosis, Carbon Capture, Carbon Utilisation, Circular Economy

PAPER ID: CEST2021_00685

Green Strategies and Business Ecosystems

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ABSTRACT

The green strategies together with decisions create a business ecosystem in the Environmental Goods and Services Sector (EGSS). Such an ecosystem is a result of both technological development and strategy evolution. This paper aims to present and discuss the outcomes (as relations) of this sector activity. The adopted methods in this paper are un inductive inference method supported by a literature study and deduction methods supported by statistical calculations based on secondary data Eurostat. The main result of this paper is, that the main relations are: cooperation and the creation of strategic alliances; therefore, the creation of social value is favored.

KEYWORDS: Green Management, Green Decisions, Environmental Goods and Services Sector, Circular Economy**.**

PAPER ID: CEST2021_00046

Circular Economy and Green Economy: a network analysis

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ABSTRACT

Circular Economy and Green Economy are very popular concepts in modern scientific business management literature. Several papers already addressed both concepts as synonymous while others distinguish them differently. Based on this conceptual gap, this paper aims to shed a light on these topics by mapping how scientific literature is linking these two terms. The used method is the network analysis and reports with key findings from indexed papers. Finally, a research agenda and future research topics to be further explored are proposed.

KEYWORDS: Circular Economy; Green Economy, Sustainability; network analysis.

PAPER ID: CEST2021_00101

Dredged sediments as a natural resource

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ABSTRACT

The periodic removal of sediments is necessary to ensure the functionality of ports, to facilitate navigation, for construction, expansion and environmental cleanup processes. The management and fate of the resultant tons of dredged material is a costly issue that must be addressed. Many technologies for the disposal of dredged sediments take no consideration of sediment' reclamation. However, in line with the principles of the circular economy sediment should be treated as a new resource for sustainable reuse rather than as a waste.

The aim and the scope of this paper is to examine the possibilities of sediment' management in the context of the circular economy by presenting sustainable, economically and environmentally friendly "green" management options of dredged sediments. Case studies of alternative and beneficial uses of sediments include the development and restoration of coastlines and landscapes, the construction of water barriers and flood works, sediment use in agriculture, in the production of bricks and ceramics, as well as for road construction.

KEYWORDS: beneficial uses, dredged sediments, bricks, cement, circular economy

PAPER ID: CEST2021_00679

SESSION 49 - HYDROLOGY AND WATER RESOURCES

Saturday 4 September - afternoon

Estimation of Evapotranspiration under the Effect of Climate Change in Egypt

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ABSTRACT

Accurate estimation of evapotranspiration is important for water resources management. In this study, using historical meteorological data of 21 stations, the FAO Penman-Monteith method (FAO56-PM) was applied to predict the reference evapotranspiration (ET_o) in Egypt during the late of this century (2071–2100) under the effect of the representative concentration pathways scenario (RCP4.5). The highest values of ET_o were recorded in the southern part of the country with an average of 7.53 mm/day in Asyut. These values gradually decreased from south to north, where the lowest ET_o was recorded in the northern part of the country with an average of 3.73 mm/day in Baltim. ET_o is expected to increase at the late of the century throughout the country, and the highest values will occur in the Western Desert (53% in Kharga). On the other hand, the northern part of the country will witness a slight increase in ET_o to a maximum of 8% in Baltim. Moreover, the increase of ET_o in the summer season is more significant than in other seasons. These results would help in impact assessment and adaptation strategies of climate change impacts on evapotranspiration in Egypt.

KEYWORDS: Evapotranspiration, Penman-Monteith, Climate Change, Temperature, Egypt.

PAPER ID: CEST2021_00051

A Stochastic Approach to Resilience Assessment of Urban Water Systems from Source To Tap

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ABSTRACT

The design of urban water systems faces long-term uncertainties in a multitude of parameters, from the hydroclimatic and socioeconomic realms, such as population growth, climate change and shifting demand patterns. To analyze such systems in a holistic way, many models for sub-systems are typically involved, while the performance of different designs is generally measured against a variety of metrics and in different times scales for each sub-system. In this work, we present a framework for stress-testing urban water systems based on the novel metric of a system's resilience, i.e., the degree to which a water system continues to perform under progressively increasing disturbance. The framework covers the entire water cycle, by coupling a water resources management model to a hydraulic water distribution model thus covering the water system from source to tap. The framework is underpinned by a stochastic simulation module supporting the representation and capturing of uncertainty throughout the water cycle. To assess the system's resilience under uncertainty, we "stress-test" it with an ensemble of scenarios whose parameters are stochastically changing within a design horizon. The approach is showcased through a synthesized case study.

KEYWORDS: resilience assessment; water resources management; source-to-tap water systems; strategic planning; uncertainty

PAPER ID: CEST2021_00147

Uncertainty aspects of 2D flood modelling in a benchmark case study

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ABSTRACT

In this study, we investigate the contribution of several uncertainty drivers towards the total uncertainty of a 2D flood model, in a benchmark case study under steady flow conditions. The simulator used for the analysis is the in-house FLOW-R2D software, whilst the benchmark case study consists of a compound trapezoidal channel, which represents the main channel and the floodplains. Unlike the conventional taxonomy of the uncertainty sources (input data, parametric and structural), we define five drivers: a) the forcing driver which consists of the inflow to the computational domain; b) the geometric driver which depends on the topography of the case study; c) the physical driver which incorporates all the parameters required to describe a physical process (such as friction); d) the computational driver which includes the parameters needed for computational reasons (e.g. space step); e) the structural driver which is metric for the weakness of the numerical model to capture an idealized analytical solution or observed data, due to the abstraction from reality. For the quantification of each driver contribution, we present the Uncertainty Index, which is based on the stochastic Monte Carlo technique.

KEYWORDS: flood modelling, uncertainty, Monte Carlo

PAPER ID: CEST2021_00521

Simulation of an urban flash flood: the 2017 flood event in Mandra, Attica

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ABSTRACT

This study deals with the 2D flood simulation of an urban flash flood event that took place on November 15, 2017 in Mandra, Attica. The well-known hydrodynamic software HEC-RAS was used for the flood simulation. The model input was an ensemble of 100 hydrographs, derived from the simulation of the rainfall-runoff process of the Agia Aikaterini catchment, which flows into Mandra. The study focuses on a grid search-based calibration of the model parameters, by comparing simulation results to post-flood field data. A Morris-based sensitivity analysis was used in order to reduce the number of parameters to be calibrated and therefore reduce the dimensions of the problem and the computational cost. Five parameters were selected for the sensitivity analysis: a) the Manning coefficient of the city roads; b) the Manning coefficient of urban blocks characterized by low roughness; c) the Manning coefficient of urban blocks characterized by high roughness; d) the confidence interval of the empirical distribution of the 100 hydrographs ensemble; e) the energy slope used for the downstream boundaries. It was found that the parameters with the most significant impact were the input hygrograph's confidence interval (first) and the Manning coefficient of the city roads (second).

KEYWORDS: urban flood, flash flood, 2D hydrodynamic model, HEC-RAS.

PAPER ID: CEST2021_00524

Updating hydrologic studies and the impact on hydraulic design

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ABSTRACT

Flood events causing damages, fatalities, trigger new flood protection studies. Updated hydrologic study conforming with recent developments is required. Implementation of 2007/60/EU Directive led to Preliminary Flood Risk Assessment and Flood Risk Management Plans, establishment of related guidelines and point precipitation IDF relations for all stations in Greece, often giving higher rainfall depths. Use of the CN method for hydrologic losses gives more than proportional increases in the resulting discharge predictions. Comparing past and future conditions (2000-2018) has been facilitated by available landcover data through the Copernicus program, while designer's judgment is still needed to predict further trends in land practices/ urban development. Evaluation of climate change effect is often required for project financing. Main issues are sea level rise, increase of precipitation extremes, associated landslide risk. Current predictions involve high uncertainty. Precipitation trends investigated reveal no evidence of climate change effect, due to limited records. It is suggested that confidence limits are used instead. Urban networks designed for low return periods is difficult to be upgraded. Main watercourses' flood protection design has to account for the anticipated worsening of runoff to achieve the required level of flood protection and resilience. Case studies for two major streams in Greece are presented.

KEYWORDS: hydrologic prediction, flood protection, hydraulic design, IDFs, past and present conditions

PAPER ID: CEST2021_00575

Implementation of flow duration curves for evaluating the environmental flow

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ABSTRACT

In this research work, the implementation of Flow Duration Curves (FDC) was assessed, as a mean of estimating the environmental flow (e-flow) in rivers segments in Greece. The FDC of fifteen river basins varying in size and geomorphological characteristics and covering a wide area of mainland Greece, were derived by using high quality monthly discharge measurements of two years period. The e-flows were first calculated by applying the current Greek regulation method, which makes use of measurements of only the summer and September months, and by relating the e-flow as a percentage of the Mean Annual Flow (MAF). The e-flows were then plotted upon the FDC and compared with specific quartiles. The results show that the e-flows calculated by both the Greek regulation methodology and the 10% of MAF are a very good approximation of the 90% quantile of the FDC (Q_{90}) while the 30% MAF falls very close to the 70% quantile (Q_{70}). Therefore this study suggests that the Q_{90} could be used insted of the Greek regulation method, as it produces quite similar but safer (higher) discharge values. It was also indicated, that a strong correlation of 10% MAF to Q_{90} and 30%MAF to Q_{70} exists.

KEYWORDS: Flow duration curves, environmental flow, ecological flow, basic flow, Q_{90}

PAPER ID: CEST2021_00269

Application of a GIS based distributed model for rainfall runoff simulations

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ABSTRACT

In this research work, the development and application of a distributed rainfall – runoff model, to be used in flood related simulations was performed. The model utilizes the time–area diagram theory in order to calculate and route the runoff of each grid to the basin's outlet. The selected study area is the upper part of the Alfeios river basin, the Karitaina basin, located in southern Greece, while historic rainfall data from regional rain gauges were used, which were interpolated through GIS tools into spatially gridded rainfall fields, with a one-hour temporal scale. The performance of the distributed model was evaluated through its comparison with two lumped models, one based on GIS techniques and the other one based on the unit hydrograph derived from historical rainfall-runoff events. Finally, the abovementioned models were also compared and evaluated with the observed hydrograph of the studied event. The results showed that the distributed model performed well considering that no calibration has been carried out regarding the hydrological losses.

KEYWORDS: Hydrological modelling, rainfall-runoff, GIS, Alfeios, distributed model

PAPER ID: CEST2021_00270

Automated *In-Situ* Cyanotoxin Assessment Toolbox for Real-Time Surface Water Monitoring (CYANOBOX)

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ABSTRACT

Automated In-Situ Cyanotoxin Assessment Toolbox for Real-Time Surface Water Monitoring, CYanoBox, is a 3-year project, coordinated by the innovation and technology company CyRIC, for the development of novel biosensors, and reliable at-source detection of toxic metabolites. The project aims to deliver an autonomous, affordable, and easy to operate water monitoring system as an early-warning tool for surface waters affected by cyano-HABs. CYanoBox comprises of an innovative water processing system that can remotely filter and lyse the cyanobacterial cells in-situ so that an accurate measurement is taken for both the extracellular and intracellular concentration of one of the most important groups of cyanotoxins, the hepatotoxic microcystins. The focus is on optimizing the method to lyse the cells in a way that maximizes the recovery of targeted cyanotoxins, followed by the development of biosensors for cyanotoxins identification and quantification. Being able to detect accurately and remotely the concentration of cyanotoxins in surface water without the physical presence of humans, it will be beneficial to the actual waterbodies, administrators, local communities, and researchers. This system will remotely evaluate the severity of a bloom based on its toxicity and track changes in water quality that traditional discrete monitoring activities usually miss.

KEYWORDS: cyanobacteria, monitoring, sensors, surface water

PAPER ID: CEST2021_00054

SESSION 50 - ENVIRONMENTAL ODOUR, MONITORING AND CONTROL

Saturday 4 September – after2noon

Integrated monitoring system based on Citizen Science approach for the proactive management of environmental odors emissions

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ABSTRACT

Odours emitted from industrial and environmental protection plants have been included among atmospheric pollutants as they are cause of annoyance for the exposed residents. The control of the odour emissions is therefore a key aspect to pursue. The research presents and discusses the development of an innovative odour monitoring system based on the combination of analytical instruments and intense citizen participation, with the aim of continuously control the odour emissions and evaluating their real annoyance. The experimental activities were carried out with reference to a real application case in a sensitive municipality in which are located several odour emitting plants. To engage social participation, a specific mobile phone application was developed. Regards to the analytical measurements, advanced instrumental odour monitoring systems (IOMS) were installed on the territory. All the measures collected were directed to a web platform, aimed at data processing. Interactive maps able to proactively identify possible undesirable conditions linked to odour annoyance events were generated in real-time, representing the output of the integrated system. The results demonstrated the efficiency of the proposed odour monitoring system for odour management and the importance of applying the citizen science approach to assess real perception and thus avoid complaints.

KEYWORDS: IOMS, dispersion models, odour annoyance, aroma wheel

PAPER ID: CEST2021_00577

Sustainable treatment of air pollutants by moving bed biofilm reactor (MBBR) coupled with algae photobioreactor (APBR)

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ABSTRACT

The presence of high concentrations of VOCs in the atmosphere can lead to negative consequences for humans and the environment. The treatment of these compounds is thus necessary before their release into the atmosphere. In the study, an advanced moving bed biofilm reactor (MBBR) coupled with an algae photobioreactor (APBR) is presented with the aim of investigating its application for the sustainable biodegradation of toluene (C_7H_8). The results highlight that the MBBR alone shows a high removal efficiency (RE), ranging from 98.37 ±0.79% to 99.84 ±0.14%. Whiile, setting the Algal PhotoBioreactor (APBR) as second treatment, the biodegradation of toluene increases up to 99.91%. The research depicts the potential of the investigated system to biodegrade volatile organic compounds (VOCs), leading to a healthy environment.

KEYWORDS: odour, plastic carrier, greenhouse gases, toluene biodegradation, volatile organic compounds.

PAPER ID: CEST2021_00815

Ground based integrated path differential absorption sensor for remote sensing of CO_2, CH_4 and H_2O atmospheric greenhouse gases

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ABSTRACT

An autonomous, ground-based, integrated path, differential absorption light detection (IPDA) system is presented, capable of measuring multiple gases concentration in the atmosphere. The device was developed to monitor small scale locations with high greenhouse gases emissions and is equipped with three low optical power CW DFB diode lasers for the atmospheric detection of CO_2, CH4, H_2O. The system is capable to detect additional gases in the atmosphere by installing proper diode lasers in the near-infrared spectral range. A novel method calculating the concentration of gases is proposed based on the intensity of the H_2O absorption line. The values calculated by this method were compared with those from DIAL equation are found to be in agreement. The device was tested on measuring background concentrations of the gases in the atmosphere.

KEYWORDS: Greenhouse gases, methane, carbon dioxide, sensor, near-infrared, laser

PAPER ID: CEST2021_00554

Removal of gaseous ammonia released from odorous composting leachate employing carbonaceous adsorbents prepared from agro-industrial wastes

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ABSTRACT

Biological and composting processes used in the treatment of municipal solid waste typically are sources of odour pollution (gaseous pollutants include SO_2, NH_3, H_2S and other toxic air pollutants). In this work, the removal of NH_3 present in odorous composting leachate was assessed for the first time in a fixed-bed column loaded with carbonaceous adsorbents prepared by hydrothermal carbonization (HTC) assisted with sulphuric acid and by pyrolysis of carbon precursors (olive stone and malt bagasse). The resultant adsorbents were characterized to study their surface chemistry and textural properties. Scarce work studying the HTC in presence of additives, but H_2SO_4-assisted HTC allow to obtain acid hydrochars with accuracy properties for NH_3 adsorption. In this work, the hydrochar prepared from olive stone by H_2SO_4-assisted HTC shows the highest NH_3 adsorption capacity (11.4 mg g^{-1}), evidencing that acidity contributes more significantly to the removal of NH_3 than the specific surface area of the adsorbents. The NH_3-saturated hydrochar was regenerated by washing with distilled water and subsequently re-used in the adsorption of NH_3, obtaining satisfactory performance (68% of the mean NH_3 adsorption capacity of its respective first use).

KEYWORDS: adsorption, biomass waste, waste valorisation, hydrochar, carbon-based materials.

PAPER ID: CEST2021_00098

Anaerobic biodesulfurization in different inoculums

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ABSTRACT

Sulfur compounds in liquid fuel are undesirable and the level of these compounds in diesel fuel is strictly regulated in the last 15 years by the European Union. These stringent regulations are imposing an urgent requirement for fuel terminals to produce fuels having ultra-low sulfur content. A promising Eco-Technology is to employ Biodesulfurization (BDS), a process where the bacteria (liquid phase) are mixed with oil at ambient temperature and pressure to selectively remove organosulfur components from oil fractions without degrading the carbon skeleton of the compounds. Most of the studies have examined the BDS under aerobic conditions using pure cultures or mix inoculum, and the main byproducts remain in the liquid phase. However, the present study explored a new proof of concept; BDS under anaerobic conditions using inoculums from various anaerobic sources. The enrichment in each inoculum took place several months and electron donors were used. In addition, the microbial profile over time was examined at the end of the BDS using next generation sequencing. The BDS of oil under anaerobic conditions profits of aeration cost, as well as the advantage of releasing H_2S in the gas phase, which can be easily treated using the existing H_2S technologies.

KEYWORDS: Fuels; oil; sulfur; microorganisms; dibenzothiophene.

PAPER ID: CEST2021_00527

SESSION 51 - EMERGING POLLUTANTS

Saturday 4 September- afternoon

Investigation of the performance of green nano Zero Valent Iron for the removal of emerging contaminants from water

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ABSTRACT

Nano Zero Valent Iron (nZVI) is considered as a promising nanomaterial for the removal of a wide range of recalcitrant pollutants from contaminated water and soil. Due to its high reactivity, large surface area, its catalytic and reductive properties along with the ability to be produced at low cost using herbal extracts, technologies incorporating nZVI are recently receiving a lot of attention. This study focuses on the utilization of nZVI made of green tea extracts which is supported in a cationic exchange resin, to remove selected emerging contaminants, classified as non-steroidal anti-inflammatory drugs and endocrine disrupting chemicals from water. The effectiveness of the nZVI resin (R-nFe) and the effect of crucial parameters, as the contact time, initial pH, nZVI resin's dose, and the pre-treatment of the nZVI resin with NaCl was evaluated through batch experiments. The effect of the resin was also investigated in the removal performance. Results indicate that most of the selected compounds can be removed efficiently in acidic pH values, and the pre-treatment of the nZVI resin with NaCl is optimal for achieving higher removal efficiencies. However, the adsorption capacity of the resin seems to play also an important role in the removal of some targeted compounds.

KEYWORDS: nano zero valent iron, green synthesis, endocrine disrupting chemicals, pharmaceuticals, emerging contaminants

PAPER ID: CEST2021_00276

Smart Technologies for the Control of Emerging Contaminants in Ambient Air

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ABSTRACT

Air quality protection and control is an issue of growing interest. The aspects related to the spread of the coronavirus have accentuated this attention. Furthermore, among the emerging contaminants (EC's) in ambient air, the microplastics (1 – 5 μm) are a great concern arising from anthropogenic activities. These pollutants may bring detrimental effects on human health. To control the EC's, the first activity is the characterization. To date, limited studies highlight and describe technologies able to identify and measure the presence in the air of these types of emerging pollutants (EP's). Furthermore, the presented studies show a methodology gap in their experiments.

The research presents and discusses the state-of-the-art adopted technologies to characterize MPs in ambient air and pointing out strengths and weaknesses. Knowledge gap, uncertainties and recommendations are highlighted. The paper provides useful information in enhanced monitoring to support policymakers in emerging microplastics pollutants and related issues, as well as potential smart technology to be implemented.

KEYWORDS: microplastics, air quality management, emerging pollutants, smart instrumentation

PAPER ID: CEST2021_00331

Evaluation of Toxicity of Three Antibiotics to Germination and Early Growth of *Trifolium alexandrinum* Seeds

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ABSTRACT

Antibiotics are one of the most important emerging contaminants as they have been detected in several environmental compartments including soil. Compared to the wide literature on the effects of antibiotics on aquatic organisms, knowledge and understanding of their potential effects on terrestrial environment is still scarce, especially when mixtures are taken into consideration. In this study, a screening-level phytotoxicity assay was used to evaluate the effects of three antibiotics (Oxytetracycline, Levofloxacin, Ampicillin) individually and in mixtures, on seed germination, root and shoot elongation of Egyptian clover (*Trifolium alexandrinum* L.) After five days exposure time, the acute effects of individual antibiotics and their binary and ternary mixtures were assessed using three endpoints, namely percentage of seed germination, shoot length and root elongation. The results of the study indicated that plant germination was insensitive to the individually tested antibiotics, with no significant decreases up to the highest treatment concentration of 100 mg L^{-1}. Root elongation was observed as the most sensitive end point in individual antibiotics. However, increase in the root and shoot elongation was observed in mixtures relative to the individual antibiotics. The results show the importance of evaluating the toxicity of antibiotic mixtures, since they might have distinct effects when compared to the individual compounds.

KEYWORDS: Phytotoxicity, Antibiotic mixtures, *Trifolium alexandrinum*, Germination

PAPER ID: CEST2021_00418

Extraction And Determination Of Pharmaceutical Compounds Adsorbed Into Microplastics

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ABSTRACT

Microplastics (MPs) are pollutants of emerging concern. These small particles are found throughout the world. Its best-known negative effects are that they can confuse marine organisms that would feed on them, or block their airways. In addition, they have been shown to act as vectors of contamination too.

In this work, a methodology for the extraction of ten widely used pharmaceutical compounds adsorbed into MPs has been developed. This methodology is based on Ultrasound Assisted Extraction (UAE) followed by Ultra-High Performance Liquid Chromatography Tandem Mass Spectrometry (UHPLC-MS/MS). In the optimal conditions, Limits of Detection (LODs) between 0.25 and 15.8 $ng \cdot g^{-1}$ were obtained. The optimized method was successfully applied to different MPs samples taken from three beaches of Canary Islands. The results indicated the detection of all target pharmaceuticals at least one time in the analysed samples.

KEYWORDS: Microplastics, Pharmaceuticals, Ultrasound-assisted extraction, Beach pollution

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Detection of Aflatoxin M1 in milk using Mach-Zehnder optoelectronic immunosensors

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ABSTRACT

Aflatoxin M1 (AFM1) is excreted in milk of animals after ingestion of food contaminated with Aflatoxin B1 (AFB1). AFM1 has been considered as group I carcinogen since 2002, so the consumption of even low concentrations of AFM1 pose a major threat for human health. In this work, a silicon-based optoelectronic immunosensor for the detection of AFM1 in milk is developed. The immunosensor consists of ten Mach–Zehnder silicon nitride waveguide interferometers (MZIs) monolithically integrated along with their respective light sources onto the same chip. The recording of transmission spectrum is achieved through an external spectrophotometer. The MZIs are bio-functionalized through aminosilane activation and AFM1-bovine serum albumin conjugate immobilization. For AFM1 detection, a 3-step competitive immunoassay configuration is employed, including the primary reaction with rabbit anti-AFM1 antibody, followed by biotinylated anti-rabbit IgG antibody, and streptavidin. The assay is completed in 15 min. The limit of detection is 0.03 ng/mL in undiluted milk, which is below the maximum allowable limit set by European Union (0.05 ng/mL). The assay is accurate (% Recovery values: 91-112) and repeatable with intra-/inter-assay coefficients of variation <8%. The excellent analytical performance of the proposed immunosensor paves the way for accurate AFM1 determination in milk samples at the point-of-need.

KEYWORDS: Aflatoxin M1, Milk, Immunosensor, Mach-Zehnder Interferometer

PAPER ID: CEST2021_00772

The role of microbiological community on organic micropollutants biotransformation in anoxic conditions

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ABSTRACT

Information about the biotransformation of organic micropollutants (OMPs) in biological systems is currently scarce, particularly in anoxic environments. A lab-scale reactor was set up to elucidate which is the biological mechanism driving OMPs biotransformation in heterotrophic denitrifying conditions. The influence of microbial composition on the OMPs removal was analysed. Increasing levels of nitrate loading rates were applied during the study in order to analyse cometabolism. In terms of OMPs, high removal efficiency was achieved for compounds such FLX and SMX, whereas moderate removal was achieved for some antibiotics (ERY, ROX, TMP), the anti-depressant drug CTL or the natural hormones. Other OMPs, like DCF or CBZ were recalcitrant. Removal due to cometabolism was detected for BPA, ERY, ROX and CTL.

KEYWORDS: Anoxic process; cometabolism; organic micropollutants; microbial composition; heterotrophic denitrification

PAPER ID: CEST2021_00667

How to estimate biocide mass loads in urban water discharges and their impact on the river contamination?

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ABSTRACT

Biocidal substances are ubiquitous in urban areas; they are used as preservatives in daily products, building materials, and as domestic pesticides. Despite these facts, urban sources of biocides, contrary to agricultural inputs, have been overlooked in terms of environmental risk assessment. The overall objective of this communication is to explore the use of a stochastic approach to assess the impact of biocide urban discharges on the river contamination. Biocide contamination in surface waters up- and downstream the Paris conurbation was investigated. The urban origins of these biocides were explored by targeting wastewater treatment plant and combined sewer overflow discharges from comparable watersheds, and by assessing biocide mass loads (discharged and transiting in the river) using a stochastic approach based on Monte-Carlo simulations. The 18-targeted biocides were all quantified, and several were found at concentrations that can present high risk for the aquatic ecosystem. An increase in biocide loads between up- and downstream the Paris conurbation for several molecules and the contribution of urban discharges to biocide loads towards the receiving waters were ascertained. The results illustrate the interest of a stochastic approach to quantify the uncertainty on the determined values from a realistic description of the variability of biocide concentrations.

KEYWORDS: Mass loads; Stochastic approach; Stormwater; Surface water; Wastewater

PAPER ID: CEST2021_00357

Assessing the performance of green nano Zero Valent Iron in column experiments for the removal of NSAIDs from water

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ABSTRACT

The existence of emerging contaminants in the aquatic environment is globally a major concern. Among them, non-steroidal anti-inflammatory drugs (NSAIDs) are a vast category of pharmaceuticals that are widely consumed and cannot be completely removed in typical wastewater treatment systems, thus entering the environment and causing adverse effects on living organisms and human health. Nano Zero Valent Iron (nZVI) has been proved capable of removing a wide range of recalcitrant pollutants from contaminated water and soil. Its reactivity, and large specific surface area, in combination with the ability to be produced via 'green' low-cost methods make it a promising material for the reclamation of wastewater from persistent micropollutants. In this study, nZVI made of green tea extracts, was incorporated in a cationic resin and was used in continuous flow pilot experiments to investigate the removal efficiency of two nonsteroidal anti-inflammatory drugs NSAIDs from wastewater, namely Naproxen and Ketoprofen. Results indicated that the nZVI columns exhibited improved performance to the removal of these pharmaceuticals for the lowest initial concentration of pollutants and for the largest bed height investigated, but pH also played a key role on the overall process performance.

KEYWORDS: nano zero valent iron, green synthesis, continuous flow experiments, NSAIDs, emerging contaminants

PAPER ID: CEST2021_00755

Canada's New Substances Notification Regulations

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ABSTRACT

Under the New Substances (NS) Program, Health Canada (HC) and Environment and Climate Change Canada (ECCC) administer the New Substances Notification Regulations (Chemicals and Polymers) [NSNR (Chemicals and Polymers)] and New Substances Notification Regulations (Organisms) [NSNR (Organisms)] of the Canadian Environmental Protection Act, 1999 (CEPA 1999) to examine the potential risks to Canadians and their environment before the substances enter the Canadian marketplace. These regulations are an integral part of the Canadian government's national pollution prevention strategy. Under this joint endeavour between HC and ECCC, the New Substances program has completed over 20,000 New Substances Notification assessments. The following poster presentation outlines the NSNR and the substances subject to them. An overview of the regulations is provided including the definition of a new substance, the notification process, risk assessment and potential assessment outcomes, and how to find additional information and resources.

KEYWORDS: new substances, environmental risk assessment, human health risk assessment, risk management measures, New Substances Notification Regulations

PAPER ID: CEST2021_00387

Ciprofloxacin and sulfamethoxazole biotransformation products in anaerobic packed bed biofilm reactor applied to the sanitary sewage treatment

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ABSTRACT

The presence of antibiotics in the environment has received a lot of attention in recent years due to their ability to promote and spread antimicrobial resistance. In this work, the biodegradation of the antibiotics ciprofloxacin (CIP) and sulfamethoxazole (SMX), as well as the concurrently generation of their biotransformation products (BTPs) were assessed in an anaerobic packed bed biofilm reactor (APBBR) treating sanitary sewage. Initially, anaerobic batch assays at high concentrations of the antibiotics (5 mg L^{-1}) were performed to identify the metabolites generated during the CIP and SMX biodegradation in methanogenic condition. From the mass transitions (m/z) of the identified BTPs, they were analyzed along the spatial profile of the APBBR fed with sewage (300 ngCIP L^{-1} and 400 ngSMX L^{-1} approximately). Three BTPs were identified: one related to the biodegradation of CIP (m/z 316) and two related to the biodegradation of SMX (m/z 256 and m/z 270). The molecular structures of the BTPs revealed that the biotransformation occurs mainly in the isoxazole ring of SMX and there was a dehydroxylation in the CIP molecule. Nonetheless, the sulfonamide and fluoroquinolone molecular structures remained intact in the anaerobic effluent stream, thus presenting residual antimicrobial activity in the environment.

KEYWORDS: Anaerobic fixed bed biofilm reactor; Antibiotics; Emerging micropollutants; Fluoroquinolone; Sulfonamide.

PAPER ID: CEST2021_00645

Occurrence and potential accumulation of pharmaceuticals in agricultural soils treated with wastewater under real-world environmental conditions in Cyprus

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ABSTRACT

Due to water supply shortages that result from climate change, urbanization, regional droughts and pollution, treated wastewater (TWW) is commonly used to irrigate agricultural land in arid and semi-arid regions. Compared to aquatic systems, contaminants of emerging concern (CECs) only scarcely have been studied in the terrestrial environment. The likelihood of soil and groundwater contamination by CECs as a result of TWW reuse for irrigation depends on several factors such as the physicochemical properties of these contaminants, the type of wastewater treatment technology implemented, and climatic conditions (e.g., dilution of wastewater effluent, rainfall, temperature, and irradiance) (Kasprzyk-Hordern et al., 2009). Sorption is a crucial process that controls the mobility of CECs in soil. Soil properties such as pH, organic matter, and CECs play an important role in this process. Depending on the pKa of CECs and soil pH, CECs can emerge in nonionic, anionic, cationic or zwitterionic modalities.

Herein, we investigated the occurrence and potential accumulation of 115 pharmaceuticals in soils collected, in July 2020, from treated wastewater (TWW)-irrigated fields with different irrigation histories (i.e., increasing irrigation periods from 0.5 to 10 years). More specifically, the TWW-irrigation has been implemented continuously in the 11 fields for 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 years, respectively. Moreover, 2 soil samples from adjacent neighboring rainfed fields, where wastewater irrigation was never applied before or tube-well water irrigation was applied, were collected and used as control samples providing reference "background" concentrations. Particle size analysis of sieved soils revealed that soil in the area showed characteristics consistent with a sandy clay loam, with sand and silt content ranging from 54 to 60% and 16 to 24%, respectively, while clay content varied from 21 to 26%. The sampled fields, located in the suburbs of Nicosia in Cyprus, were cultivated with alfalfa and irrigated with TWW from a membrane bioreactor treatment facility. A generic sample preparation method using solid-liquid extraction followed by solid-phase extraction was applied, which was adapted from Christou et al. (2017). The extracts were analyzed by ultra-high performance liquid chromatography coupled with a triple quadrupole mass spectrometer.

Among the examined compounds, caffeine, carbamazepine, sulfapyridine, tramadol and clarithromycin were detected in all soil samples. Sarafloxacin, sulfadimidine, metoprolol and sulfamethoxazole had a frequency of appearance of more than 55%, while theophylline, lincomycin, cefalexin and amoxicillin had much lower frequency of appearance. These results indicate that attention should be paid to agricultural soils continuously irrigated with TWW not only from the point of view of TWW quality but also from the point of view of the concentration levels of CECs and their potential accumulation.

KEYWORDS: pharmaceuticals, soil, treated wastewater, wastewater reuse

PAPER ID: CEST2021_00250

High Resolution Mass Spectrometric non-target screening and wide-scope target analysis of emerging contaminants and target analysis of legacy contaminants in adult black-tailed godwit Limosa limosa in the Netherlands – preliminary findings

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ABSTRACT

Contaminant monitoring can elucidate exposure of bird populations (and other species in the same biotic communities) to chemical risks. Long-term monitoring of contaminants in birds can moreover be used to assess the effectiveness of chemical risk management measures, identify emerging contaminants and inform chemical risk assessments, which can in turn support better chemicals management. We carried out a pilot study to assess contaminants in the Dutch breeding population of the black-tailed godwit Limosa limosa, a large wader. This is a widely distributed, migratory species, feeding in estuaries and swamps and breeding in wetlands and damp grasslands. The breeding population in The Netherlands winters in southern Europe and West Africa and contaminants in adults may therefore originate from a wide range of geographic locations. Chicks feed on Arthropods, adults on earthworms and leatherjackets and plant food. The species is classified by IUCN as Near Threatened and the breeding population in The Netherlands – where it is the National Bird – has declined significantly in recent years. We analysed contaminants in livers of 11 adult birds collected from both intensive pasture and semi-natural grassland habitats in SW Friesland – a region dominated by dairy farming. Livers were dissected at a state of the art lab to minimize risk of cross-contamination. Validated generic sample preparation protocols, designed to retain compounds with wide physicochemical properties, were used to extract both polar and non-polar emerging contaminants. Liver samples were analysed by non-target screening for 65,691 substances using cutting-edge LC-ESI (both RPLC and HILIC) and GC-APCI-HRMS methodologies. Recent advances in high resolution mass spectrometry (HRMS) offers the possibility of the simultaneous detection of thousands of compounds in environmental samples, allowing a comprehensive discovery of chemical space. Samples were also analysed using wide-scope

target analysis by LC-ESI-QTOFMS and by GC-APCI-QTOF for more than 2400 chemicals of emerging concern (CECs). We also carried out target analysis for selected legacy organic substances and for 30 metals including Hg, Pb, Al, Fe, Cu, V, Zn, As, Se, Sr, Mo and Sb analysed by ICP-MS. The poster presents preliminary results for selected substances from the wide-scope target analyses and for the metals Hg, Cd, Pb and Ni.

PAPER ID: CEST2021_00634

Perspectives on the use of contaminant data from apex predators and their prey for hazard prioritization

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ABSTRACT

One mayor challenge in today's generic risk assessment is, that only a small fraction of the marketed chemicals has been sufficiently evaluated regarding the (eco)toxicological properties or exposure scenarios, while limited data are available for the majority of substances. For instance, many of the > 20.000 compounds registered under REACH either lack data due to poor quality of registration dossiers or because data are not sufficient for a final assessment, e.g. of PBT properties. Since these substances cannot all be manually screened for hazards, automated and effective tools for prioritization are needed. One opportunity is to make better use of high-quality chemical monitoring data as applied in the LIFE APEX project. It aims at demonstrating regulatory applications of monitoring data from apex predators and their prey under the REACH and Biocidal Products Regulation. This presentation demonstrates how biomonitoring data from top-predators and their prey can be used to enhance prioritization for further hazard assessment, particularly PBT substances. We will present tools and criteria of the prioritization e.g. detection rates, hazard properties, exposure, and physical-chemical properties. The overall aim is to provide a priority list of top scored chemicals to European chemicals authorities to point out the need for further regulation.

KEYWORDS: apex predator, biomonitoring, emerging chemicals, hazard assessment, prioritization

PAPER ID: CEST2021_00609

SESSION 52 - AIR POLLUTION

Saturday 4 September - afternoon

Design of Road-Side Barriers to Mitigate Air Pollution near Roads

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ABSTRACT

The effects of using solid barriers on the dispersion of air pollutants emitted from the traffic of vehicles on roads located over flat areas were quantified, aiming to identify the geometry that maximizes the mitigation effect of air pollution near the road at the lowest barrier cost. Toward that end, a near road Computational Fluid Dynamics (NR-CFD) model that simulates the dispersion phenomena occurring in the near-surface atmosphere (<250 m high) in a small computational domain (<1 km long). Results from the NR-CFD model were highly correlated ($R^2 > 0.96$) with the sulfur hexafluoride (SF6) concentrations measured by the US-National Oceanic and Atmospheric Administration (US-NOAA) in 2008 downwind a line source emission. Then, the effects of different geometries, sizes, and locations were considered. Results showed that, under all barrier configurations, the normalized pollutant concentrations downwind the barrier are highly correlated ($R^2 > 0.86$) to the concentrations observed without barrier. The best cost-effective configuration was observed with a quarter-ellipse barrier geometry with a height equivalent to 15% of the road width and located at the road edge, where the pollutant concentrations were 76% lower than the ones observed without any barrier.

KEYWORDS: CFD; near road emissions; solid barriers; gas-phase pollutants; air pollution mitigation

PAPER ID: CEST2021_00680

Air pollution assessment for regulatory purposes: a CFD approach design

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ABSTRACT

In a context of atmospheric pollution levels on the rise, there is a growing interest in the use of pollutant dispersion tools, especially for regulatory purposes involving industrial activities. Environmental organizations from different countries legislate and encourage the use of different types of models capable to provide fast and robust results in many scenarios. However, these models are not suitable for certain complex conditions of pollutant dispersion, where CFD tools offer a powerful alternative to consider, despite their higher demands in terms of time and resources. In order to run accurate and reliable CFD simulations, some important steps must be carefully considered, such as the definition of an appropriate computational domain. As for the concerned scenario, the pollution impact assessment of industrial facilities, building such a geometrical domain poses specific challenges that are necessary to address. The present work identifies a case study of pollutant dispersion from an industrial source for which the use of CFD models is advised. A contribution is made towards the establishment of a systematic methodology for the development of CFD computational domains in the field of pollution impact assessment of industrial facilities.

KEYWORDS: pollutant dispersion; CFD; topography; computational domain.

PAPER ID: CEST2021_00707

Technology hybridization for real time particulate matter monitoring

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ABSTRACT

While the monitoring and management of air pollution remains a challenge at a regional level, it also becomes more and more sensitive at very local scale. Both, as hot spot sources, can be very localized, but vulnerable population (in schools, hospital…) due to fluidic effect, especially in cities with tall buildings, can lead to very significant disparities in local pollution levels.

For all those reasons, accurate real time measurements of local pollution is increasingly of interest for all stakeholders. So far, no satisfactory solution (microsensors, modeling...) has proven both reliable and affordable on its own as an alternative to reference analyzers. The solution can thus only come from an appropriate combination of various technologies and algorithms.

This paper presents and shows the benefit of an innovative approach to combine well known dust air quality monitoring proven equivalent method, such as beta attenuation and indicative sensors based on light scattering as a first step to allow wider hybrid networks over particulate matter monitoring and extend it to other parameters such as gases (SO_2, NO_2...), which would provide simultaneously a cost effective, reliable, and hyperlocal solution especially when combined to mathematical modelling software.

KEYWORDS: PM_{10}, $PM_{2.5}$, monitoring, air quality, micro-sensors, MP101M, hybridization.

PAPER ID: CEST2021_00673

Development of an emission inventory from commercial cooking in Attica

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ABSTRACT

The aim of this research was to estimate the pollutants that are emitted from the fuels used by the dominated types of commercial restaurants, due to their cooking demands. The study was carried out for the region of Attica; however, the methodology can be applied in many urban areas. For the calculation of emissions, the methodology proposed by the European Environmental Agency for small combustion appliances was followed while for the necessary energy consumption data as well as the cooking fuel and the cooking methods a relevant questionnaire survey was conducted to the restaurants' owners during the summer of 2020. Among the main results are that the percentage use of fuel is electricity, LPG, natural gas and coal by 35%, 29%, 22% and 14% respectively. The calculated CO, PM_{10} and Benzo(b)fluoranthene emissions for the Attica region are 3.76 tonnes, 0.34 tonnes and 0.27 kg respectively.

KEYWORDS: commercial cooking, emissions, Greece, particulate matter

PAPER ID: CEST2021_00175

Evaluation of atmospheric pollutants dispersion using CFD numerical models

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ABSTRACT

This paper describes the approach of studying air pollution by using Computational Fluid Dynamics (CFD) models. It also includes a report of a series of investigations performed in order to illustrate the potential of such models with the aim to give a solution to the dispersion to resolve the question of the dispersion of solid and gases pollutants into the atmosphere by using different validation techniques.

KEYWORDS: Air Quality, CFD, Pollution, Pollutant dispersion.

PAPER ID: CEST2021_00708

SESSION 53 - INNOVATIVE ENVIRONMENTAL SOLUTIONS

Saturday 4 September - afternoon

An innovative and eco-friendly approach to recover gold (and copper) from gold fingers of waste printed circuit boards

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ABSTRACT

Recycling waste printed circuit boards (WPCBs) is a complex problem worldwide and sustainable technologies are required. So, this work aims to offer an innovative (an European patent was submitted, EP 20216239.2 [1]) and more sustainable solution to recover high-value materials (gold and copper) from WPCBs.

The proposed process includes the following steps: (i) cutting the WPCBs´connecting terminals containing gold fingers using a mechanical tool (such as, a guillotine), (ii) swelling the cut WPCBs pieces (60 mm^2) in an appropriate organic solvent inside a low-pressure reactor (with stirring and temperature control), (iii) recovering the gold fingers from a mixture of copper foils and fiberglass using a magnetic separation process followed by sieving.

Subsequently, gold and copper were purified from the gold fingers using microwave-assisted acid leaching with nitric acid to leach copper. This process allowed recovering gold, as a solid, with high yield (99.9 wt%) and a purity grade of 74.0 wt%. Finally, leached copper was recovered by alkaline precipitation (pH around 8.8), as solid of copper hydroxide, with high yield (99.9 wt%) and a purity grade of 85.7 wt%.

The present method has the advantages to provide an innovative and smart solution that minimizes the generation of wastes (dusts and wastewaters), energy consumption and equipment´s.

KEYWORDS: E-waste, Printed circuit board recycling, Physical and chemical processes; Gold and copper recovery.

PAPER ID: CEST2021_00155

Advanced Screening Methodologies for the Comprehensive Monitoring of Intentionally & Non-Intentionally Added Substances in Next Generation Food Contact Materials

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ABSTRACT

The increasing importance of sustainability promotes the development of food contact materials (FCMs) that are safe for the consumers and environmentally friendly. The progressive replacement of ‘‘conventional’’ plastic materials with recycled plastics as well as bio-based and biodegradable polymers has already being enforced by several countries worldwide. With the safety assessment of commonly used plastic materials being still a work under progress, the evaluation of new materials and materials of a more complex nature opposes a greater challenge to the scientific community.

Even though the European Regulation (EU) 10/2011 includes the requirement that FCM manufacturers evaluate their products with respect to intentionally and non-intentionally added substances (IAS & NIAS) according to scientifically recognized methods of risk assessment, no guidelines for carrying out such a procedure are provided by the responsible authorities. This gab in the existing legislation can be attributed to the complex and challenging nature of this task. The difficulties in the analysis of food migrants are resulting, among others, from the many existing chemical classes of IAS and NIAS, the lack of analytical standards for many of them and the fact that many of these substances (e.g. oligomers) are not included in chemical or spectral databases. Consequently, the analysis of food migrants requires the use of advanced highly sensitive analytical techniques and non-targeted screening approaches.

The overall objective of this research work is to expand the existing IAS and NIAS screening approaches, allowing a more widespread and holistic overview of the food contaminants originating from the packaging materials and the potential toxicological effects on the consumers. To facilitate this purpose, innovative, comprehensive and practice-oriented next generation screening methodologies are developed, utilizing state-of-the-art instrumentation and sophisticated data evaluation procedures. In particular, we developed GC-MS/MS and GC-APCI-QTOFMS methods for the target screening of volatile IAS & NIAS, as well as LC-MS/MS and LC-ESI-QTOFMS methods for corresponding migrants of low volatility, thermal instability and high polarity. Particularly the high resolution mass spectrometric (HRMS) methods applied were utilized for further suspect and non-target screening and retrospective analysis of the obtained FCMs. For these screening procedures the entire spectrum of food simulants was evaluated with different migration protocols being employed, depending on the intended use of the analyzed samples. Risk assessment of the identified migrating compounds is also performed using the corresponding legislation, online tools and in-house built software.

The application of these workflows into a large set of products and the subsequent complete screening of migrating chemical contaminants will promote the production of inert and consequently organoleptic neutral and safe next generation FCMs. In addition, the identification of toxic substances would allow us to propose specific protective measures to the competent authorities and increase the consciousness of citizens towards packaged food. Thus, this work will assess public health risks, by facing current and future challenges.

PAPER ID: CEST2021_00700

PlomBOX - development of a low-cost CMOS device for environmental monitoring

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ABSTRACT

This paper reports on the development of a novel CMOS device employing lead-sensing bacteria to assay lead in drinking water. The objective of the PlomBOX project is to develop a low-cost sensor (£10) which can expedite access to on-demand assay methods and thus help mitigate lead intake through contaminated drinking water. The project follows three development paths: a) Certain bacteria can fluoresce or change colour when in the presence of lead. A genetically modified strain of *Escherichia coli* sensitive to lead concentrations up to 10 ppb is being developed. This constitutes the biosensor that fluoresces in proportion to the presence of lead. b) Bacteria response is imaged using a microprocessor (ESP32) with a camera module. This constitutes the optical metrology component of the PlomBOX. c) Data acquisition and control of the PlomBOX is achieved through a Bluetooth connection with the PlomApp, a custom-developed mobile phone application. Data are sent from the PlomApp to a database where a bespoke automated analysis software provides a result of the lead concentration in a sample of water. This paper reports on the instrumentation challenges of developing the electronics for the PlomBOX and on the first prototype.

KEYWORDS: biosensor, commercial CMOS cameras, Lead in drinking water, World Health Organization, *Escherichia coli*

PAPER ID: CEST2021_00164

To what extent are Bioplastics truly harmless?

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ABSTRACT

Biodegradability is a growing interest in the field of research in Bioplastics. To what extent are we fully aware of the benign impact Bioplastic has on the environment, especially in water? Wastewater treatment plants are the primary source of microplastic release in the hydrographical environment. Almost 56% of annual plastic is discarded (19% recycled, 25% incinerated), the majority of which is discharged in the ocean. To reduce the negative impact of plastic waste on the environment, Bioplastics are chosen as an eco-friendly solution. Although Bioplastics are produced from renewable sources, it is a misbelief to consider all bioplastic harmless for the environment. As a matter of fact, most bioplastics are biodegradable but not compostable, a necessary criterion of sustainability. The behavior of micro-bioplastics in the aquatic environment is a complex ongoing area of research. The aim of this work is to give insight on the overlooked damaging nature of bioplastics in both production and disposal processes. Furthermore, a focus is placed on the recovery of bioplastics from wastewater by applying circular economy criteria and technology, including WWTPs processes.

KEYWORDS: bioplastics sustainability, WWTPs, microplastics, biodegradability, wastewater

PAPER ID: CEST2021_00285

Research on vegetable farming in vertical hydroponic system

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ABSTRACT

Vertical farming is the practice of growing plants in a multi-layer system. This often includes agriculture in a controlled environment, whose purpose is the optimisation of plant growing, together with soil-free agricultural techniques, such as hydroponics, acquaponics and aeroponics. Some of the structures used for setting-up the vertical farming systems are: buildings, ship containers, underground tunnels and mine shafts.

This paper presents the study of several vegetable cultivars grown in a vertical hydroponic system, with a vegetation period of 7 to 18 days. The analysed species were: green mizuna, red mustard, green pak choi, red radish, green peas. At the end of the established vegetation period, the plants were cut, then mixed in a tasty fresh salad. Besides the explosion of tastes and special nutritional intake, this relatively new agricultural concept was proven to have a higher yield compared to the conventional farming techniques. This yield is given by the following factors: high productivity, water consumption reduced up to 70%, decrease of pesticides consumption by creating an ideal growing environment, perfectly controlled according to the requirements of each species, possibility to use such a system anywhere, even in non-agricultural areas (areas with disused agricultural land, mountain areas or even directly within shops).

KEYWORDS: microgreens, vertical farming, hydroponics

PAPER ID: CEST2021_00503

The biological growth parameters of *Fusarium proliferatum* fungus

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ABSTRACT

Due to the rapid growth of global populations, ensuring sufficient agricultural inputs with has become a new challenge for the scientific community. Moulds contamination of grains represents a major cause of food spoilage, according to statistics over 20% of global cereals production being compromised during storage period. Various species belonging to *Fusarium* genera induce a negative impact on yield and grain quality due to mycotoxins production, thus establishing the biological terms of pathogens development provides relevant information regarding timing period for applying specific control measures in order to stop the infection process of the disease.

The study aims was to investigate the influence of some abiotic parameters on the vegetative fungal growth and development, under controlled conditions. The biological material consisted in one strains of *Fusarium proliferatum*, isolated from wheat caryopses. It was established that the fungus develops in a large scale of pH, forming specific colonies between low-acid and high alkaline values (pH 4-10). Optimal growth temperature values were between 20ºC and 28ºC, with a 6ºC minimum and no growth above 38Cº. Very good sporulation and mycelial growth was obtained under permanent darkness conditions followed by continuous light variant.

KEYWORDS: *Fusarium proliferatum*, food spoilage, biological parameters.

PAPER ID: CEST2021_00809

Preliminary study of minerals, tyrosinase and elastase activity in plants from urbans park– green analytical solutions

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ABSTRACT

Users of cosmetics in particular show a strong preference for products derived from plant extracts and other natural sources, as they consider them to be environmentally friendly, safe, and capable of positively affecting the health and appearance of human skin. The present study aims to analyze the composition of elements important for skin health and toxic elements, as well as tyrosinase and elastase activity of four species (*Medicago lupulina L.¸ Fabaceae, Lotus corniculatus L., Fabaceae, Knautia arvensis (L.) Coult., Caprifoliaceae, Plantago major L., Plantaginaceae*), which are frequent inhabitants of urban parks in Zagreb. In this work, two groups of green solvents were used for extraction of plant material: Cyclodextrins (CD) and eutectic mixtures. Total reflection x-ray fluorescence spectroscopy (TXRF) was used for multi-element analysis of the studied plants, which is a fast and simple technique for quality control and safety testing of the plants. The results showed good cosmeceutical potential for all the samples and the activity of the prepared extracts was species and solvent dependent. In addition, the plants tested contained low levels of toxic heavy metals, so they are considered safe for human use. The content of other elements varies greatly due to the environment.

KEYWORDS: cosmeceutical, green extraction, minerals, TXRF

PAPER ID: CEST2021_00808

Conversion of agro-industrial wastes into non-toxic protein-rich food additives by basidial fungi strains isolated from diverse ecosystems of Georgia

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ABSTRACT

Great interest to basidial fungi is determined by their potential to convert number of lignocellulosic wastes into nontoxic compounds, cheap food, pharmaceuticals, etc. The majority of basidial fungi strains are characterized by high activity of enzymes degrading plant biopolymers, including lignin, which attracts special attention because of their use in different industries and medicine. Among 53 tested basidial fungi strains best results were obtained by *Pleurotus drynus* IN11 and *Ganoderma* sp. GV02 strains while growing on orange wastes, where 20% and 27% of protein, respectively, and up to 50% of carbohydrates were accumulated. After 10 - 20 days of solid state fermentation (SSF) in the same biomass the content of lignin was detected only in trace amounts. The content of microelements was (mg/kg): calcium 1200 - 6200, potassium 2100 - 2800, and sodium 90 - 708. Further investigation of strains allowed selection of active producers of soluble polysaccharides among which *Pleurotus ostreotus* and the representatives of genus *Ganoderma* sp. (10 - 14 g/L) were the most active. During the submerged fermentation (SF) the highest potential to produce extracellular antioxidants were detected in several strains of *Ganoderma* sp. (up to 6 g/L). Some selected *Ganoderma* strains expressed very high laccase extracellular activity (about 125000 U/L).

KEYWORDS: agro-industrial wastes, converstion, basidial fungi, protein-rich food additives.

PAPER ID: CEST2021_00621

FeBio: R&D of novel 75 kWel AD plant for difficult agricultural residues: horse manure, straw and green waste

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ABSTRACT

Substrates for biogas production will be provided mainly by residues in future. Without a complex and expensive pre-treatment, solid residues with dry matter (DM) content higher than 30%, e.g. horse manure, husk, grass or straw can only be used in small quantities in a wet anaerobic digestion (AD) plant to maintain a DM content of lower than 15%. Especially for small quantities of dry and solid residues, typical for rural and agricultural areas, the application of small-scale dry AD-plants with a maximum capacity of 75 kW_{el} can be a technical smart solution. For solid residues, the dry AD process in combination with a Combined Heat and Power Plant (CHP)is technically favourable, as it works with DM content higher than 20% and provides electricity. The objective of the „FeBio"project (running time are 4 years, from 2020 – 2023 and funded by the German Ministry for Economic Affairs and Energy (BMWi) within the 7th Energy Research Programme) is the development of a small-scale dry AD plant for solid and stackable residues with low investment costs of 4,000 - 6,000 €/kW_{el} and electricity generation costs of lower than 18 €-Cents/kWh_{el}.

KEYWORDS: biogas, straw, husk, grass, 75 kW, CHP, dry AD

PAPER ID: CEST2021_0083

SESSION 54 - SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION

Saturday 4 September - afternoon

Proceedings of the 17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

Practical Applications of Groundwater Modeling in Contaminated Site Investigation and Remediation

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ABSTRACT

Modeling is a very useful tool in the investigation and remediation of contaminated sites, that is generally misunderstood and underutilized. Often, modeling is perceived as requiring protracted and expensive efforts, beyond the means of most projects. However, developing a clear set of objectives and understanding the limitations of each modeling effort enables us to develop the information that needed and to obtain regulatory closure. We are providing examples of how the application of these principles allows to obtain valuable results expending only modest effort and cost.

KEYWORDS: modeling, contamination, investigation

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Data Visualization Techniques for Contaminated Site Investigation and Remediation

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ABSTRACT

Site investigations and remedial actions generate large amounts of data. While tabulating the data is necessary for the purpose of satisfying reporting requirements and comparisons to standards, it does not allow us to understand and explore relationships in the data to obtain important information on items such as contaminant source or fate and transport. Data visualization tools allow us to explore and understand these relationships. However, application of these tools requires planning and proper selection of assumptions, to avoid reaching improper conclusions. We are providing examples of how simple tools provide powerful information for site closure.

KEYWORDS: visualization, contamination, investigation

PAPER ID: CEST2021_00248

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Reductive Debromination of 1,2-dibromoethane and tribromoethylene by a Shrimp-Shell Biochar and Green Rust Composite

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ABSTRACT

Simple brominated ethanes and ethylenes like 1,2-dibromoethane (DBA) and tribromoethylene (TrBE) are widespread, toxic contaminants and able to persist in soil and groundwater. Some of these compounds are used as intermediates in the production of resins and as wood preservatives. Previous uses include additives for leaded fuel and fumigants for agricultural use (Falta et al., 2005). For the corresponding chlorinated ethylenes, a combination of layered iron(II)-iron(III) hydroxides (green rust) and biochar has been reported to efficiently dechlorinate and thereby detoxify the compounds within a short time span (Ai et al., 2019). For the brominated equivalents, there is only little research on their corresponding debromination reactions, although the contaminants are often present in anoxic sediments and groundwaters (Patterson et al., 2007). In this study, it is demonstrated that various shrimp shell biochars can catalyze the abiotic debromination of tribromoethylene, 1,2-dibromoethane, cis/trans-dibromoethylene, vinyl bromide and bromoethane by green rust sulfate in aqueous solution and in groundwater samples. 1,2-dibromoethane and tribromoethylene were reduced to ethylene and acetylene respectively, within 24 hours, using a shrimp shell biochar, pyrolyzed at 900°C for 2 hours, followed by acid treatment. All reactions followed pseudo first-order kinetics. Further work is being performed on post pyrolysis treatments. Three treatments have been tested: no treatment (NT), acid treatment (AT) and acid treatment + CO_2 activation (CO_2). The SS900CO_2 was the most reactive. The SS900NT was the least reactive. Full reduction of DBA and TrBE was observed by total molar recovery of ethylene and acetylene

PAPER ID: CEST2021_00382

Column experiments to investigate the fate of per- and polyfluoroalkyl substances (PFASs) in the subsurface during soil stabilization with colloidal activated carbon

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ABSTRACT

Remediation of sites contaminated with per- and polyfluoroalkyl substances (PFASs) is key to reduce the contamination of drinking water sources and subsequent human exposure. PFAS production and use is increasingly being restricted worldwide, however, legacy contamination plumes in soil and groundwater system are still posing a threat due to their persistence against degradation. One of the most widely studied soil remediation techniques for PFASs is stabilisation, which results in the long-term entrapment of the contaminants with the addition of fixation agents in the subsurface, aiming to prevent their leaching from soil to groundwater. In relation to this, the aim of this study was to identify the leaching behaviour of PFASs in a treatment scenario using activated carbon. Results have shown significantly increased sorption of PFASs in soil amended with activated carbons compared to untreated soil. Additionally, there was a positive correlation between the length of the perfluorocarbon chain and sorption efficiency. The study is a step towards increasing our understanding on the efficiency and longevity of stabilisation with activated carbons as a remediation strategy for PFAS-contaminated soils and groundwater.

KEYWORDS: PFAS, adsorption, contamination, remediation, groundwater

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Contaminated Soil Management In Greece: Eu And International Best Available Practices And Recommendations

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ABSTRACT

Contaminated soil management is one of the most rapidly developing environmental protection subjects. Unlike most EU countries, Greece does not have a robust Soil Strategy and as a result a Contaminated Soil Management Framework. Currently in Greece, contaminated soil management is part of the hazardous waste management framework, which is a problematic practice for consultants, industries, and pertinent authorities. The purpose of this paper is to provide recommendations based on the available EU and international best practices and a realistic roadmap, including both technical and non-technical subjects, for a Contaminated Soil Management Framework in Greece. To achieve this purpose a thorough literature review and a questionnaire study carried out where a group of competent contaminated soil international and national experts from private and public sector participated. The questionnaire covered the entire field of contaminated soil management from soil legislation and derivation of soil and groundwater screening values to sampling methods and stakeholder engagement.

KEYWORDS: Contaminated soil, Contaminated Soil Management Framework, Best Available Practices, soil screening values, sampling methods

PAPER ID: CEST2021_00852

SESSION 55 - HYDROLOGY AND WATER RESOURCES

Saturday 4 September - afternoon

What is the impact of earth observation and in-situ data assimilation on seasonal hydrological predictions?

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ABSTRACT

Earth Observations (EO) have become popular in hydrology because they provide information in locations where direct measurements are either unavailable or prohibitively expensive to make. Recent scientific advances have enabled the assimilation of EOs into hydrological models to improve the estimation of initial states and fluxes which can further lead to improved forecasting of different variables. When assimilated, the data exert additional controls on the quality of the forecasts; it is hence important to apportion the effects according to model forcings and the assimilated datasets. Here, we investigate the hydrological response and seasonal predictions over the snowmelt driven Umeälven catchment in northern Sweden. The HYPE hydrological model is driven by two meteorological forcings: (i) a downscaled GCM meteorological product based on the bias-adjusted ECMWF SEAS5 seasonal forecasts, and (ii) historical meteorological data based on the Ensemble Streamflow Prediction (ESP) technique. Six datasets are assimilated consisting of four EO products (fractional snow cover, snow water equivalent, and the actual and potential evapotranspiration) and two in-situ measurements (discharge and reservoir inflow). We finally assess the impacts of the meteorological forcing data and the assimilated EO and in-situ data on the quality of streamflow and reservoir inflow seasonal forecasting skill for the period 2001-2015. The results show that all assimilations generally improve the skill but the improvement varies depending on the season and assimilated variable. The lead times until when the data assimilations influence the forecast quality are also different for different datasets and seasons; as an example, the impact from assimilating snow water equivalent persists for more than 20 weeks during the spring. We finally show that the assimilated datasets exert more control on the forecasting skill than the meteorological forcing data, highlighting the importance of initial hydrological conditions for this snow-dominated river system.

KEYWORDS: earth observations, hydrology, forecasting, data assimilation

PAPER ID: CEST2021_00425

Large sample hydrology and its importance in hydrological forecasting

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ABSTRACT

Catchment scale investigations are indeed valuable for detailed process investigation and therefore to understand the local conditions that affect forecast skill. However these are limited when it comes to scaling up the underlying hydrometeorological hypotheses. To advance knowledge on the drivers that control the quality and skill of hydrological forecasts, much can be gained by comparative analyses and from the availability of statistically significant samples. Large-scale modelling (at national, continental or global scales) can complement the in-depth knowledge from single catchment modelling by encompassing many river systems that represent a breadth of physiographic and climatic conditions. In addition to large sample sizes which cover a gradient in terms of climatology, scale and hydrological regime, the use of machine learning techniques can contribute to the identification of emerging spatiotemporal patterns leading to forecast skill attribution to different regional physiographic characteristics. Here, we draw on two seasonal hydrological forecast skill investigations that were conducted at the national and continental scales, providing results for more than 36,000 basins in Sweden and Europe. Due to the large generated samples, we are capable of demonstrating that the quality of seasonal streamflow forecasts can be clustered and regionalized, based on a priori knowledge of the local hydroclimatic conditions. We show that the quality of seasonal streamflow forecasts is linked to physiographic and hydroclimatic descriptors, and that the relative importance of these descriptors varies with initialization month and lead time. In our samples, hydrological similarity, temperature, precipitation, evaporative index, and precipitation forecast biases are strongly linked to the quality of streamflow forecasts. This way, while seasonal river flow can generally be well predicted in river systems with slow hydrological responses, predictability tends to be poor in cold and semiarid climates in which river systems respond immediately to precipitation signals.

KEYWORDS: large sample, seasonal forecasting, hydrology, machine learning, attribution

PAPER ID: CEST2021_00427

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Evaluating flooding impact to riverine bridges. The case of the Historical Bridge of Arta in Epirus, Greece

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ABSTRACT

Climate impacts are expected to intensify weather related flooding events that are the most common and damaging natural disaster. Riverine bridges are particularly prone to failure during floods and their disruption may impair significantly flood evacuation plans. Thus, in the design of bridges, it is especially important to consider the impact of flooding and more specifically to determine the flow characteristics around bridges for a range of discharges including flood conditions. Typically, we perform such calculations using 1D approaches. In the present work we demonstrate that 1D approaches are not adequate as follows. Firstly, we apply the conventional approach using the hydrodynamic model HECRAS-1D in the Historical Bridge of Arta and determine the hydrodynamic characteristics and forces. Secondly, we apply the 3D CFD model FLOW3D and repeat the calculations. Thirdly, we compare the results of both approaches and draw the following conclusions: (1) Under normal flow conditions, the two approaches give similar results for the hydrodynamic forces on the bridge piers that range from 12 to 18 KN/m^2, and (2) Under flood conditions calculated forces using FLOW3D increase dramatically ranging from 34 to 37 KN/m^2, while these using HECRAS-1D remain at the same levels as for normal flow conditions.

PAPER ID: CEST2021_00617

A Decision Support Matrix for Water Quality Based Stormwater Management

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ABSTRACT

Extreme weather events and climate change are stressing urban stormwater systems beyond their capacity, posing potential threat to both the built and natural environments. This paper aims to contribute to risk mitigation through evaluating the feasibility of using a decision support matrix for developing an e-monitoring system for stormwater quantity and quality.

The decision support matrix used in the design of the e-monitoring system was created using data from previous water quality research and it assumes that water quality is influenced by the characteristics of the watershed. This premise was put to the test during an investigation of water quality across the catchment of the pilot site in Viimsi Parish, Estonia.

The comparison of the developed matrix and the sampling results revealed that the assumed relationships do not hold on a small catchment and that there is a need for further validation of relationships between surrogate and traditional water quality parameters.

KEYWORDS: stormwater, water quality, case study, e-monitoring

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Comparison of Analytical and Modeling solutions of the hydrodynamic behavior of drainage channels covered by reed beds

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ABSTRACT

The purpose of this work is the validation of modeled turbulent features induced by hydrodynamic interaction between water flow motion and rigid emergent reed beds obtained by employing both analytical and Shallow-waters approaches. The experimental dataset employed for the validation was collected during three hydraulic experiments performed in a vegetated reclamation channel under three different scenarios of riparian vegetation management: one discharge for (1) vegetation in total abandonment, with infesting reed beds in natural conditions, and two discharges for (2) central riparian vegetation cleaning, with the presence of two side buffers of reed beds in undisturbed conditions. In particular, Reynolds shear stresses and Turbulent Kinetic Energy were computed based on the values of measured water flow velocity acquired by an acoustic Doppler velocimeter (ADV), located at the vegetated channel's upstream cross-section. The preliminary results of the present work embody a useful tool for the prediction of the effects of riparian vegetation in vegetated reclamation channels colonized by such riparian species at real scale.

KEYWORDS: Ecohydraulics; Vegetated channels; Turbulence; Aquatic ecosystems; Shallow-waters.

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Water Losses Assessments to support decision making in Water Supply System management

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ABSTRACT

In order to reduce costs related to water supply service, modernization measures should be carried out to water losses. The paper presents an analysis and assessment of water losses carried out based on data provided by a water utility company. The basic indicators of water loss according to the International Water Association were then determined, such as: the leakage percentage (LP), the real leakage balance (RLB), the unavoidable annual real losses (UARL), and the infrastructure leakage index (ILI). On the basis of the categories given by IWA, we can see that the analysed water supply network is classified as a network of very good technical performance. The obtained water loss indicators in the examined water supply system (WSS) are comparable to the indicators in other collective water supply networks in Poland.

Keywords: water supply system (WSS), water losses, water losses indicators.

PAPER ID: CEST2021_00820

Impacts of Wildfires on Surface Runoff and Erosion: The Case Study of a Fire Event in Pelion Area, Greece

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ABSTRACT

Wildfires can trigger dramatic increases in surface runoff and erosion, because of the burned vegetation and the appearance of a condition of soil-water repellence. Fire-enhanced surface runoff generation and soil erosion constitute adverse effects of high concern for a long-term future period after a fire event occurrence. The current study investigates the increase on peak surface runoff and sediment loss as a result of a fire event that occurred in Pelion area in Greece on June 27th, 2007. The boundaries of the burned area were determined using satellite images, and the total burned area was found to be almost 60km^2. The land cover of the area prior to fire event, mainly included forest, seminatural and agricultural areas as determined by the raster datasets produced by the Copernicus land cover program. The change of peak surface runoff discharge pre- and post- fire event was estimated using the Natural Resources Conservation Service – CN (NRCS-CN) method, while the sediment loss was also estimated. The fire event was found to significantly increased peak surface runoff, which may cause the occurrence of flood events in the downstream area.

KEYWORDS: Wildfires; Land use change; Surface runoff; NRCS-CN method; Sediment loss

PAPER ID: CEST2021_00566

Impacts of Land Use and Land Cover Change in a Mediterranean Mountainous Area on Surface Runoff During the Period 1945 – 2018

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ABSTRACT

Changes in land use and land coverage strongly interrelated with changes in runoff. The effects of land use and land cover change on peak surface runoff and sediment loss, was investigated in a mountainous catchment, namely Lakka catchment located in Thessalia region in Greece.Most of the Lakka catchment is covered by pastures, agricultural, forest and seminatural areas. Land cover of the study area for the years 1945, 1960, 1996, 2007 and 2018 was captured by the method of the photointerpretation, using the appropriate pairs of the aerial photographs and the stereoscopic glasses (SA030-4X), and by the method resulting from the use of the datasets produced by the Copernicus land cover program. The aim of the study is to investigate the evolution of peak runoff discharge during the period 1945-2018, against a background of land use and land cover change. The Natural Resources Conservation Service – CNmethod was utilized in order to estimate peak runoff discharge while the sediment transfer was also estimated. Agricultural land area was found to be significantly increased, against forest and seminatural areas during the study period, resulting to an increase of peak surface runoff, which may cause flood problems in the downstream areas.

KEYWORDS: Land use and land cover change; Surface runoff; Photointerpretation; Aerial photographs; NRCS-CN method

PAPER ID: CEST2021_00567

Average seasonal soil erosion and sediment deposition in the Aliakmon and Axios river catchments using the RUSLE model

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ABSTRACT

Anthropogenic pressures in coastal areas are responsible for various problems that might cause degradation of their environmental status and limitations in the provision of their ecosystem services. In this framework, the assessment of soil erosion and sediment deposition is of major importance since they have significant environmental and economic impact. In this paper, the Revised Universal Soil Loss Equation (RUSLE model) was used to assess the average seasonal soil erosion and sediment deposition in the Aliakmon and Axios river catchments in Thermaikos Gulf, Northern Greece; areas of important environmental and economic value. The RUSLE is an empirical model which in combination with GIS and remote sensing is able to estimate soil erosion through the prediction of long-term seasonal soil loss and sediment deposition.

KEYWORDS: Aegean Sea, RUSLE model, GIS, watershed

PAPER ID: CEST2021_00596

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Influence of Common Solar and Climate Cycles on Groundwater Level Variations

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ABSTRACT

The groundwater is one of the most important natural resources. It provides drinking water and water for businesses. The level of groundwater varies in time. It has significantly seasonal oscillations and long-term variations, induced by rainfalls and climatic droughts. The seasonal, interannual and decadal cycles of groundwater level are studied by reconstructed time series for several groundwater stations in England for the period 1891-2015 provided by the British Geological Survey. The monthly groundwater level time series are created by the program AquiMod by real measurements of groundwater level data, precipitation, temperature and estimation of potential evapotranspiration, soil drainage, unsaturated-zone flow and groundwater flow. The common cycles of Total Solar Irradiance (TSI), precipitation and Palmer Drought Severity Index (PDSI) are determined by means of the Method of Partial Fourier Approximation. The solar and climate cycles are compared with the groundwater oscillations in narrow frequency bands with periodicities between 1 and 125 years. The variations of seasonal amplitudes are analyzed together with solar and climate Indices. The possibility of forecast of groundwater variations on the base of common solar, climate and groundwater cycles is discussed.

KEYWORDS: groundwater level, precipitation, PDSI, solar cycles

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CEST 2021

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Athens, Greece, 1 to 4 September 2021

Variations of Mean Daily Discharge of Danube River at 16 Stations

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ABSTRACT

The river discharge is the main source of freshwater for large surface areas. Its deep minima are connected with drought events, while its maxima – with floods. The time series of river discharge consist of significant seasonal variations, modulated by long-term oscillations. The seasonal, interannual and decadal cycles of Danube river discharge are studied by time series of mean daily data from 16 stations. The data from Orsova station started in 1840. Three stations started in 1900, and the rest – in 20s of the last century. Time series of maximal discharge and seasonal amplitude are created. Their variations in narrow frequency bands are analyzed by the Method of Partial Fourier Approximation (PFA) and compared with the corresponding cycles of the solar activity. The amplitudes of seasonal harmonics from the PFA are compared for all stations. The time delay of the 11-year solar signals to the reaction of river discharge at used stations, are determined from the phase differences. Possible forecast of periods with maximal river discharge on the base of solar cycles is discussed.

KEYWORDS: river discharge, seasonal variations, solar cycles

PAPER ID: CEST2021_00368

SESSION 56 - WATER TREATMENT

Saturday 4 September - morning

CEST 2021

Proceedings of the 17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

Alternatives for removing fluoride from water for human consumption and water for reuse

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ABSTRACT

This compilation aims to describe the studies carried out focusing on the treatment of 100-127 mg/L of wastewaters involving different fluoride removal alternatives which demonstrated efficacy. Adsorption by bone char, both in batch as in continuous systems, including chemical and thermal regeneration of the adsorbent, composed of apatite in its structure (70-76%) is highlighted. Bone char showed an adsorption capacity of 6.8 mg/g, well fitted by the Freundlich model and being able to be regenerated until five cycles using NaOH solution. Using a monopolar configuration with 8 aluminum electrodes and current density of 7.53 mA/cm^2 during 60 min of electrocoagulation, a treated stream containing 1 mg/g (pH of 6-6.5) or 36 mg/L (without pH control) have been obtained. An using the most conventional treatment, precipitation with calcium sources, 60 min of reaction with the use $CaCl_2$ was able to reduce the fluoride concentration from 139 mg/L to 8 mg/L using $CaSO_4$ the concentration was reduced to 12 mg/L, that was further decreased to 10 mg/L, after 24 hours, without agitation. Then, the process to be chosen depends on the facilities and chemicals available and also the requirements of specific treated stream downstream.

KEYWORDS: Bone char; Fluoride removal; Adsorption; Electrocoagulation; Precipitation

PAPER ID: CEST2021_00752

Efficiency of Arsenic Removal from Water Using Fe-Modified Biochar from Date-Palm-Leaves Combined with Spectral Induced Polarization (SIP) Monitoring

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ABSTRACT

In this study, lab-scale column batch adsorption experiments were conducted to demonstrate the efficiency of Iron-modified Biochar (Fe-BC) produced from date-palm leaves at 500^{o}C to remove arsenic (As) from contaminated water. The As removal capacity were monitored by both chemical analysis and spectral induced polarization (SIP) techniques. The results showed that high removal capacity of As was achieved when the sand-backed column was amended with 5 and 10% Fe-BC compared to sand only. Results showed that the Fe-BC achieved arsenic removal rates of more than 98% compared to the 17% by sand only (control).SIP monitoring over the duration of the experiment (16 hours) showed changes in the recorded signals that were consistent with the As removal, as confirmed by chemical analysis. It can be concluded that BC made from date-palm leaves and modified with Fe has shown excellent efficiency of removing As and that SIP can provide reliable and fast real time monitoring of the treatment process.

KEYWORDS: Biochar, spectral induced polarization, arsenic, water treatment

PAPER ID: CEST2021_00119

Removal Of Arsenic From Water Using Iron-Coated Pomelo Peel (ICPP)

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ABSTRACT

This study investigated the removal of arsenite (As(III)) and arsenate (As(V)) in aqueous solution using iron-coated pomelo peel (ICPP). Batch adsorption experiments were performed to evaluate the effects of initial pH values (2.0–10), contact time (1–1440 minutes), initial concentration (0.05–5 mg/L) on the As(III) and As(V) removal capacity by ICPP. The Langmuir maximum adsorption capacities of ICPP of As(III) and As(V) at pH 7.0, and 25 °C were 1.51 mg/g and 1.64 mg/g, respectively. The capacities were significantly higher than that of raw pomelo peel (PP) material at the same condition (q_{max} As(III) = 0.032 mg/g and q_{max} As(V) = 0.036 mg/g). Adsorption kinetics data fitted well with the Elovich model and the adsorption process quickly reached an equilibrium at around 120 min. The results shows that the As(III) and As(V) adsorption performance of ICPP were much better than that of PP, granular activated carbon (GAC) and many iron-based adsorbents. Thus, ICPP has potential as a filter media for efficiently removing toxic arsenic ions from water.

KEYWORDS: Arsenic removal; Adsorption; Iron-coated pomelo peel; Water treatment.

PAPER ID: CEST2021_00174

Nutrient Removal from Stormwater using Australian Native Plants in Constructed Floating Wetland

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ABSTRACT

Stormwater pollution causes excessive nutrient influx to rivers and lakes, which can trigger algal bloom and subsequent damages to the freshwater ecosystem. Constructed Floating Wetland (CFW), a cost-effective technology, uses aquatic plants in a hydroponic system to strip nutrients from stormwater through plant uptake. In this study, performance of two native Australian plants such as *Eleocharis acuta* (*EA*) and *Baumea preissi* (*BP*) in removing nutrients (NH_3-N, NO_3-N, and PO_4-P) was investigated. Experiments were conducted outdoor in microcosm (20L) buckets, including an unplanted control bucket. About 65% and 96% of Total Inorganic Nitrogen (NH_3-N + NO_3-N) was removed in 14 days by *EA* and *BP*, respectively. Both plants could remove up to 40% of PO_4-P in the same duration. A significant difference ($p<0.05$) between control and planted buckets was detected in ANOVA analysis. First-order kinetic rates (k) for both plants revealed that *BP* (k=0.341, 0.099 and 0.044 per day) has higher kinetic rates than *EA* (0.174, 0.021 and 0.039 per day) for all nutrients (NH_3-N, NO_3-N and PO_4-P), respectively. Elevated level of Dissolved Oxygen (DO) was observed in *EA* planted bucket, raising interest for further research. This study proved the suitability of CFW system to treat stormwater using Australian native plants.

KEYWORDS: stormwater, treatment, floating wetland, aquatic plants, nutrients.

PAPER ID: CEST2021_00176

Preliminary study on fluoride removal from contaminated groundwater by nanofiltration

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ABSTRACT

In this work, a commercial nanofiltration (NF) membrane, named SPR 10113, was used for the first time to treat a real F-contaminated groundwater (F= 8.9 mg/L) coming from deep crystalline aquifer of Calabria Region (Southern Italy), in order to verify its efficiency in terms of fluorine rejection and quality of the permeate. Before treatment, a complete geochemical characterization was performed. The used membrane exhibited a fluoride rejection value ranging from 94 to 96 %, lowering the Fconcentration below the limit established by WHO. Moreover, the results prove that a low ionic load was maintained in solution, producing a demineralized water not suitable for long-term drinking consumption. Nevertheless, the produced water can be also used without any further re-mineralizing process for agricultural or other purposes.

KEYWORDS: Fluoride, water treatment, nanofiltration, membranes

PAPER ID: CEST2021_0000395

Modelling the operation of a Water Treatment Plant based on Artificial Neural Networks

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ABSTRACT

The main purpose of this study is to model the operation of a Drinking Water Treatment Plant (DWTP) using its main operational and water quality parameters in a fast, easy and reliable way. This study is based on a large number of data from recent years (2019-2021). The DWTP has a maximum capacity of 110,600 m^3/day and is located at Hersonissos, Crete in Greece. The methodology that was followed comprised of the development of Artificial Neural Networks (ANN) in the MATLAB programming environment. Since the 1990s the ANN modelling approach has gained popularity for prediction and forecasting due to its ability to capture complex nonlinear relationships. Two models were developed with satisfactory results with regards to Mean-Square Error (MSE) and Regression Coefficient (R) values. The models were able to predict the main operational parameters such as the dosages of coagulants, flocculants and disinfection (O_3, $Cl_{2(g)}$) chemicals rendering them a useful tool for the DWTP operator. For future work a greater number of tests are planned to check different ANN input parameters and architectures with different numbers of hidden neurons.

KEYWORDS: water, treatment, artificial, neural, network

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Environmental Burdens of a Large Water Treatment Plant: The Operational Phase

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ABSTRACT

Being a metropolis, Istanbul requires a well-functioning urban service system. Water supply is among the most important infrastructures in this city that has around 15-16 million habitants. There are many water treatment plants all around Istanbul to facilitate healthy water supply to people. On the other hand, these plants are sources of negative environmental impacts. In this perspective, it is necessary to investigate the ways to reduce these negative environmental impacts. The objective of this study is to evaluate the environmental impacts of Kagithane Water Treatment Plant (KWTP) by adopting life cycle assessment (LCA) methodology. KWTP is one of the biggest water treatment plants in Turkey. The treatment plant is located on the western side of Istanbul. It withdraws water from Terkos Lake and Alibey Dam. Energy input is addressed as the most important contributor to all environmental impact categories. In conclusion, it is recommended to develop strategies for the reduction of energy consumption together with adopting from renewable sources for energy input.

KEYWORDS: Water treatment, Environmental impacts, Life cycle assessment, Operation.

PAPER ID: CEST2021_00677

Synthesis of Fe_3O_4-Ag Nanocomposite and Their Performance as Surface Modifiers for TiO_2 Membranes in Treating Oily Wastewater

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ABSTRACT

Membrane technology has shown extraordinary performance in treating oily wastewater. Yet, more research is focused towards enhancing the performance of the separation process. In this work, Fe_3O_4-Ag composite nanoparticles (NPs) were synthesized using the co-precipitation technique and applied on the surface of TiO_2 ceramic membranes to enhance their performance in terms of oil emulsions separation. The NPs were characterized using the FTIR, XRD, among others. The Fe_3O_4-Ag NPs were coated on the surface of the ceramic membranes using vacuum coating method by which a uniform layer of the NPs was formed on the surface. Results showed that the contact angle of the pristine ceramic membrane was found to be 75° ± 2.2°. On the other hand, the modified membrane contact angle was found to be 10.1° ± 2.2° indicating a super hydrophilic surface. Furthermore, the modified membranes showed water flux of 1065 $L \cdot m \cdot h^{1}$ (LMH) which is 2.8 higher than the pristine membrane (380 LMH). Lastly, the surface-coated membranes showed a total oil rejection of 61.8% compared to 56.5% in the pristine membranes. These results showed the potential of using these modified membranes in treating oily wastewater from refineries.

KEYWORDS: Membrane technology, Oily wastewater, Nanoparticles, Surface Modification.

PAPER ID: CEST2021_00162

Removal of wood dyes from aqueous solutions by sorption on un-treated pine sawdust

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ABSTRACT

Synthetic dyes are extensively used in industry for various applications among which is the preparation of dyed wood veneers. The discharge of effluents containing dyes is of great concern due to their toxicity, mutagenicity and carcinogenicity and causes serious environmental problems. In this work, the possibility of using un-treated pine (*Pinus radiata*) sawdust, a waste product from the wood industry, as biosorbent for the removal of wood dyes from wastewaters was investigated. The BET surface area of the material was 0.36 ± 0.01 m^2/g and the point of zero charge 4.8. Batch adsorption experiments were performed at 25ºC, natural pH (5.1, 6.0, 6.2 for blue, black and red dyes, respectively), 100 rpm and initial dye concentration of 5 mg L^{-1} to analyze the effect of the adsorbent dose (5 or 10 g L^{-1}) and contact time (up to equilibrium) on the adsorption percentage for three dyes (blue, red and black). The highest adsorption percentage was attained at 10 g L^{-1} for an equilibrium time of 48 h: 67 ± 2.46% for blue, 34.46 ± 0.34% for black and 29.93 ± 0.27% for red. The maximum adsorption capacity decreased in this order: blue, 0.374 ± 0.032 mg g^{-1}; black, 0.183 ± 0.001 mg g^{-1} and red, 0.161 ± 0.002 mg g^{-1}. Kinetic data were best fitted to the pseudo-second order model, which suggests a chemisorption process.

KEYWORDS: pine sawdust, wood dyes, biosorption, wastewaters

PAPER ID: CEST2021_00438

New polyacrylonitrile (PAN)-based porous carbons for the removal of industrial wood dyes from aqueous solutions

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ABSTRACT

Synthetic dyes degradation is a difficult task due to their complex aromatic structure, although its elimination by adsorption is effective. The aim of this research is to produce porous carbons derived from polyacrylonitrile (PAN) as wood dyes adsorbents. PAN is a nitrogen-rich precursor transformed at high temperature into highly porous carbonaceous structure with uniform and size-tunable pores useful for the adsorption of bulky molecules such as dyes. Three types of porous carbons were synthesized: N-doped carbon (P-C), N-doped activated carbon with 4-fold excess of KOH (P-ACT) and N, S-co-doped carbon with sulfur in a 1:1 weight ratio (P-S). Synthesis was performed in two stages: oxidation (280ºC) and carbonization (800ºC). Carbon characterization was performed by different techniques (BET, SEM, EDX, XPS, RAMAN, and pH_{PZC}). Adsorption experiments were conducted on batch mode to study the effect of pH (2, natural and 12), solid/liquid ratio (0.5 and 2 g L^{-1}) and initial concentration (23-27 and 230-285 mg L^{-1}) on the adsorption of a red dye used industrially for preparing dyed wood veneers. Adsorption data were analyzed and well fitted by the pseudo-second-order kinetic model. P-ACT showed the best results of dye removal capacity at all concentrations and pH´s.

KEYWORDS: polyacrylonitrile-based porous carbons, wood dye, adsorption, wastewater

PAPER ID: CEST2021_00439

SESSION 57 - EMERGING POLLUTANTS

Saturday 4 September - afternoon

Sampling Strategies of Microplastic in Stormwater Runoff from Separate Drainage Systems

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ABSTRACT

The occurrence of microplastic in terrestrial and water environments can be traced back to anthropogenic activities. Urban drainage systems play a role in transporting microplastic from urban sources into receiving waters or soils. The analysis (including sampling, sample preparation and detection) of microplastic are very complex and time-intensive, and sampling alone is the main contributor to uncertainty in the process. However, the lack of representative and comparable sampling strategies complicates the efforts to quantify emitted loads and to identify sources and pathways. Therefore, strategies for sampling microplastic in different wastewater compartments were developed and tested. The ongoing phase, however, focuses on sampling stormwater runoff in separate sewer systems. A new autonomous sampling concept for stormwater was designed and implemented to capture large sample volumes. The sample volume plays an important role with respect to the representativeness. Samples are then prepared, both in situ and in laboratory to produce five size fractions (1000, 500, 100, 50, 5 µm). Preliminary results show that urban drainage systems transport different loads of at least four microplastic types; namely polyethylene (PE), styrene-butadiene rubber (SBR), polypropylene (PP) and polystyrene (PS). High PE concentrations are detected in all stormwater samples, followed by SBR, a main tire wear constituent. SBR loads showed dependency to the number of dry-weather days prior to sampled rain events.

KEYWORDS: Microplastic, sampling strategies, separate sewer systems, WWTP

PAPER ID: CEST2021_00090

Determination of 56 perfluoroalkyl acids and precursors in top predators and their prey from Northern Europe by LC-MS/MS

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) are a class of emerging substances that have proved to be persistent and highly bioaccumulative. They are widely used in industrial and consumer applications and are known for their long-distance migration and toxicity. In this study, 65 recent specimens of a terrestrial apex predator (Common buzzard), freshwater and marine apex predators (Eurasian otter, harbour porpoise, grey seal, harbour seal) and their potential prey (bream, roach, herring, eelpout) from northern Europe (United Kingdom, Germany, the Netherlands and Sweden) were analyzed for the presence of legacy and emerging PFAS, employing a highly sensitive liquid chromatography electrospray ionization tandem mass spectrometry (LC-ESI-MS/MS) method. Fifty-six compounds from fourteen classes were measured; 13 perfluoroalkyl carboxylic acids (PFCAs), 7 perfluoroalkyl sulphonic acids (PFSAs), 3 perfluorooctane sulfonamides (FOSAs), 4 perfluoroalkylphosphonic acids (PFAPAs), 3 perfluoroalkylphosphinic acids (PFPi's), 5 telomer alcohols (FTOHs), 2 mono-substituted polyfluorinated phosphate esters (PAPs), 2 di-substituted polyfluorinated phosphate esters (diPAPs), 6 saturated fluorotelomer acids (FTAS), 3 unsaturated fluorotelomer acids (FTUAs), 2 N-Alkyl perfluorooctane sulfonamidoethanols (FOSEs), 3 fluorotelomer sulphonic acids (FTSAs), 2 perfluoroether carboxylic acids (PFECAs) and 1 chlorinated perfluoroether sulphonic acid (Cl-PFESA). 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 an accelerated solvent extraction (ASE), followed by clean-up through solid phase extraction (SPE). Method detection limits and method quantification limits ranged from 0.02 to 1.25 ng/g wet weight (ww) and from 0.05 to 3.79 ng/g (ww), respectively. Method accuracy ranged from 40 to 137 %. Method precision ranged from 3 to 20 %RSD. The sum of PFAS concentration in apex predators (liver) ranged from 0.2 to 20.2 μg/g (ww), whereas in the fish species (muscle tissue) it ranged from 16 to 325 ng/g (ww). Our analyses showed that all specimens were primarily contaminated with PFOS, while the three PFPi's included in this study exhibited FoA 100%. Additionally, C9 to C13 PFCAs were detected at high concentrations in apex predator livers despite phase-outs and increasing regulation of these compounds together with C8-based PFAS. Overall, PFAS concentrations were one to four orders of magnitude higher in predator liver tissues than in fish muscle, suggesting bioaccumulation and biomagnification of PFAS up the food chain. The high variety of PFAS and the different PFAS composition in the AP&P samples is alarming and merits the attention of regulators.

KEYWORDS: PFAS, LC-MS/MS, SPE, emerging pollutants, top predators

PAPER ID: CEST2021_00712

Investigating the accumulation of 115 pharmaceutical compounds in the water-soil-plant continuum and the leaching potential using lysimeters irrigated with wastewater from a CAS and MBR system, under real-field conditions

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ABSTRACT

Treated wastewater (TWW) reuse for irrigation is recognized as one of the indispensable practices for the mitigation of water scarcity. However, the presence of contaminants of emerging concern (CECs) in TWW act as a limiting factor in effectively applying the reuse practices. The possible uptake and bioaccumulation of CECs in the edible parts of food crops and fodders during TWW irrigation, and their subsequent entry into the food chain have attracted great scientific attention over the last years. This study aimed at assessing such challenges mediated from TWW irrigation of lettuce plants grown in lysimeters under real field conditions, and irrigated with treated effluent from conventional activated sludge and membrane bioreactor treatment facilities. Different matrices such as control tap water, TWW, leachate, soil and lettuce were collected and analysed for 115 pharmaceutical compounds using ultra-high performance liquid chromatography coupled with a triple quadrupole mass spectrometer. In total, 23 compounds were detected in all the examined samples belonging mostly to macrolides, sulfonamides and quinolones antibiotics. Four compounds namely clarithromycin, sulfamethoxazole, ciprofloxacin and tramadol were found in the investigated water-soil-plant samples. Furthermore, tramadol was also detected in leachate samples. Information on the quantified findings will be presented during the oral presentation.

KEYWORDS : pharmaceuticals; soil; treated wastewater; wastewater reuse; crops;

PAPER ID: CEST2021_00217

Quantitative target screening and soil bioavailability assessment as tools to assess risks associated with wastewater reuse for irrigation

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ABSTRACT

Multi-residue analysis of various classes of contaminants of emerging concern (CECs) present in wastewater, along with improvements in analytical methodologies, may allow for future application of promising wastewater tracers, thus providing wastewater treatment plant (WWTP) operators and regulatory authorities with a more definitive toolbox to assess contamination associated with wastewater discharge and reuse practices. In June 2020, the Regulation EU 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse was published (EU, 2020). With the increasing drive from both policy and practice to facilitate treated wastewater reuse in agricultural irrigation, there is an urgent need to identify and characterize the risks associated with the occurrence of CECs in treated wastewater.

In this study, a quantitative target screening of 200 CECs in 24-hour composite wastewater influent and effluent samples was performed. The wastewater samples were collected, in April 2018 during 7 consecutive days, from the 5 largest WWTPs located in 4 major cities of Cyprus, employing (i) conventional activated sludge (CAS) process followed by chlorination, (ii) membrane bioreactor (MBR) technology and (iii) MBR technology followed by chlorination. The methodology included a generic solid-phase extraction protocol which was followed by an Ultra-High Performance Liquid Chromatography coupled with Quadrupole-Time of Flight Mass Spectrometry (UHPLC-QTOF-MS/MS) method, and post-acquisition data treatment (Gago-Ferrero et al., 2020). The 200 target compounds comprised 185 pharmaceuticals and related metabolites and transformation products, 10 industrial chemicals and 5 artificial sweeteners.

In total, 63 CECs were detected in influent and effluent wastewater samples. Metformin, valsartan, diclofenac, sucralose and acesulfame were among the most abundant compounds in influent samples, while sucralose, diclofenac, guanylurea, valsartan, carbamazepine and benzotriazole were among the most abundant compounds in effluent samples. The parent molecules of clarithromycin, citalopram and metformin were transformed upon CAS and MBR treatment and their associated TPs, N-desmethyl clarithromycin, N-desmethyl citalopram, and guanylurea were detected in effluent samples. Interestingly, N4-acetyl sulfamethoxazole was detected only in MBR effluents, while guanylurea in

both CAS and MBR, indicating that enzymatic activity may differ in the two processes leading to different TPs. A qualitative approach to assess the bioavailability in soil was applied for the 5 most abundant compounds in effluent samples. This approach, described by Revitt et al. (2021), combines data and expert judgement to assess the likelihood of occurrence and the magnitude of impact contributing to the assessment of the risks related to wastewater reuse for irrigation.

KEYWORDS: contaminants of emerging concern, metabolites, transformation products, high-resolution mass spectrometry, risk assessment, wastewater reuse

PAPER ID: CEST2021_00259

Cometabolic biotransformation of organic micropollutants under aerobic heterotrophic conditions

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ABSTRACT

The role that heterotrophs present in activated sludge play in the removal of organic micropollutants (OMPs) has not been clearly elucidated despite their increasing relevance in the conception of novel wastewater treatment plant technologies. OMPs are often present in wastewaters at concentrations insufficient to support microbial growth and therefore their biotransformation would occur cometabolically thanks to the action of enzymes involved in the metabolism of primary substrates. Determination of such enzymatic activities could be very useful to better understand the process. In this study, an aerobic heterotrophic reactor spiked with 20 OMPs was set up to assess the role of the heterotrophic population in OMPs biotransformation, to identify the key biotransformation reactions and to decipher the enzymatic activities carrying out such biotransformations. Results have shown that heterotrophs can extensively biotransform the selected OMPs and that the main reactions responsible for OMPs biotransformation were oxidation, hydrolysis and conjugation routes, leading to transformation products potentially formed through oxygenases, dehydrogenases, hydrolases and transferases.

KEYWORDS: Cometabolism; enzymes; heterotrophs; pharmaceuticals; transformation products

PAPER ID: CEST2021_00659

Effects of sunscreens on plants: Impact of TiO2 nanoparticles on the phytoremediation of oxybenzone

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ABSTRACT

Increasing levels of sunscreens have been found in surface waters, and in waste water. In most cases mixtures of organic and inorganic sunscreen compounds can be detected. Wetland plants, and vegetation along shores have been used as biological filters for this kind of pollution along beaches, and in phytoremediation. The situation is complicated since organic sunscreens like Oxybenzone (OBZ) can be present in the environment as emerging contaminant together with inorganic nanoparticulate TiO2 as typical for the composition of many sunscreens. Hence, potential effects caused by TiO2 must be considered when investigating the performance of aquatic plants with regard to fate and potential remediation of OBZ. When toxic effects of both, OBZ and TiO2 on plant development were evaluated, OBZ significantly inhibited germination rate of tomato (Lycopersicum esculentum) seeds, while no effect was observed for germination of barley (Hordeum vulgare). Interestingly, co-exposure with TiO2 lowered the toxicity of OBZ on the tomato seedlings as there were no differences on germination rate and root length between co-exposure and control treatments. Moreover, growth inhibition tests with Lemna minor showed that addition of TiO2 even enhanced growth of the plantlets, by increasing the frond area. Furthermore, influence of TiO2 at concentrations of 3 mg/L on the uptake and removal of OBZ (5 µM) by plants was exemplarily examined with respect to the variations in uptake and metabolism of OBZ in a hairy root culture system of horseradish (Amoracia rusticana). Co-exposure with TiO2 led to an increased accumulation of OBZ in the plant tissues, while transient decreases of the transformation rate to OBZ metabolites was recognized when TiO2 had been added to the media. It might hence be concluded that Ti nanoparticles deriving from sunscreens may generally reduce the phytotoxicity of the co-occurring OBZ and increase the uptake of this compound in plants. Further studies must consider the interaction of these PPCP molecules with the transformation capacity of plants when planning to apply phytoremediation for UV-filter contaminated water.

KEYWORDS: sunscreen, nanoparticles, TiO2, phytoremediation, oxybenzone

PAPER ID: CEST2021_00020

Effect of water extractable organic matter from Pamvotis lake sediment on three psychoactive drugs under simulated solar light

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ABSTRACT

Psychoactive drugs are classified as contaminants of emerging concern but there is limited information on their fate in surface waters. Here, we studied the fate of three drugs (sertraline, clozapine and citalopram) upon irradiation in the presence of the Pamvotis lake organic matter (WEOM) extracted from sediment under mild conditions. WEOM was characterized by spectral techniques. It showed a percentage of aromaticity of 10.2% and an average molecular weight of 1.7 kDa and had optical characteristics confirming its humic nature. WEOM (5 $mgC.L^{-1}$) enhanced the drugs phototransformation under simulated solar light by a factor of 2, 4.2 and 16 for sertraline, clozapine and citalopram, respectively. The drastic inhibiting effect of 2-propanol (300.5 mg/L) demonstrated that hydroxyl radical was the key intermediate in these reactions. The photoproduct analysis by UHPLC-HRMS revealed common reactions for the three drugs: oxidation of the N-containing aliphatic ring with or without O atom inclusion and of the aromatic ring with phenols formation, N elimination, and substitution of the halogen by OH. Sertraline and citalopram also underwent elimination of the halogenated ring while for clozapine opening of the N-containing aliphatic ring was observed.

KEYWORDS: antidepressants, photodegradation, organic matter from sediment, hydroxyl radicals, photoproducts

PAPER ID: CEST2021_00477

SESSION 58 – ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY

Saturday 4 September - afternoon

Novel hybrid technology for the sustainable development of the circular economy in urban agriculture

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ABSTRACT

Climate change and environmental pollution are just some of the main challenges to be addressed. A number of actions have been taken, in particular the circular economy has proved to be among the most effective in overcoming the traditional approach of the linear economy. Circular economy means not only minimizing the waste produced by giving it a new life, but also preserving the use of resources such as energy and water.

Among the different technologies developed by a circular economy approach, the use of photobioreactors and aquaponics systems are growing. They are closed systems of cultivation and growth of microalgae, which are the most important microorganisms in aquatic ecosystems for the global carbon balance and are fundamental for the capture and bioconversion of carbon dioxide (CO_2) into energy, are widely used.

The aim of this study is to highlight the synergistic action that could be provided by the combinated action between a photobioreactor microalgae and an aquaponic system.

Specifically, the algal biomass obtained, after being dehydrated, could be partly used to feed the fish species in aquaculture, while the remaining part is treated in order to produce biofuels and biopolymers that are produced with high added value.

The aquaculture system, in turn, thanks to the metabolism of the fish species involved and specific treatment, i.e. disinfection with UV + ozone, and biological treatment with self forming dynamic membrane, provides a source of nutrients indispensable for algal and vegetables growth.

KEYWORDS: urban agriculture, phototobioreactor, sustainable development, circular economy

PAPER ID: CEST2021_00286

Biogas upgrade via ex-situ technologies

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ABSTRACT

The biological upgrade of biogas to biomethane (CH_4 > 90%) is a popular emerging technology, since the produced CO_2 is not removed but is converted to biomethane using hydrogen (H_2). The initial aim of the present study is the acclimatization of a microbial population derived from a typical biogas plant, under high concentrations of H_2, as well as the development of an enriched biomass in hydrogenotrophic methanogens. The enriched biomass was used to inoculate ex-situ bioreactors for biomethane production under continuous operation. Specifically, a bubble reactor and a trickle bed reactor were studied, and their performance was compared under the same operating conditions. Both reactors were provided with a mixture of H_2, CH_4 and CO_2, which was injected through a conventional diffuser. The methane content in the upgraded biogas reached 92.7±1.1% and 95.7±1.1% for bubble and trickle bed reactor respectively, under a loading rate of 1.26 L_{H2} $L_{reactor}^{-1}$ d^{-1} (11.5h gas retention time). However, at increased H_2 loading rates the trickling bed reactor outperformed the bubble reactor.

KEYWORDS: biogas upgrade, anaerobic digestion, biomethane, hydrogenotrophic methanogenesis

PAPER ID: CEST2021_00386

The potential impact of an implementation of microalgae-based wastewater treatment on the energy balance of a municipal WWTP in Central Europe

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ABSTRACT

The integration of a photobioreactor for wastewater treatment by microalgae is proposed as a future alternative for cost-efficient and environmentally friendly nitrogen and phosphorous removal in municipal WWTPs. The high growth rates and higher biogas yields (compared to conventional sewage sludge) of algal biomass can significantly improve the energy balance of a WWTP. This is currently being considered especially for countries in subtropical climate zones like Spain or Israel.

As this study focuses on temperate climate zones with changing seasons, lower temperature and less sunlight, the energy potential of an implemented wastewater treatment by microalgae is discussed for an existing WWTP (32,000 population equivalents) in Central Germany. For the dimensioning of the plant and the determination of the energy-rich biomasses, the observed influent loads of the plant were used and the calculation was carried out according to valid regulations. The observation of algae growth figures is based on pilot-scale test series from Germany and thus corresponds to the selected climatic conditions. Initial results show a shift in the energy balance from a current energy demand of 662,173 kWh a^{-1} to energy production of approx. 1.9 $MWh_{el.}$ a^{-1}.

KEYWORDS: microalgae, wastewater treatment, energy balance, renewable energy

PAPER ID: CEST2021_00430

Microalgae biomass cultivation and harvesting optimization in biological carbon capture and utilization systems for biofuels production

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ABSTRACT

The boosting of greenhouse gas (GHG) emissions into the atmosphere due to anthropogenic activity contributes significantly to climate change. According to the Green Deal by 2050, net zero greenhouse gas emissions must be achieved. Therefore, actions are needed in order to control GHG emissions. The research presents and discusses the optimization of the microalgae biomass cultivation phase and the harvesting process in an advanced membrane photobioreactor (mPBR) with the aim to improve its production for green fuel generation. Experimental activities are carried out by considering Chlorella vulgaris microalgae as photosynthetic microorganism. A dark/light cycle of 12/12 hours was implemented by varying the light intensity from 100 to 300 µmol m^{-2} s^{-1}. Different L/G rate, by keeping the gas flow rate (G) constant at 100 ml/min and increasing the liquid flow rate recirculation (L) from 500 to 1500 L min^{-1}, has been tested to boost up the productivity of microalgae. Results highlight optimal production of microalgae biomass concentration up to 1.45 g L^{-1}. Then a dynamic membrane module was implemented for the harvesting of the biomass. The work contributes to the field of climate change mitigation actions, by providing useful information to improve green energy production from algae biomass.

KEYWORDS: Photo-bioreactor, Dynamic membrane, Microalgae, Biofuels.

PAPER ID: CEST2021_00590

Production and characterization of microalgae biomass from dairy wastewater

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ABSTRACT

During the last decade, a large scientific effort has been directed towards the cultivation of microalgae in dairy wastewater. Among different microalgal species, *Chlorella sorokiniana* is a small, fast-growing, robust microalgae that can be grown under mixotrophic conditions. In the current study, sequencing batch experiments were conducted with *Chlorella sorokiniana* and three different types of milk processing wastewater: raw dairy wastewater (DWW), anaerobically treated DWW, and cheese whey. The wastewater were analyzed before and after treatment with microalgae while the microalgal biomass was collected at the end of the experiments and characterized for proteins, lipids, starch as well as for the existence of specific organic compounds. According to the results, the protein content of microalgal biomass reached 52.8% when anaerobically treated DWW were used. Important concentrations of lutein and b-carotene were also found in the collected biomass.

KEYWORDS: microalgae, characterization, dairy wastewater treatment, valorization

PAPER ID: CEST2021_00228

Prohibition of the cultivation of Genetically Modified Organisms in Cyprus through the attitudes of stakeholders

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ABSTRACT

The biotechnology industry has always been held under close public scrutiny and even more so whenever new technology or findings are released. Opponents of genetically modified organisms (GMOs) support that scientific risk assessments are not sufficient to address potential long-term hazards for health or the environment, while proponents criticize the current regulatory framework for being influenced by political and other non-scientific interests. It is important to note that, the role of the stakeholders, non-governmental organizations (NGO), politicians, and scientists, including their attitudes and interests have a significant influence not only on public opinion but also on the decision-makers. This paper aims to examine the attitudes of NGOs and politicians, on the cultivation of GMOs, since Directive (EU) 2015/412, came into force. Directive (EU) 2015/412 refers to the possibility of Member States (MS) restricting or prohibiting the cultivation of GMOs in their territory. This exploration is conducted through a qualitative study with representatives of NGOs and politicians, focusing on the grounds that the Republic of Cyprus may invoke to ban the cultivation of GMOs. The results showed that biodiversity and ecosystems in an isolated island, with a large percentage of Natura 2000, protected areas, land fragmentation, promotion of organic farming as well as traditional agricultural varieties, and beekeeping are the key reasons for the prohibition of genetically modified crops (GMC) in Cyprus.

KEYWORDS: GMO, cultivation, opt-out, stakeholders

PAPER ID: CEST2021_00193

PART B – POSTER PRESENTATIONS

HYDROLOGY AND WATER RESOURCES

Simulated effects of streambed vegetation on river hydraulics and the habitat suitability of freshwater macroinvertebrates

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ABSTRACT

We modelled the effects of flexible and rigid streambed vegetation on river hydraulics and macro-invertebrate habitat suitability in flows/discharges ranging from near-dry to floods, in the Oinoi Stream (Attica, Greece). Vegetation was mapped in spring and summer, simulated using two-dimensional ecohydraulic models (VEG_{SP}: spring model, corresponding to moderate vegetation cover; VEG_{SU}: summer model, corresponding to dense vegetation cover), and the results were compared to those of a non-vegetation-including model (VEG_{O}). Flow velocity (V) was negatively correlated and water depth (D) was positively correlated with vegetation type and density. Compared to VEG_{O}, mean D was 22-40% higher and mean V was 20-34% lower in high/near-flood flows. In low/near-dry flows, V and D were only slightly influenced by vegetation (approx. 10-15% change). Macroinvertebrate habitat suitability (HSI) was higher in densely vegetated areas in both spring and summer, and remained high in near-flood flows, in contrast to the VEG_{O} model (max. HSI change 49.5%). We conclude that streambed vegetation shapes slow-flowing, deeper habitats, and is also a key element for maintaining suitable macroinvertebrate habitats. Ecohydraulic models could be applied to differentiate vegetated river reaches that need flood protection from those that need geomorphic and habitat restoration within accurately designed river management plans.

KEYWORDS: Bottom vegetation, riparian vegetation, hydraulic-habitat models, hydrodynamic models, telemac

PAPER ID: CEST2021_00672

Evaluation of Satellite-based Rainfall Estimates for the Upper Blue Nile Basin

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ABSTRACT

Water resources planning and management are generally based on precipitation data. In the Nile Basin, conventional rain gauges are normally sparse, and hence, satellite-based rainfall estimates have become vital for hydrometeorological studies in the basin. However, estimates from satellite rainfall products are prone to bias and need to be validated in this region. In this study, four widely used high-resolution products (TRMM-3B42-RT, PERSIANN-CCS, GSMAP, and CHIRPS-V2) were evaluated against monthly ground observations from 44 stations over the Upper Blue Nile Basin during the period (2003-2013). The evaluation process is based on several standard statistical criteria to assess the ability of both satellite products and bias correction methods to capture the rainfall characteristics of this area. The results show that rainfall estimates from CHIRPS have a more reliable agreement with ground measurements than other products, especially in the wet season. The findings demonstrate the importance of assessing and correcting the outputs of different satellite rainfall products to be used for various hydrological applications in the Nile Basin.

KEYWORDS: Satellite precipitation products, CHIRPS, GSMAP, PERSIANN, TRMM, Upper Blue Nile Basin.

PAPER ID: CEST2021_00048

Analysis of the extreme water phenomenon (hydrological drought) in the small river basins in NE Romania

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ABSTRACT

This paper presents an analysis of one of the climatic dangers experienced in recent times is the high intensity of the drought phenomenon on small rivers in NE Romania that affects society and ecosystems. As a case study, it is intended to identify statistically significant trends in the minimum flow characteristics of the Trebes Negel representative basin.This basin is located in the excessive continental temperate climate of the area, which is characterized by annual rainfall of only 500-600 mm. The parameters studied for this hydrological basin are a reference point for all small basins in Romania, located in the same natural environment and used in research. As a reference year, the year 2015 is analyzed, the project is registered in the Trebes Negel basin in September and October on the tributary of the Trebes river (Negel river, at the Magura hydrometric station) for 36 consecutive days.

KEYWORDS: hydrological drought, small basins, minimum flow, climate change

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Analysis of the 0.1% and 1% floodbands relating to the nv area of the ceahlau massive, the confluence sector of the bistrița river with his tributary - bistriciora river

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ABSTRACT

The study aims to outline the flood potential of a mountainous area, in the context of simulating flooded areas, GIS techniques being essential in determining the spatial and probabilistic impact of this type of hydrological phenomena. The resulting modeling highlights the floodplains and the probabilities of manifestation of 0.1 and 1%. The localities situated downstream of the Tulgheș hydrometric station are at risk, but the current methodology generates cartographic materials at an optimal resolution, initially for highlighting and later for the amelioration of vulnerable areas and the effective reduction of damages following a possible flood.

KEYWORDS: flood, flow, numerical terrain model, SIG, HEC-RAS

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EMERGING POLLUTANTS

Combining consumption-based approach and chemical analysis for identifying pharmaceuticals occurrence in hospital wastewater

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ABSTRACT

This study aims to compare and correlate the concentrations of pharmaceutical found in hospital wastewater via chemical analysis with those estimated based on consumption data. For this reason, wastewater samples were collected from different points of the sewerage system serving a Greek hospital and analysed using LC-QTOF-MS for more than 200 compounds. Consumption data were collected in parallel from the hospital pharmacy and used for finding the Predicted Environmental Concentrations of pharmaceuticals in hospital wastewater. The measured concentrations on found pharmaceuticals were different between different days and point of sampling. Significant agreement was found between wastewater analysis and consumption data for some pharmaceuticals, while poor correlation for others.

KEYWORDS: Pharmaceuticals, concentrations, hospital wastewater, chromatographic analysis, sewage epidemiology

PAPER ID: CEST2021_00177

Investigation of the presence of organic micropollutants in biota specimens from the Antarctica ecosystem using state-of-the-art wide-scope target and suspect HRMS methodologies.

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ABSTRACT

The contamination of the aquatic ecosystem with organic micropollutants due to anthropogenic activities, over the last decades, is a well-known issue. Due to the frequent detection of these chemicals in various environmental compartments, they are considered as potential threats to the aquatic ecosystem. Although a percentage of them has been studied in detail since 1980s and are already included in existing legislation or monitoring programmes, thousands of organic micropollutants, characterized as chemicals of emerging concern, 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). The distribution of organic micropollutants in the living organisms and, subsequently, their bioaccumulation in the upper trophic levels of the food webs, along with their potential toxic properties, underline the necessity for regular environmental monitoring studies (Badea et al., 2020; Montesdeoca-Esponda et al., 2018). Furthermore, chemicals detected in organisms are highly possibly bio-accumulative (B) and persistent (P), thus fulfilling two out of three PBT criteria considered under REACH legislation. Consequently, the systematic monitoring of organic micropollutants in biota specimens is of high importance, in order 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 they 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 occurrence of persistent organic micropollutants in remote areas, including Arctic and Antarctica regions, will contribute in the prioritization of these substances. It is expected that, due to the global warming, the polar areas will become more accessible and, consequently, more polluted from anthropogenic activities. Although the occurrence of many organic micropollutants has been investigated in Arctic region through targeted analytical methodologies, in the context of Arctic Monitoring and Assessment Programme (AMAP, 2017), the contamination and sources of persistent chemicals in the Antarctic continent have not been systematically investigated yet.

In order to assess the presence of ubiquitous organic micropollutants in biota specimens from remote areas, 4 samples of organisms from the lower trophic levels (macrophyte, sea star, sea urchin, fish) and 10 apex predator samples (3 different matrices; placenta from Weddell Seal, muscle from Gentoo Penguin and Crabeater Seal, egg from Adelie Penguin and Gentoo Penguin) were gathered from 2018 to 2020 in Antarctica and were analyzed following state-of-the-art wide-scope target screening methodologies.

The 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 complementary chromatographic techniques (both liquid and gas chromatography) and ionization modes (using electrospray and atmospheric pressure ionization) coupled to High Resolution Mass Spectrometry, in order to broaden the chemical domain accessible to wide-scope target analysis and suspect screening. The samples were screened for the presence of more than 2,400 organic pollutants, included in the target list of the National and Kapodistrian University of Athens (NKUA). NKUA 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 LC target list is available as S21 UATHTARGETS in the NORMAN Suspect List Exchange https://www.norman-network.com/nds/SLE/ (DOI: 10.5281/zenodo.3723478) and the GC target is available as S65 UATHTARGETSGC (DOI: 10.5281/ zenodo.3753372)]. The target list is being updated on a regular basis, since new compounds of concern are continuously being identified. Moreover, the archived HRMS chromatograms were uploaded into NORMAN Digital Sample Freezing Platform (DSFP) for the suspect screening of more than 65,000 chemicals, included in the NORMAN SusDat (Alygizakis et al, 2019). These data are also available for future retrospective screening of organic micropollutants.

Strict criteria of mass accuracy (<2mDa), isotopic fitting (mSigma<50), retention time (<0.20 min) and fragmentation pattern match were applied during the screening process, while the standard addition method was used for quantification purposes of the detected analytes (Gago-Ferrero et al, 2020). Preliminary results indicate the presence of dozens of organic micropollutants in low concentration levels (μg/L). Specifically, chemicals classified in different categories, such as personal care products (galaxolide, benzophenone-3 and methylparaben), plant protection products (including fenuron and endothall) and pharmaceuticals (for example hydrocortisone). Moreover, parent and transformation products were detected in the Antarctica organisms (such as nicotine and nor-nicotine), underlying the added value of wide-scope target screening.

KEYWORDS:

Antarctica; Organic Micropollutants; High Resolution Mass Spectrometry; Biomonitoring; Apex Predators.

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Study on the fate of the chemical uncoupler 3,3′,4′,5-tetrachlorosalicylanilide (TCSA) in activated sludge process and investigation of its effects to different aquatic organisms

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ABSTRACT

This study examines the biodegradation of 3,3′,4′,5-tetrachlorosalicylanilide (TSCA) by activated sludge and investigates its effects to different aquatic organisms. According to the experimental results, the fate of the target compound in activated sludge systems is governed by the mechanisms of sorption and biodegradation, while almost 90% of TCSA is expected to be removed in an aerobic activated sludge system operating with hydraulic residence time of 10 h. Ecotoxicity experiments shown that TSCA toxicity decreased from Daphnia > Vibrio > Lemna, while an ecological threat is possible in rivers where treated wastewater is diluted up to 100-fold.

KEYWORDS: TSCA; biodegradation; activated sludge; effects; EC50; bioassays

PAPER ID: CEST2021_00179

Patterns of drug use and chemical exposure in Athens (Greece) during COVID-19 pandemic using wastewater-based epidemiology.

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ABSTRACT

After the first COVID-19 case in 2019 in Wuhan, China, the virus SARS-COV-2 has rapidly spread nationwide, alarming both the public and scientific community (Cascella et al., 2021). Currently, there are no treatments available for COVID-19, hence reducing the virus transmission and vaccinations are the key strategies for the management of the pandemic. Countries around the globe, including Greece, have already implemented such containment measures (Yuki et al., 2020, Parlapani et al., 2020). The pandemic, in combination with strict restriction policies in all aspects of human activity, may considerably affect human lifestyle, behavior and mental health. As a result, changes in drug consumption and other chemicals' use are highly likely to occur.

Wastewater-Based Epidemiology (WBE), is a continuously growing field for the quantification of analytes in wastewater samples. WBE uses biomarkers, which reflect a populations' health status and elaborate on pathogen and substance exposure and consumption (Choi et al., 2018). Offering great sensitivity and selectivity (Diaz et al., 2012), LC-MS, is the most widely used analytical technique for the application of WBE. TOF mass spectrometers on the other hand exhibit intrinsic characteristics, such as extra selectivity and retrospective analysis (Alygizakis et al., 2020). Hence, they are ideal for wide-scope target screening strategies, as well as for transformation products (TPs) identification, including unknowns (Hernandez et al., 2012, Nika et al., 2017).

The objective of this study was to investigate and reflect the potential effects of COVID-19 pandemic in drug consumption and chemicals' use, through influent wastewater analysis. The focus of this study was given during the 2020-2021 lockdown period in Athens, Greece. For this purpose, untreated wastewater was sampled during representative periods before and during quarantine. Samples were analyzed by two complementary analytical methods; a highly-sensitive LC-MS/MS method (Gago-Ferrero et al., 2015) and a generic and wide-scope LC-ESI-QTOF-MS method (Gago-Ferrero et al., 2020). Target screening of pharmaceuticals and drugs of abuse was performed with LC-MS/MS. Concerning the HRMS analysis, both wide-scope target and non-target screening methodologies were applied for the detection of the analytes of interest and their respective transformation products (TPs). The detected concentrations were back-calculated into normalized population loads (PNLs), based on parameters such as flow rate, population estimation etc (Thomaidis et al., 2016). The results reflected patterns in various chemicals' use (e.g. pharmaceuticals, illicit drugs, antimicrobials, surfactants etc.), some of which can be closely attributed to the impact of COVID-19 pandemic on the population.

KEYWORDS: COVID-19 wastewater-based epidemiology, wastewater treament plant of Psyttaleia (Athens), high-resoltution mass spectrometry (HRMS), LC-MS/MS

PAPER ID: CEST2021_00841

Investigating the impact of landfill leachates in groundwater quality through the monitoring of multiclass emerging contaminants by LC-HRMS

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ABSTRACT

Due to their economic advantages, landfills are the primary repository of municipal solid wastes, receiving everyday by-products such as food wastes, plastic containers and product packaging materials, unused pharmaceuticals, textile and other products. As a result of the higher demand and better quality of consumer products, the profile of chemicals in solid wastes has changed during the last decades. Landfill leachates are produced during the precipitation and percolation of water through waste, biochemical processes in wastes cells and the inherent water content of wastes themselves (Eggen et al., 2010).

Emerging Contaminants (ECs) from landfill leachates can transport in the subsurface and leachate-affected aquifers surrounding landfills, contaminating groundwater. Their fate is high affected by the soil type and availability of aqueous electron acceptors (e.g., constituent concentrations) in the aquifer, temporal variations in the configuration of redox zones down-gradient, biogeochemical and microbial processes affecting contaminant transport, and hydrodynamic framework (e.g., groundwater recharge events and seasonal water-table fluctuations) (Ramakrishnan et al., 2015). Moreover, transformation products (TPs) of ECs may be produced during abiotic or biodegradation processing, with unknown ecotoxicological behavior. Therefore, the contamination of freshwater reservoirs with leachates from deposition sites could pose a serious threat to the environment and human health and needs further investigation.

The aim of this study was the determination of ECs and their TPs in landfill leachates and groundwater from the surrounding area, to investigate the potential impact of landfill contaminants on the aquifer. For this purpose, both raw and treated landfill leachates and groundwater samples were collected in 2021 in Greece. For the determination of emerging contaminants, Solid-Phase Extraction using mixed-mode cartridges with 4 sorbents was used for the extraction and pre-concentration of the anlyes with different physicochemical properties. The samples were analysed by LC-ESI-QTOFMS and the HRMS chromatograms were screened with an in-house wide-scope database of more than 2,300 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 TPs and metabolites (Nika et. al, 2020). The concentrations of the contaminants in leachates were calculated based on the standard addition method.

Preliminary results indicate the presence of pharmaceuticals such as lidocaine, niflumic acid, paracetamol and ketoprofen, the stimulant nicotine and several industrial chemicals including benzotriazole, 2-OH-benzothiazole, 2-amino-benzothiazole, bisphenol A and S, and perfluorinated substances such as PFBuS, PFOA and PFHpA, in the raw leachates.

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Designing sustainable processes for the valorization of industrial and environmental waste streams towards industrializable polyhydroxyalkanoates

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ABSTRACT

In the present study different environmental and industrial waste streams are assessed as feedstock for the production of bioplastics adequate to be used for food packaging applications or for the formation of fully biodegradable garbage bags. For the production of bioplastics i.e. polyhydroxyalkanoates (PHAs), both pure cultures and mixed consortia were assessed in one stage bio-process, i.e. direct bioconversion of the wastes and a two stage bio-process i.e. bioconversion of the wastes after their acidification by mixed acidogenic mixed consortia in mesophilic conditions. For the recovery of PHAs from the microbial biomass cost effective and environmental friendly protocols are investigated aiming to minimal solvent use and maximum recovery yields. The quality of the obtained polymers is assessed via the detailed analysis of their physicochemical and mechanical properties and their characterisation of their behaviour during the moulding process. The health effect and food safety of the PHAs oligomers and final formulated products are also assessed by evaluating their antitumor effects *in vitro*, on different cell lines known to represent subtypes of colon cancer, as well as their effect on epithelial barrier function by measuring the type 2 protease-activated receptor.

KEYWORDS: poly-hydroxyalkanoates; waste valorization; phenolics; blue alga biomass; food packaging, food safety.

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Nation-wide monitoring campaign of 49 contaminants of emerging concern in surface waters and sediments (EMNAT 2018): occurrence and PNEC exceedance evaluation

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ABSTRACT

The overall objective of the 2018 survey campaign of contaminants of emerging concern in surface waters (continental and coastal) and sediments known as EMNAT 2018, is to provide monitoring data for the emerging contaminants prioritization exercise, which will allow the update of the list of relevant substances to be monitored (SPAS), as part of the future Water Framework Directive (WFD) monitoring programmes (2022).

This campaign collected nearly 14,000 data regarding 49 contaminants of emerging concern (32 biocides and 17 surfactants) in surface waters and sediments on 98 sites in mainland France and in the French overseas regions.

Linear Alkylbenzene Sulfonic acids (LAS) were the most frequently quantified surfactants and at the highest median concentrations in water and sediment samples, in metropolitan France and in the overseas regions. Fipronil was the most frequently quantified biocide in water samples in metropolitan France and in the overseas regions, but at lower median concentrations than other biocides. Methyl nonyl ketone was the most frequently quantified biocide and at high median concentrations in sediment samples from mainland France and in overseas regions.

Based on the available predicted no effect concentrations (PNEC), several contaminants were identified as highly and moderately critical regarding the PNEC exceedance and will be considered to be included in the SPAS list for the next WFD cycle.

KEYWORDS: Biocides, surfactants, river waters, coastal waters, ecotoxicological threshold exceedance

PAPER ID: CEST2021_00674

ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Artificial Neural Network (ANNs) for predicting petroleum hydrocarbons from heavy metals contaminated soils around fuel stations

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ABSTRACT

Petrol stations are classified as a dangerous source of pollution for the human population due to the toxicity of emissions from evaporated vehicle fuels and fuel spillages. The contaminants released in the environment are mainly complex mixtures of petroleum hydrocarbon compounds (PHCs) and heavy metals, especially lead. Lead phased out as a fuel additive by the dawn of the 21st century, but some soils near old or long-standing gas stations have been contaminated.

Contamination found at these sites, affecting groundwater, drinking water, and the soil, can run deep and spread over an area that extends well beyond the site's border.

The correlation between heavy metals and heavier petroleum hydrocarbons (C>12) in soils from an urban area near petrol stations has been studied, looking to predict the organic concentration through inorganic contaminants concentration values. Metals were analyzed by ICP-OES and FP-XRF (Field Portable XRF), while PHCs were analyzed by GC/FID. No linear statistical correlation has been proved between Pb, Cu, Mn, V, Zn, Sn, Fe, and PHCs. The ANNs model, instead, has been demonstrated to have the capability to determine the relationships between organic and inorganic contaminants, allowing an accurate prediction of PHCs (C>12) (R^2=0,86).

KEYWORDS: Artificial Neural Network predictions, heavy metals, field portable XRF, petroleum hydrocarbon compounds

PAPER ID: CEST2021_00347

Climatology of the impact of atmospheric circulation on surface meteorological conditions over Greece

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ABSTRACT

Large-scale atmospheric circulation is a critical factor that controls the surface climatic conditions of a specific region. The scope of this work is to examine this relationship for different climatic regions over Greece and provide a detailed descriptive statistical analysis for multiple parameters related to heat and drought. The atmospheric circulation patterns are provided using a neural network approach and the surface climatic parameters are extracted from 17 surface meteorological stations for a 30-year period. In detail, for each circulation pattern the maximum and minimum temperature, the diurnal temperature range along with the precipitation amount are assessed. The 32 identified regimes describe effectively the large-scale atmospheric circulation, and they are found to affect significantly the climatic parameters variability. Interesting statistical aspects are extracted for each climatic region and specific atmospheric circulation patterns are found to be associated with extreme heat and drought in the region. The persistence of atmospheric circulation is examined and associated with unusual episodes. The quantification of the large-scale effect on climatic parameters anomalies is demonstrated and is also discussed in terms of the effect of local topography and urbanization in each site.

KEYWORDS: Atmospheric circulation, climate, temperature, precipitation

PAPER ID: CEST2021_00486

Validation of ENVI-met microscale model with in-situ measurements in warm thermal conditions across Athens area

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ABSTRACT

Validation is critical for quantifying accuracy, errors and limitations of models' results. This study examines the ability of ENVI-met model to simulate thermal conditions in high spatial resolution. Field measurements from 11 central sites (squares and parks) across the greater area of Athens, Greece, incorporating 15 days of campaigns in July and August were used. Air temperature, relative humidity, wind speed, grey globe temperature and total solar radiation were monitored at 1.1 m above the ground using a mobile meteorological station. In addition, Mean Radiant Temperature, Physiologically Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI) were calculated incorporating in-situ measurements. The full force method for ENVI-met initial conditions was applied, using hourly data from the nearest meteorological stations. Validation metrics including Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and the index of agreement (d) were used to measure the model accuracy. The results showed that air temperature is simulated with adequate accuracy (MAE = 1.6 ºC and d = 0.8) while PET and UTCI also present a high percentage of agreement (MAE = 5.3 ºC and 3.3 ºC; d = 0.7 and 0.8, respectively). Overall, the study provides further confidence that the ENVI-met can be utilized as a reliable model for further research analysis.

KEYWORDS: ENVI-met; thermal indices; field surveys; micrometeorological measurements; summer

PAPER ID: CEST2021_00261

Determining the phenological stages of Nestos-Delta (*Alnus glutinosa*) riparian forest (Natura 2000 site) by using radiation transmittance data

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ABSTRACT

Trees' phenology is a key factor for most forests' physiological processes. The precise definition of the start-end dates and the duration of each phenological stage is critical. In the present study, radiation data were used from pyranometers installed at the *Alnus glutinosa* riparian forest of Nestos-Delta (Natura 2000 site), within the implementation of LIFE-PRIMED project. The pyranometers were placed inside the stand (below the trees' canopy) and also in a forest opening. The radiation transmittance coefficient τ (unitless) was estimated on a daily basis for the period October 2019 to December 2020. τ can be used for the forest's phenological stages determination. Four stages were identified. The first concerns the development of leaves and starts at mid April until mid June, as τ decreases with a rate of about 0.0071 d^{-1}. At the second stage (mid June to mid September) the canopy is fully developed and effective and τ presents almost stable low values (0.13). During the third stage (mid September to late December) senescence and gradual rejection of leaves occurs as τ increases with a rate of 0.0062 d^{-1}. During the last stage of the leafless canopy (late December to mid April), τ becomes maximum (0.6) and stable.

KEYWORDS: Forest micrometeorology, LIFE-PRIMED, solar radiation, light transmittance, deciduous forest

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Analyzing 50 Years of Major Fog Events Across the Central Coastal Plain of Israel

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ABSTRACT

This work presents an analysis of 152 major fog events that have been occurring for five decades (1967-2017) across the central coastal plain of Israel. Analysis of the meteorological data shows that fog events in the experimental area predominantly occur under two sets of synoptic conditions – Red Sea Trough (44%) and Ridge (41%), while the incidence of fog events peaks between March and June. In particular, the results obtained indicate a decreasing trend in the number of fog events and their duration over time where the frequency of radiation fog has decreased over time when compared to the incidence of advection fog. Further investigation is required in order to determine the reasons for the decreasing fog trends observed. However, possible drivers include climate change and the urban heat island effect. The paper provides a long-term analysis of data in a region that lacks reliable time series of this length and highlight important insights for future research.

KEYWORDS: fog trends, visibility, advection, radiation

PAPER ID: CEST2021_00105

A model-based study on the impact of different tree configurations on the thermal conditions of an urban square

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ABSTRACT

The number of studies on mitigation and adaptation strategies aiming at the improvement of the urban microclimate increased remarkably during the last decades. Most studies are focusing on the impact of various design layouts, on thermal environment and pedestrians' thermal sensation. The present study examines the effect of shading trees with different leaf area densities (LAD) on the microclimate and thermal sensation in an urban open area, namely the Syntagma square, Athens, Greece. The microclimatic model ENVI-met was applied to simulate thermal conditions during a summer day when a field monitoring survey has taken place in that square. The Physiologically Equivalent Temperature index (PET) was employed to estimate thermal conditions in the square and the nearby areas. Model results showed that dense vegetation (LAD above 2) has a greater cooling effect compared to sparse vegetation (LAD between 1 and 1.5 and LAD between 0.5 and 1.0) resulting thus to a decrease in daily air temperature and PET at around 0.7 ^{o}C and 4 ^{o}C, respectively, in areas under tree canopies. Further analysis quantified the effects of various vegetation leaf densities on thermal conditions and thus the importance of the existence of dense vegetation in urban squares under Mediterranean climate conditions.

KEYWORDS: ENVI-met; thermal sensation; microclimatic conditions; leaf area density; summer

PAPER ID: CEST2021_00469

ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY

Production of added-value metabolites during growth of wild-type yeast strains on media composed of biodiesel-derived crude glycerol

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ABSTRACT

Wild-type yeast strains of *Metschnikowia* sp., *Rhodotorula* sp. and *Rhodosporidium* sp. were grown under nitrogen-limited conditions with crude glycerol employed as sole substrate in shake flasks, under nitrogen-limited conditions, with initial glycerol concentration ($Glol_0$) ≈45 g/L. Yeasts presented interesting DCW production. *Metschnikowia* sp. strains produced significant quantities of intra-cellular polysaccharides (i.e. the strain V.V.-D4 produced 11.0 g/L of endopolysaccharides, with polysaccharides in DCW ≈63% w/w). The only yeast strain presenting typical oleaginous characteristics was the strain *Rhodosporidium toruloides* DSM 4444, that presented lipid in DCW values >20% w/w, and increased its lipid concentration (in g/L) over the whole period of the fermentation performed. On media with higher $Glol_0$, interesting lipid-accumulating capacities (maximum lipid =12.5 g/L, maximum lipid in DCW =43.0-46.0% w/w, conversion yield of lipid on glycerol consumed =0.16 g/g) were seen. Cellular lipids of most yeasts contained mainly oleic and palmitic acid. Finally, “crude” lipids (chloroform/methanol 2/1 v/v extract) produced by *R. toruloides* DSM 4444 during growth on glycerol, were mainly composed of triacylglycerols.

KEYWORDS: Biodiesel-derived glycerol; endopolysaccharides; single-cell oil; *Rhodosporidium toruloide*s; yeast biomass

PAPER ID: CEST2021_00506

Lipid production by *Rhodosporidium toruloides* during growth on biodiesel-derived crude glycerol

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ABSTRACT

Rhodosporidium toruloides DSM 4444 when grown on biodiesel-derived glycerol under nitrogen-limited conditions was revealed as an efficient microbial lipid produced. This strain when cultivated on glycerol at initial concentration (Gly_0) ~50 g/L produced dry cell weight (DCW) =18.1 g/L containing lipids =30.3% in DCW. This strain produced DCW=27.3 g/L containing lipid =54.5% w/w when Gly_0 concentration was adjusted to ~90 g/L, with all other fermentation parameters (including nitrogen concentration) remaining constant. At the late growth phases, cellular lipids were re-consumed. Balanced growth phase (trophophase) and idiophase (phase of synthesis of the secondary metabolite) at the trial with Gly_0~90 g/L were successfully simulated with the aid of a modified Velhlust-Aggelis model that fitted very well on the experimental data, while optimized parameter values were found to be close to the experimental ones. Lipid extraction process was studied by using two different methods [extraction of DCW with a mixture of chloroform/methanol 2/1 (v/v) or acidification of DCW, boiling and subsequent extraction with a mixture of chloroform/methanol 2/1 (v/v)] and no differences were observed for the studied strain. Cellular lipids of this yeast contained mostly oleic acid, constituting suitable precursors for the synthesis of 2nd generation biodiesel.

KEYWORDS: Crude glycerol; 2nd generation biodiesel; single-cell oil; *Rhodosporidium toruloides*

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SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION

Fire-induced oxidation of Cr(III) in serpentine soils

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ABSTRACT

Ophiolite rocks and their weathering products are the major hosts of Cr(III)-bearing phases in the Earth's crust. Trivalent Cr is rather benign, but risks arise because of its potential for oxidation to the toxic and carcinogenic hexavalent form. Manganese oxides are the most effective natural oxidants, whereas oxidation by atmospheric oxygen is, luckily, very slow. However, oxidation reactions under the highly oxidizing environment of wildfires are largely unexplored. Under this context, we examined the genesis of Cr(VI) by fire-induced heating of ultramafic rocks and serpentine soils. Total Cr(VI) contents of unheated soils ranged from 1.3 to 24 mg kg^{-1}, while the water-soluble fraction accounted for less than 2% of total Cr(VI). After heating the soil samples at 600°C for 1 h, total Cr(VI) contents increased by factors 2-41. The water-soluble fraction accounted for 33–52% of total Cr(VI). Our results suggest that in fire-impacted areas, there is an increased risk of geogenic Cr(VI) contamination. Even though soil temperatures could exceed 700 °C, our preliminary results showed that Cr(VI) contents in a fire-impacted site did not change as dramatically as under laboratory conditions.

KEYWORDS: ophiolites, serpentinites, geogenic Cr, oxidation, wildfire

PAPER ID: CEST2021_00209

INNOVATIVE ENVIRONMENTAL SOLUTIONS

The inter-organizational green careers – literature review and a conceptual framework

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ABSTRACT

The analysis of publications indexed in Scopus and Web of Science databases revealed that there is a lack of research on designing an internal green career in companies. Therefore, the paper aims to present the searching results and characterize the possibilities of the development of internal green careers taking into account the knowledge about green jobs and HRM. The paper is based on the literature studies and is conceptual. The adopted methods are inductive and deductive inference methods. This paper presents a review of the new green HRM concepts.

KEYWORDS: Environmental management, green HRM, green jobs, sustainable development

PAPER ID: CEST2021_00053

AIR POLLUTION

CO abatement via Ir-based catalysts: effect of the support and preparation method on catalytic activity and stability

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ABSTRACT

Here we report on the effect of the support and preparation method on the activity and stability of Ir-based catalysts under CO oxidation. Alunina-ceria-zirconia (ACZ: 60wt%Al_2O_3 – 40wt%$Ce_xZr_{1-x}O_2$, x=0.25, 0.5, 0.75) mixed oxide supports with high oxygen storage capacity (OSC) were synthesized via two different methods, hydrothermal (ACZ-H) and co-precipitation (ACZ-P), and used as supports of Ir nanoparticles, so as, besides the Ce/Zr composition to also deal with the effect of the preparation method on catalytic performance. ACZ supports and counterpart Ir/ACZ catalysts were thoroughly characterized using various techniques, while catalytic measurements were conducted under excess O_2 conditions (1.0% CO, 5.0% O_2, balance He at 1 bar) in the temperature range of 100-400^{o}C. Both pre-reduced and pre-oxidized catalysts were evaluated, while their sintering behavior after experiencing several sequential oxidative thermal aging steps was also studied. The results demonstrated superior textural characteristics (BET surface area and pore volume) of Ir/ACZ-H catalysts as well as stronger interaction of Ir nanoparticles and support particles than that of Ir/ACZ-P, resulting to better CO oxidation efficiency and stability. All catalysts demonstrated stable CO activity after thermal aging, reflecting beneficial influence of ACZ support on the sintering resistance characteristics of Ir nanoparticles.

KEYWORDS: CO oxidation, Iridium, Alumina-ceria-zirconia

PAPER ID: CEST2021_00321

DISASTER RISK REDUCTION AND MANAGEMENT

Quantifying and mapping urban trees' decay severity using thermal and spatial indices: implications for tree hazard assessment and management

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ABSTRACT

Wood decay, a crucial factor in tree stability, is an internal long-term interaction between fungi and tree that leads to the disruption of energy flow, temperature abnormalities on the tree's surface, and possible tree mortality, especially when the decay extent is close to the threshold of 33%. In this study, arboreal vegetation species' stability in two urban parks in the city of Mytilene, Greece, was evaluated, in accordance with the tree failure criterion, by measuring the trees' morphological traits along with their decay severity. Thermal indices were developed by analyzing tree trunks' temperature data, and strength loss equations associated with wood decay were applied for each tree. Temperature spatial dependence across each tree's trunk was estimated using Moran's I index, while statistically significant spatial clusters were assessed using local spatial autocorrelation statistics. Relationships between tree stability, thermal, and spatial indices, were established using linear and logistic regression models. Finally, the Getis-Ord Gi* statistic was used for the recognition of hazardous tree hotspots in the urban parks, and the kriging geostatistical procedure was applied for mapping their spatial extension. The results have shown that thermal and spatial indices can sufficiently explain decay severity, identify hazardous trees, and contribute to tree health assessment for specialized park management.

KEYWORDS: Urban tree stress, infrared thermography, geospatial analysis

PAPER ID: CEST2021_00335

AGROFORESTRY, FOREST AND AGRICULTURAL SUSTAINABILITY

Production parameters and nutritional value of *Pleurotus ostreatus* mushroom cultivated on agricultural wastes

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ABSTRACT

The influence of two alternative agro-residues (barley and oat straw-BO and beech wood residues-BW) used as main cultivation substrates in respect to wheat straw-WS was examined on the production and quality characteristics of *Pleurotus ostreatus*, strain AMRL 144. Evaluation included fungal bio-transformation efficiency with respect to substrate colonization and carposome production time, biological efficiency-BE%, as well as mushroom number, size, colour and firmness. The effect of these wastes was also evaluated on moisture content, crude protein, total polysaccharides, lipid and phenolic content of whole sporophores. First mushrooms appeared 19-42 days after inoculation, with WS and BOS substrates promoting earlier sporophore initiation than BW did. As for BE%, the highest values were recorded at BOS and BW wastes (75.30% and 64.26% respectively) compared to the conventional WS. Mushroom protein content was significantly increased when BW was used (28.25% versus 11.02 in WS) and so did colour lightness in BOS (L*=78.16). Firmer mushrooms were also produced in BOS and BW substrates (7.25 N) than in WS (6.56 N), while polysaccharides were synthesised in high amount, mostly in mushrooms cultivated in BW (35.47%) and consisted mainly of glucose (in higher than 70.5% w/w). Phenolic synthesis was promoted in BO and BW (640 mg/l GAE) versus WS (400 mg/l GAE) substrates. Mushroom lipid content, on the contrary, was not affected by the substrate used.

KEYWORDS: Mushroom cultivation, agro-residues fermentation, protein, carbohydrates, lipids

PAPER ID: CEST2021_00380

Rural Development and Local Government - The example of the Regional Unit of Evritania in the development of beekeeping

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ABSTRACT

The region of Evritania is a mountainous area of Central Greece. Its intense and rough terrain is characterized by lush diversity in flora and fauna species and landscapes. It has a long history that extends back to pre-historical times. However, this unique nature's hot spot is facing during the last decades, intense depopulation driven mostly by financial factors (lack of job opportunities mostly to young people). In its effort to providing solutions to face this problem, the prefecture of Central Greece funded a research project to investigate, unfold and highlight beekeeping as a successful activity that could contribute to farmers' income. The project is based on a participatory approach, in close collaboration to farmers (beekeepers). The initial results from the project indicate the substantial potential of beekeeping as an activity that can enhance local economy but mainly the importance of regional authorities' involvement and support in local development.

KEYWORDS: beekeeping, local authorities, *Abies* spp. fir honey, mountainous forest, climate change.

PAPER ID: CEST2021_00848

Mechanism of tolerance and adaptive strategies developed by Moringa oleifera (L) during its growth under a salt constraint in hydroponics

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ABSTRACT

Moringa oleifera (L) is a promising species to be used in reforestations of dry areas. A question that remains to be investigated is its resistance to salinity conditions. This work's major goal was to investigate the response of this species in increasing salinity conditions, in order to increase our understanding on the mechanisms of tolerance and/or sensitivity and of the morpho-physiological and biochemical responses of *Moringa* plants under a salt constraint. *Moringa* seedlings were subjected to increasing concentrations of NaCl, 0 (control), 50, 100 and 150 mM NaCl. The results suggest that the variations in the responses of the parameters analyzed depend on the concentration and the duration of application of the salt. Vertical growth, relative average growth rate (RGRh), and relative water content showed a great variability of responses, depending on the concentration and the duration of application of NaCl. Leaf area (SF) was affected by salinity whereas leaf succulence index (ISF) and photosynthetic pigments (chlorophylls (a), (b), were significantly improved by such stress. The results suggest a strong resistance of the species to high doses of NaCl and in particular those greater than 50 Mm. Salinity conditions cause the accumulation of organic solutes (proline and soluble sugars), as a physiological adaptation to prolonged salinity.

KEYWORDS: dry areas, salt constraint, tolerance mechanism, Tunisia

PAPER ID: CEST2021_00849

Fir decline and necrosis: the role of climate change and forest fires

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ABSTRACT

Chronologies of tree-ring widths of living and dead trees were analyzed from a stand of Cephalonian fir, located in an adjacent to a burned by a forest fire area. The purpose of the research was to investigate, from a dendroecological point of view, the fir forest dieback phenomenon, but also the role of forest fires in the evolution of the phenomenon. The results show that the dead fir trees lag in tree-ring width growth. The abrupt growth change in tree-ring width in the dead trees 1-2 years before necrosis, indicates that forest fires accelerate the evolution of the phenomenon. It seems that forest fires, besides the immediate destruction of fir forests, accelerate the necrosis of fir trees, which is primarily caused by the observed increase in drought and temperature due to climate change.

KEYWORDS: dendroecology, tree-rings, *Abies cephalonica* fir decline, forest fires, climate change.

PAPER ID: CEST2021_00571

Detoxification of molasses and production of mycelial mass and polysaccharides from *Morchella conica* mushroom.

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ABSTRACT

The impact of molasses on the fungal mass, valuable secondary metabolites' production and quality characteristics of the edible wild ascomycetous *Morchella conica*, strain AMRL78 was examined in this study. *Morchella* mycelium were produced in submerged, static and agitated cultures and the C/N ratio of the medium was determined to ~20. Evaluation included determination of the dry mycelial mass (X, g/L), endopolysaccharides synthesized (IPS, g/L), the consumption of total sugars (TS, g/L) and molasses' phenolic-reduction and decolorization. The influence of agitation conditions was also evaluated. Results showed that *M. conica* appeared a significant production of dry mycelial mass (up to 16 g/L) and agitation had some impact upon X formation. A simultaneous high consumption of TS appeared both in agitated and static cultures. Maximum values of ~ 4.5 g/L IPS were recorded. *M. conica* reduced satisfactory phenolic compounds and the color of the molasse substrate (up to 46% and 20%, respectively). It is concluded that *M. conica* is a fungus of higher importance, amenable for simultaneous molasses detoxification and production of added-value compounds.

KEYWORDS: liquid fermentation, mushrooms, *Morchella*, agro-industrial wastes, molasses, endopolysaccharides, detoxification

PAPER ID: CEST2021_00574

Biotechnological treatment of oil mill waste-water to produce high value-added mycelial products.

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ABSTRACT

Several trials with *Pleurotus pulmonarius* mushroom were carried out in liquid state cultures, in synthetic media containing commercial glycose and olive mill wastewater (OMW) with phenolics concentration adjusted to 10% and 30% v/v. Results demonstrated that at the end of fermentation period the phenolic content reduction was very high (93-95%), as well as substrate decoloration, with values ranging from 70% to 85% (medium containing 10 and 30% v/v phenolic compounds respectively), indicating the great capability of *Pleurotus* strains for OMW detoxification. Moreover, the highest phenolic concentration (30% v/v) affected positively biomass and intra-cellular polysaccharide (IP) production, reaching 30.61 g/L and 4.30 g/L, respectively. On the other hand, although lower values of biomass and IP in absolute values were synthesized in the medium with 10% v/v phenolic compounds (22.66 and 3.92 g/L respectively), the amount of IP in relative values was as high as 20 w/w. The maximum anti-oxidant activity (expressed as total phenolic compounds) of 0.4 g/L was also determined in *P. pulmonarius* biomass produced in the medium with 10% v/v phenolics. In conclusion, the examined mushroom species could be used with great success as a mean of biological treatment of OMWs with simultaneous production of high nutritional value products (biomass, polysaccharides, phenolic compounds).

KEYWORDS: Liquid fermentation, agro-industrial wastes, *Pleurotus pulmonarius*, polysaccharides, detoxification

PAPER ID: CEST2021_00581

LIFE CYCLE ANALYSIS - LCA

Circular Economy and Life Cycle Assessment For Wine Sector

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ABSTRACT

Wine production contributes to a variety of environmental loads, mainly due to the use of fertilizers and pesticides in the vineyard and to the production of glass bottles. Sicily, in particular, holds the record for the major production of wine in the South of Italy, favored by pedoclimatic characteristics of the island. Considering the great focus placed on "environmental sustainability", the winery "Cantine Nicosia has decided to implement to their new product, called "Sabbie di Sutta Cerrasuolo di Vittoria DOCG", which consists of a new bottle of red wine, an environmental accounting tool: the "Life Cycle Assessment" (or LCA) regulated by UNI EN ISO 14040:2006. Quantification of the emissions, revaluation of agricultural waste with consequent cost savings the capability to: estimate the environmental burden of materials, to compare and contrast competing products and the risk reduction are just some of the numerous benefits that can be obtained through the adoption of the LCA.

KEYWORDS: Environmental sustainability, LCA, Risk reduction, Green economy, Wine sector

PAPER ID: CEST2021_00329

A case study on the application of Product Social Impact Assessment to the agri-food sector: ready-to-eat beetroot.

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ABSTRACT

The main objective of this study is to apply the Product Social Impact Assessment (PSIA) handbook to a case study. The method used to quantify the social impacts is to identify the stakeholders and the social topic, indicators, and then to apply the impact analysis method. Social studies identify the retailing stage as the phase with the greatest social risk in the life cycle followed by the product transformation phase. However, the infeasibility of focusing this study on the multiple companies involved in the commercialization, led the processing stage company to be chosen as the central part of the study. The preliminary evaluation of the social topics of the stakeholders, presents an average of +0.88 points on the level scale (-2 to +2), which positions the company beyond the generally acceptable situation, in continuous improvement.

KEYWORDS: PSIA, Social LCA, employment, local community, sugar beet, food.

PAPER ID: CEST2021_00795

Life Cycle Assessment of Cheese in Terms of Climate Change

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ABSTRACT

Milk products are important sources of nutrients in the human diet; however, they have a significant impact on the environment, particularly because of the greenhouse gases that are generated during the production of these products. Therefore, this study aims to analyze the impact of life cycle of Cagliata cheese on climate change. In this study, the selected functional unit is 1t of Cagliata cheese produced in Lithuania and exported to Italy. The environmental impact evaluation of the product in terms of CO_2 eq. covered four stages: milk production, cheese production, packaging, and transportation. Emission factors for each stage was recalculated based on data from the cheese producer and the literature review. Results show a total carbon footprint of 2.109 t CO_2 eq./1t of Cagliata cheese throughout the life cycle. The primary production stage of milk contributed the most - some 1.058 t CO_2 eq./1t (50% of the total life cycle carbon footprint), cheese production phase - 0.65 t CO_2 eq./1t of cheese. Based on the results improvement options are suggested for producer to minimize cheese contribution to the climate change.

KEYWORDS: life cycle assessment, cheese, climate change, Lithuania

PAPER ID: CEST2021_00069

SPATIAL ENVIRONMENTAL PLANNING

Detection of disturbances of thyme habitats on Lemnos Island with Landsat time series analysis

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ABSTRACT

Landsat time series data, freely available in recent years, are commonly used for land cover change detection and monitoring ecosystem disturbances. The thyme habitats are areas under protection because of their high ecological value. However, human activity that leads to competition in land use, mainly from overgrazing, constitutes an increase threat to these habitats. The impact of these disturbances is under-reported and their detection remains essential for thymes conservation. The island of Lemnos was selected as a study area, because of the significant areas of thyme habitats, currently under pressure due to abandonment of the rural countryside, desertification, overgrazing and systematic fires over the last decades. A long-term Landsat time series was created and various vegetation indices have been calculated, such as NDVI, SAVI etc. Change detection algorithm (BFAST) was used for detecting and characterizing significant changes (break points) within the time series. The thyme habitats of Lemnos have been decreasing significantly in terms of size, due to fires and transformation to new grazing areas for livestock production. For the conservation of thyme habitats measures should be taken with participation of local stakeholders, including livestock breeders and beekepers. Satellite monitoring techniques are important tools that could facilitate this conservation process.
This research is co-financed by Greece and the European Union (European Social Fund- ESF) through the Operational Programme “Human Resources Development, Education and Lifelong Learning 2014-2020” in the context of the project “Methodology of spatio-temporal analysis for disturbances on thyme areas, for their conservation and restoration at the level of local communities, combining multi-spectral systems across multiple spatial scales” (MIS 5048198).

KEYWORDS:
Thymes conservation, spatio-temporal analysis, multi-spectral images, Landsat, vegetation indices, Lemnos
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ECOLOGY, ENVIRONMENTAL CHANGE AND MANAGEMENT

Pro-ecological business models – case study in Poland

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ABSTRACT

Currently, ecological postulates as the idea of green economy are more and more often used in the economy. Hence the priority in company management is the subject of pro-ecological business models. The purpose of this article is to present the idea of creating business models in line with sustainable development and the green management convention. Pro-ecological approach to creating a business strategy can be the key success factor. There are different business models, that can introduce ecology to the company, i.e. Pro-Effectiveness Model of Corporate Social and Environmental Responsibility and the Entrepreneurial Model of Corporate Social and Environmental Responsibility. The idea of those models will be presented. Also shortened results of research on the subject of pro-ecological aspects of Polish enterprises will also be presented.

KEYWORDS: business model, pro-ecological, sustainable development

PAPER ID: CEST2021_00814

ENERGY TECHNOLOGIES AND SUSTAINABILITY

Sustainable Highways: The challenges of the future

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ABSTRACT

Road transport and infrastructure are keys to the evolution and prosperity of modern society. Connecting people and places, goods and services in safe, efficient, and sustainable way is essential for creating and maintaining sustainable and inclusive growth across society and the economy. A sustainable highway should satisfy lifecycle functional requirements of societal development and economic growth while reducing negative impacts to the environment and consumption of natural resources. In the future, highway infrastructure will face increasing pressures and impacts from a range of issues including changing weather patterns, population growth, capacity constraints, shortage of land and capital and rapidly changing technologies that outstrip the pace of new infrastructure development. From the other point, advanced technologies and intelligent transport solutions will play a significant impact on the transport solutions in the future. In this paper, the increasing environmental pressures that highway face and the new advanced technologies that might shape the highways infrastructure are presented.

KEYWORDS: highway, sustainability, infrastructure, advanced technologies

PAPER ID: CEST2021_00165

Feasibility of coupling hydrogen and methane production during sewage sludge digestion

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ABSTRACT

Anaerobic digestion is a technology widely used for the stabilisation of sewage sludge in wastewater treatment plants (WWTP). This technology presents several advantages such as the production of energy and the use of this energy to cover the demand of the treatment plant. However, sludge digestion systems may not produce an enough amount of biogas to cover a great fraction of the total energy demand. In the present manuscript is evaluated the introduction of a fermentative hydrogen phase and the effect produced in the system in terms of the energy balance. Food waste were considered as carbohydrate rich co-substrate and batch fermentation of this process is evaluated. The system was modelled using SuperPro designer considering conventional waste activated sludge system for the treatment of wastewater whereas the sewage sludge line was studied under mesophilic regimens. The mass and energy balance indicated an increase between 20 - 60% in the whole valorisation process, reporting as suitable this alternative when using digestate as inoculum source for starting-up the hydrogen process.

KEYWORDS: Enhancing performance, biogas productivity, energy efficiency

PAPER ID: CEST2021_00742

ADVANCED OXIDATION PROCESSES

Valorisation of polyolefins into magnetic carbon nanotubes: application as catalysts in wet peroxide oxidation of paracetamol

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ABSTRACT

This work deals with the application of magnetic carbon nanotubes (MCNTs) in the catalytic wet peroxide oxidation (CWPO) of paracetamol (PCM), a pharmaceutical compound selected as model contaminant of emerging concern (CEC). MCNTs were synthetized by catalytic chemical vapor deposition (CCVD) at 850 ºC, considering low-density polyethylene (LDPE), high-density polyethylene (HDPE), and polypropylene (PP) as carbon precursors representative of urban plastic solid waste. Magnetite supported in alumina (Fe_3O_4@Al_2O_3) nanoparticles previously synthesized by sol-gel were used as catalysts in the CCVD process. The synthesized MCNTs were tested in the CWPO of PCM at 80 ºC, monitoring during 24 h the concentration of H_2O_2, PCM, Total Organic Carbon (TOC) and aromatic compounds. All MCNT catalysts show activity allowing to decompose completely the pharmaceutical in aqueous solutions after 360 min. In particular, the MCNTs synthesized from HDPE lead to complete removal of the pollutant after 30 min of reaction. By TOC analysis, it was observed that the CNTs led to obtain mineralization degrees higher than 38% of the pollutant after 24 h. Aromaticity test indicated that the catalyst prepared from HDPE promotes more degradation of the intermediates than the catalyst prepared from LDPE and PP.

KEYWORDS: Contaminants of emerging concern, carbon nanotubes, micropollutants, advanced oxidation processes, plastic waste.

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$TiO_{(2)}/Fe_{(2)}O_{(3)}$ based Composites for Solar-driven Photocatalytic Degradation of Amoxicillin

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ABSTRACT

The occurrence of trace amounts of antibiotics in various bodies of water was directly linked to the development of antibiotic resistant pathogens. Recently, Amoxicillin (AMX) was added on the second EU "watch list" based on the proposed European Decision 2018/840/EU. Its presence in drinking water samples and wastewater effluents is related to limited removal by common municipal wastewater treatment plants. As such, new remediation techniques must be applied to remove these substances. One of the promising solutions is the application of advanced oxidation technologies, e.g. sustainable solar-assisted photocatalysis. In this study, composites made of TiO_2 and α-Fe_2O_3 (hematite) were developed, prepared and immobilized in a form of thin films. The sandwich-type composite includes commercial TiO_2 (P_{25} Aeroxide) and α-Fe_2O_3 with different layer configurations immobilized to the substrate via spin coating technique forming: (i) TiO_2 layers covering α-Fe_2O_3, (ii) α-Fe_2O_3 layer over TiO_2 and (iii) physically mixed 50% (w/w) of TiO_2/Fe_2O_3. Since the composites were obtained using commercial nano-powders, they were inspected for optical properties only using DRS analysis. Photocatalytic activity under solar irradiation was assessed by treating targeted pharmaceutical pollutant AMX in the presence and absence of additional oxidants; hydrogen peroxide (H_2O_2) and persulfate (S_2O_{82}-). In the absence of any oxidant, TiO_2 (top) – α-Fe_2O_3 (bottom) achieved the fastest degradation of AMX among all as-prepared composites, possessing first order rate constant of 4.6 x 10-3 min-1, higher comparing to benchmark TiO_2 P_{25} as well (3.5 x 10-3 min-1). The same arrangement of composite was found to be of highly beneficial toward AMX removal in the presence of persulfate salts, while H_2O_2 did not show significant influence. The influence of pH and persulfate salt on AMX degradation rate was establish by the means of statistical planning and response surface modeling. The AMX degradation pathway was established and formed intermediates evolution/degradation were correlated with the changes in biodegradability and toxicity toward two bioassays; Daphnia magna and Vibrio fischeri. Influence of water matrix constituents (Cl-, CO_{32}- , NO_3- , PO_{43}- and natural organic matter) on AMX removal was established, while Reactive Oxygen Species (ROS) scavenging was also employed for further understanding of AMX degradation mechanism.

KEYWORDS: Solar Photocatalysis, TiO_2/Fe_2O_3, Persulfate, Amoxicillin

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Oxidation of acetaminophen by ultrasound waves and H_2O_2 combined technology

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ABSTRACT

This study analyses 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 was 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%. Oxidazing 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

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CLIMATE CHANGE MITIGATION AND ADAPTATION

Determination of greenhouse gases emissions from pmdi products in Greece

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ABSTRACT

The focus of the current study is on the estimation of greenhouse gases (GHG) emissions from pressurized Metered Dose Inhalers (pMDIs) products in Greece. The emissions are expressed as carbon dioxide equivalent (CO_2eq). The total emissions of the pMDIs were estimated at 47.53 kt CO_2eq and they represent the 0.052% of the total Greek GHG emissions. In addition, calculations separately for each pMDI category showed that short-acting β-agonist (SABA) pMDIs have the highest contribution on the total pMDIs emissions, due to higher annual sales. Two scenarios were implemented for evaluating possible reduction of the pMDI emissions in Greece. In scenario A, the replacement of the current propellants contained in pMDIs products, with HFA 152a which is a low Global Warming Potential (GWP) propellant was suggested. In scenario B, the emissions were estimated for the replacement of HFA 134a by the HFA 152a and the reduction of the amount of propellant contained in each pMDIs. It is concluded that implementing the above scenarios could result to a significant decrease (89-96%) of the CO_2eq emissions by pMDIs products.

KEYWORDS: greenhouse gases, pMDI emissions, propellant

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Review of the IPCC landfill gas emissions model

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ABSTRACT

Almost all developed nations have agreed to report their annual greenhouse gas (GHG) emissions, under the UN Framework Climate Change Convention of 1997. But only a few directly measure their landfill gas emissions. Most use the Intergovernmental Panel on Climate Change (IPCC) landfill gas model to calculate them. This paper examines the accuracy of these default factors, checking references cited by the IPCC for choosing each default factor. It finds that some of these studies were misquoted and several IPCC default factors have no scientific basis. The model is conservative: for example emission inventory compilers are required to avoid underestimation, rather than to find the most accurate possible estimate of emissions. Landfill gas is usually recovered with gas extraction systems, and used to generate electricity. If landfill operators' record-keeping is not good enough, the gas is assumed to be emitted, even if methane was recovered all year. Overall, the model's default factors appear to overstate generation of methane and landfill emissions.

KEYWORDS: Review IPCC landfill gas model

PAPER ID: CEST2021_00692

HEAVY METALS IN THE ENVIRONMENT

Zinc and Nickel Accumulation in Unicellular Photosynthetic Algae *Chlamydomonas reinhardtii* Grown in Metal-contaminated Media

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ABSTRACT

In this study, Zn and Ni accumulation in unicellular freshwater migroalga Chlamydomonas reinhardtii was investigated. C. reinhardtii cells were grown in media polluted with several concentrations of either Zn or Ni. Tolerance of this organism to Zn and Ni pollution was examined and the growth curves for different Zn and Ni pollution levels were constructed. The Zn and Ni distribution in a cell population of Chlamydomonas reinhardtii cells were quantitated at the end of the logarithmic phase of the cultures by conventional and single cell Inductively Coupled Plasma – Mass Spectrometry (ICP-MS and SC ICP-MS). The effects of the metal accumulation on the lipid profile of the cells were also examined by easy ambient sonic-spray ionization mass spectrometry (EASI-MS).

KEYWORDS: Zinc, Nickel, Chlamydomonas reinhardtii, Single Cell-ICP-MS, lipidomics

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WASTEWATER TREATMENT

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Application of quorum quenching to improve performance of membrane bioreactors: A comprehensive mini-review

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ABSTRACT

Membrane bioreactors (MBRs) have been widely used for wastewater treatment, presenting however a major disadvantage, the membrane fouling problem. The sludge microorganisms produce soluble microbial products (SMP) and extracellular polymeric substances (EPS) that lead to a formation of a sticky biofilm layer. This biofilm layer causes membrane biofouling since the activated sludge substances attach to the membrane. Quorum quenching (QQ) constitutes an innovative method that effectively reduces membrane fouling with its research being evolved rapidly. Quorum quenching is the disruption of the inter-species and intra-species signaling pathways. The QQ application results in minimization of membrane biofilm formation, SMP and EPS production, and therefore membrane fouling reduction. This review work summarized all the cutting-edge research and patents of the application of the QQ method for membrane fouling reduction, the methods for screening QQ activity and biofouling mitigation, and finally described the challenges of the QQ application in real scale MBR units. This mini review may be valuable and appropriate for further development work.

KEYWORDS: Quorum quenching; Quorum sensing; Membrane biofouling; Membrane bioreactors; Biofilm mitigation

PAPER ID: CEST2021_00370

Applying solar distillation for the sustainable management of olive mill wastewater

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ABSTRACT

Olive mill wastewater (OMWW) is a major by-product of olive oil production industry. Its chemical characteristics (high concentrations of COD and TSS, low pH value, existence of total phenols at the range of some ppm) does not allow its efficient treatment using conventional physiochemical or biological wastewater treatment methods. On the other hand, an important number of compounds with bioactive properties have been detected in OMWW increasing the scientific and economical interest for their recovery. In the current study, lab experiments were initially conducted using conventional distillation to study the role of temperature and initial OMWW characteristics to the composition of the distillate. Chromatographic analysis revealed the presence of different bioactive compounds in the distillates as well as the positive role of temperature's increase on their recovery. A pilot-scale solar still system was afterwards constructed to investigate the simultaneous solar drying of OMWW and the recovery of bioactive compounds with antioxidant properties in the distillate. The system operated in different experimental cycles and the produced distillates and solid residues were analyzed for the presence of bioactive compounds and the energy content, respectively.

KEYWORDS: *olive mill wastewater, solar distillation, polyphenolic compounds, antioxidants, recovery*

PAPER ID: CEST2021_00191

ENVIRONMENTAL POLLUTION

Assessment of surface water quality on an oil extraction area in Albania

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ABSTRACT

Oil extraction activities in Albania are considered as highly polluting for surface waters, but more for the number of direct spills in riverine waters. The aim of this study was to assess the surface water quality for a period of 5 years (2014-2018) in four seasons based on different physico-chemical parameters in the Seman River, in Zharreza reservoir and drainage canal, located in the district of Fier, Albania. Seventeen chemical parameters were monitored such as pH, DO, EC, TSS, Cl^-, NO_3^-, Total-N, Total-P, BOD_5, COD, Cr(VI), Cu^{2+}, Ni^{2+}, Pb^{2+}, Cd^{2+}, Total Oil Grass and Temperature. The values of pH, EC, Cl^-, NO_3^-, Total-N, were in all cases within the limits set by EU, WHO and IFC standards, while DOs were below the limit values of 5.0 mg L^{-1} in all stations. TSS exceeded the limit value 1000 mg L^{-1} (according to EU standard) at the two Seman stations. Total-P, BOD_5 and COD also exceed the limits of EU and WHO but below the limit values of IFC for surface water of oil extraction fields. Total Oil Grass concentrations were > 0.5 mg L^{-1} (EU standard) and > 10 mg L^{-1} according to IFC in all cases except for the three values measured in the Zharreza reservoir. The concentrations of Cr (VI), Pb^{2+} and Cd^{2+} were higher than three references, and especially Cd^{2+} and Pb^{2+} were up to 20 times more than the standard. Also, the concentrations of Cu^{2+} and Ni^{2+} were higher, according to IFC both upstream and downstream of Seman River as well as in the drainage channel.

KEYWORDS: Seman River, chemical water parameters, EU standards, WHO standards, IFC standards.

PAPER ID: CEST2021_00840

ATMOSPHERIC CHEMISTRY AND PHYSICS

Determination of atmospheric amines in boreal forest using unmanned aerial drone with an integrated miniaturized air sampling system

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ABSTRACT

Amines are ubiquitous in the atmosphere and their presence is considered important especially due to their hazard to human health and their contribution to new particle formation that can affect climate change. In this study, tailor-made mesoporous functionalized silica sorbents were used in in-tube extraction (ITEX) and solid-phase microextraction (SPME) Arrow sampling systems for the collection of amines in air. The aerial drone carrying these sampling systems was versatile and flexible allowing the simultaneous use of miniaturized exhaustive (ITEX) and non-exhaustive sampling techniques (SPME Arrow), permitting the reliable collection of amines in both gas phase and aerosol particles. The air samples were collected in summer 2020 at the SMEAR II station (Finland), followed by the analysis using thermal desorption gas chromatography-mass spectrometry. Alignment of the chromatograms and spectral deconvolution were used for untargeted data processing. Amines that were identified from the samples were quantified and semiquantified by using the partial least squares regression approach. Up to ten different amines were tentatively identified from the samples and were quantified and semi-quantified with the average concentration of up to 40 ng m-3 in the gas phase and up to 128 ng m-3 in particles.

KEYWORDS: amines, miniaturized air sampling technique, aerial drone, ITEX sampling, SPME Arrow sampling

PAPER ID: CEST2021_00434

Thornthwaite's approach for assessing aridity changes during the last seven decades in the urban environment of Heraklion-Crete in Greece

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ABSTRACT

Changes in aridity, especially to more arid classes, can have a strong impact on vegetation development in urban environments affecting also the inhabitants' health and quality of life. In this work, water related parameters (i.e. Potential evapotranspiration PET, water deficit D and surplus S) and aridity index AI were examined according to Thornthwaite's approach, in the city of Heraklion – Crete in Greece during the period 1955-2017. The decadal analysis of seven decades (1950s to 2010s) indicates that S remains negligible, however PET and D have increased values varying from 938mm in 1980s to 1007mm in 2010s for PET and from 396mm in 1960s to 568mm in 2010s for D, whereas precipitation has decreased presenting maximum in 1960s (579mm) and minimum in 2010s (422mm). Therefore, the recent decade (2010s) is more arid compared to the past, displaying the lowest AI value (0.42). During the previous decades, AI was much higher with values between 0.60 in 1960s and 0.44 in 1990s, indicating that the region was at the edge of the threshold (0.50) for changing aridity zone from sub-humid (SH) to semi-arid (SA), according to UNEP's classification.

KEYWORDS: Climate, Aridity, Crete, Thornthwaite, UNEP

PAPER ID: CEST2021_00226

MARINE ENVIRONMENT AND COASTAL MANAGEMENT

Correction of the predicted wave characteristics using regression methods – a case study for the Iberian coastal environment

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ABSTRACT

The west Iberian coast is affected by various storms developed in the North Atlantic Ocean. For this reason, an accurate prediction of the sea state conditions is very important to manage the protection of the harbours and population living in the coastal cities. In recent years computing power has increased significantly, which has allowed the improvement of the numerical models. The wave models have undergone the same evolution, which makes them an important tool for the most accurate prediction of the wave conditions. In this study, the wave predictions on the west Iberian coast are performed with the SWAN model. Simulations are performed in winter 2013-2014 when various storms affected all the European coasts. It is well known that in the simulation of extreme wave events some errors may occur. Altimeter measurements are used to correct the errors that appeared in the simulation results. By using these measurements together with regression methods, it was possible to improve the significant wave height fields simulated with the SWAN model in each point of the computational domain of the target area. This improvement is indicated by the statistical parameters calculated by comparing the simulated significant heights with buoy measurements.

KEYWORDS: SWAN, West Iberian coast, hindcast wave data, correction, regression methods.

PAPER ID: CEST2021_00339

Implications of small-scale fisheries in Istrian waters on cartilaginous species

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ABSTRACT

In small-scale fishing in the northern Adriatic region, a certain percentage of catches consists of cartilaginous fish, and is still considered as bycatch. Despite global concerns about their overfishing, they are still understudied. In order to obtain data on the presence of cartilaginous fish in catches, 13 fishing trials using trammel nets were carried out from October 2020 to March 2021 at three fishing locations along the Istrian coast (northern Adriatic): Umag, Poreč and Cape Kamenjak. Nets were set in the afternoon and hauling was performed the next day. The stretched mesh sizes of the bottom trammel nets were 80 and 140 mm and the total length of the nets was 30,700 m. Among the 33 species with 403 specimens recorded in the total catch, six species with 23 specimens were cartilaginous: *Dasyatis pastinaca*, *Mustelus mustelus*, *Prionace glauca*, *Scyliorhinus canicula*, *Scyliorhinus stellaris*, *Torpedo marmorata*. Since our preliminary results show that cartilaginous species are common in Istrian waters, we suggest more accurate record keeping of their catches, considering existing fisheries management strategies.

KEYWORDS: cartilaginous fish, bycatch, small-scale fisheries, Adriatic Sea

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ENVIRONMENTAL MANAGEMENT AND POLICIES

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Desalinated water and power for a seaside hotel: a case study using off-grid solar and wind

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ABSTRACT

A hybrid combination of solar and wind energies for a remote seaside hotel is analyzed. More specifically, a hotel in Hammamet, Tunisia, powered by photovoltaic panels and a wind turbine is evaluated, with water generated by desalination using reverse osmosis. This isolated accommodation establishment is off-grid, having to produce its own drinking water, energy for cooking, lighting, etc. The power balances in these PV-wind-desalination systems is strongly influenced by the sunshine, the wind, and the demand. Based on an analysis of needs, the system is then sized. The variable nature of renewable energy sources, combined with unpredictable changes in load, require the simultaneous implementation of high power and high energy density storage systems. Thus, an storage system by lead-acid batteries for power and an elevated storage tank is considered, developing an autonomous microgrid connected to a variable charge. The system was validated by simulations (performed by Matlab/Simulink), based on data from the location, allowing us to predict the dynamic behavior. The simulation results validate the performance of the system.

KEYWORDS: Renewable energy; Water supply; Off-grid systems; Reverse Osmosis; Seawater desalination; photovoltaic, wind turbine

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Green organizational culture – its essence, elements and methods of diagnosis

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ABSTRACT

The analysis of papers indexed in Scopus database revealed that insufficient attention is paid to organizational culture treated as one of the crucial factors in shaping employees' appropriate behaviors towards natural environment. Taking this into account the purpose of this paper is to present green organizational culture which is an element of general organizational culture and reflects the organizational attitude towards environmental issues. In particular, the author discusses the essence of this culture, its elements – taking into account Schein's concept of cultural layers – and methods of its diagnosis used in previous studies. Since the paper is of theoretical-conceptual nature, it is based on literature studies combined with a scientific reflection. It contributes to the development of knowledge through providing synthesis of previous studies and highlighting challenges related to proper diagnosis of this culture.

KEYWORDS: environmental sustainability, green HRM, employee behavior

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Green Jobs in multinational companies - an initial network and content analysis

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ABSTRACT

Several current research studies on green jobs focus mostly on rural areas and analyze this problem in the context of Circular Economy or specific industries. However, the context of multinational companies is still uncovered. This study aims at mapping the field by relating the Green Jobs in multinational companies in the business/ management literature. The research method used in this paper is network analysis based on the results obtained from the Dimensions database, totaling 67 documents. Findings revealed that this research area is at its birth stage and proved the need for advancing the field. The avenues for future research are addressed.

KEYWORDS: Green jobs, multinational companies, network analysis, environmental management, green human resource management.

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How we boost science in the cities

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ABSTRACT

The PULCHRA project explore the open schooling concept in the theme "Cities as urban ecosystems" and in view of creating new partnerships in local communities to foster science education for all citizens. Schools, in cooperation with other stakeholders become agent of community well-being, taken the theme to be explored encompasses the natural environment, the built environment and the socio-economic environment in cities. This is of great importance, taken that the urgency of cities to be approached as urban ecosystems is underestimated and limitedly linked to science education for all citizens. The open learning course (https://pulchra-schools.eu/lessons/) allow the widening of the stakeholders following the project and benefiting from the educational resources and the overall approach for cities as urban ecosystems. The course supports the deepening of knowledge of the stakeholders and other end users who follow the project. An important part is building trust in the scientific approach based on experience. Engaging in environmental education has a direct impact on the community and the personal life of the participants.

KEYWORDS: science, cities, SDG's, education, open schooling, motivation, activation, creativity, innovation, community well-being.

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ANTIBIOTIC RESISTANSE

Influence of antibiotics on Arcobacter-like cells and their biofilm formation

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ABSTRACT

Arcobacters belong to Gram-negative bacteria, the rod cells can be slightly curved into the shape or spiral. Their growth is typical in a microaerophilic environment, but some species are able to grow under aerobic or anaerobic conditions. The purpose of this study was to test the *in vitro* effect of many antibiotics on planktonic cells and biofilm formation of *Arcobacter*-like bacteria. The minimum inhibitory concentration (MIC) is the standard assay for testing antibiotic susceptibility of bacteria. So, the MIC of antibiotics were determined by the broth microdilution method. The most of the more than 60 strains showed high susceptibility to gentamicin (98.4%), ciprofloxacin (95.2%) and to erythromycin (93.6%). Biofilm formation in the presence of antibiotics was evaluated by modified Christensen method. All strains were able to form a biofilm after 24 h of exposure. The highest biofilm formation was found in case of *A. defluvii* LMG 25694 and *A. butzleri* strains as well as in lower concentration of antibiotics. Biofilm formation ability is often associated with bacterial virulence, environmental survival and increased antibiotic resistance compared to planktonic cells. The biofilm formation represent a potential danger of infections and then a risk to human health, in particular due to antimicrobial-resistant strains.

KEYWORDS: Antibiotic resistance, *Arcobacter*-like species, biofilm, antibiotic, antimicrobials

PAPER ID: CEST2021_00804

BIOWASTE

Enzymatic hydrolysis followed by alcoholic fermentation of prickly pears (*Opuntia ficus-indica* L.) cladodes and fruits using *Saccharomyces cerevisiae* E1A

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ABSTRACT

The cultivation and production of biomass of prickly pear is of particular interest due to the fact that it can be grown in arid areas, producing higher amounts of biomass with lower inputs (water, fertilizers etc.) compared to other crops. The present study examines whether enzyme hydrolysis is capable to increase the amount of reducing sugars available to *S. cerevisiae* E1A strain to be used during alcoholic fermentation. Enzymatic hydrolysis was performed using the commercial enzymes Termamyl and Celluclast applied at various concentrations of dried cladodes and of dried fruit and added juice from discarded fresh prickly pears in order to enrich the quantity of sugars into the solution. The substrate used in the bioreactor experiment consisted of 100 g/L of dried cladodes with 40 g/L of dried fruit, which after the addition of the juice resulted in the synthesis of a liquid growth medium containing 48 g/L of sugars. The microorganism finally managed to produce a significant amount of endopolysaccharides inside the yeast biomass (22.12% w/w) while biomass (DCW) production was of 4.35 g/L. Ethanol at 21.54 g/L with a yield of ethanol produced per unit of sugar consumed $Y_{EtOH/S}$ was equal to 0.49 g EtOH / g of substrate.

KEYWORDS: Saccharomyces cerevisiae strains, enzymatic hydrolysis, bioethanol, enzymes, prickly pear (Opuntia ficus – indica (L.)).

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CASE STUDIES OF MACRO- AND MICROPLASTICS POLLUTION IN COASTAL WATERS AND RIVERS

Photoluminescence spectroscopy on commercially available plastic products

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ABSTRACT

Commercially available plastic products are produced for specific applications. They represent polymeric compounds, i.e. base materials mixed with various types of additives such as pigments. The identification of the plastic type is the key goal in microplastics analysis but also the key process when it comes to recycling macroscopic plastic litter. Established methods to analyze microplastic particles are FTIR spectroscopy and Raman spectroscopy. Both methods have shortcomings regarding plastic size and measurement speed. In 2020 Ornik et al. demonstrated that polymeric base materials can be differentiated from natural materials using photoluminescence spectroscopy. Here, we extend this method by examining commercial polymeric packaging materials found in the supermarket, which are colored by different pigments.

KEYWORDS: Microplastics, photoluminescence, detection technique, detection limits

PAPER ID: CEST2021_00260

RIVER SYSTEMS IN DIVERSE CLIMATES AND ENVIRONMENTS

Chemical weathering rates and CO_2 consumption in the Savuto basin (Sila Massif, Italy) inferred from riverine water chemistry

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ABSTRACT

The aim of this work was to estimate the silicates (SWR) and carbonates (CWR) weathering rates as well as the CO_2 consumption in the Savuto basin (Sila Massif, Southern Italy), studying the riverine water chemistry. Six sampling sites were investigated. Starting from the rain composition, atmospheric and anthropogenic inputs were subtracted to total dissolved load allowing the estimation of the SWR and CWR. The obtained weathering rates are: (i) SWR= 9.6 t/km^{2}a and (ii) CWR= 12.8 t/km^2. Moreover, an indirect estimation of CO_2 moles consumed was performed based on the reaction stoichiometry for both silicate ($CO_{2\ sil}$) and carbonate ($CO_{2\ carb}$) weathering processes. The results show that the consumption of $CO_{2\ sil}$ is equal to 2.2x10^5 mol/Km^2 a, whereas the consumption of $CO_{2\ carb}$ is equal to 3.5x10^5 mol/Km^2 a.

KEYWORDS: Chemical weathering; CO_2 consumption; riverine water chemistry.

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NEW SOLUTIONS FOR A BETTER AND SUSTAINABLE AGRICULTURE

Monitoring of the leafhopper *Scaphoideus titanus* and symptoms associated with yellows diseases in vineyards in the Viticulture Region of Moldova, Romania

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ABSTRACT

Monitoring action is a key component of integrated pest management programs that aims to obtain valuable early data regarding the pests and their crop damages. By this, it is possible to select and apply the most appropriate strategies for pest control before reaching to economical threshold. The leafhopper *Scaphoideus titanus* (Hemiptera: Cicadellidae) is the main natural vector that spreads in Europe the golden flavescence diseases (Flavescence Dorée), one of the most destructive grape yellow diseases produced by phytoplasma. This paper reports the results of a 4-year survey on spreading and abundance of *S. titanus* in vineyards from Moldova region in Eastern Romania as well as specific symptoms for phytoplasma diseases. Fifty-one plantations were investigated during 2016-2018 and 2020. Visual observations were performed to evaluate the symptoms of yellows diseases and yellow double sticky traps to monitor the leafhopper. Results revealed that 84.3% of plantations showed symptoms characteristics to yellows diseases associated with phytoplasmas presence with an incidence between 0.5 and 29.5%. Chardonnay white cultivar was the most affected. The leafhopper *S. titanus* was recorded in all investigated vineyards with different abundance. Total abundance of the pest, from June to October, was between 10 and over 1600 specimens per trap per site.

KEYWORDS: Scaphoideus titanus, Romanian grapevine,

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GREEN CHEMISTRY

Optimization of eco-friendly olive leaf (Olea europea L.) extraction methods for cosmeceutical applications

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ABSTRACT

Demand for natural and organic cosmetics is growing rapidly every year. This increases interest in herbal extracts that contain biologically active ingredients able to prevent and delay skin aging. Olive (*Olea europaea* L., Oleaceae) is a small tree mostly utilized for its fruit, whose oil is widely used in traditional Mediterranean cuisine. Olive leaves, rich in bioactive phenolics such as oleuropein and verbascoside, are commonly utilized as a traditional drug for numerous chronic conditions, such as diabetes and cardiovascular diseases[1]. In this work, eco-friendly, polypropilene glycol (PPG)-based extraction of olive leaf was optimized using a IV-optimal mixture design. Powder herbal material was subjected to extraction using different ternary solvent mixtures consisting of PPG, lactic acid and water. Ultrasound-assisted and magnetic stirrer-assisted extraction were compared in regard to their extraction efficiency. Total polyphenol (TP) content was determined spectrophotometrically, while the quantification of oleuropein and verbascoside was performed using HPLC. Cosmeceutical activity of the extracts prepared using the optimized extraction conditions was investigated through their antioxidant activity (DPPH radical scavenging activity, the activity in the β-carotene linoleic acid assay) and the inhibitory activity on the selected enzymes (elastase, collagenase, tyrosinase and lipoxidase). The most appropriate solvent mixture for extraction of olive leaf phenolics was PPG:water:lactic acid (28.6:63.6:7.8 w/w/w). Magnetic stirrer-assisted extraction was shown to be more efficient, as well as economically and environmentally more acceptable option for the extraction of target phenols. Optimal time for TP, oleuropein and verbascoside extraction, determined by kinetics measurements, occurred at 20 min of extraction process (Fig. 1a.). Correlation between mass concentration (γ) of extracted phenolics against mass of the employed herbal material was determined to be linear indicating a good solubility of target compounds in the selected solvent (Fig. 1b.). The prepared extracts were efficient antioxidants and enzyme inhibitors deeming them appropriate candidates for active cosmeceutical ingredients in natural cosmetics.

KEYWORDS: Olive leaf, Oleuropein, Polyphenols, Cosmeceutical, HPLC.

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Cyclodextrins as encapsulating agents for green extraction of Helichrysum *italicum* phenolics

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ABSTRACT

Immortelle, (*Helichrysum italicum* (Roth) G.Don, Asteraceae) is a flowering plant widely used in natural cosmetics. In this work, cyclodextrin (CD)-based ultrasound-assisted extraction of immortelle bioactive principles were investigated. Optimal extraction condition and amounts of various CD (α-CD, hydroxypropyl-β-CD, hydroxypropyl-γ-CD) required for efficient encapsulation of phenolic compounds were determined in three steps. In the first step, the most appropriate CD and the extraction time were selected and compared to the extraction efficiency of water/ethanol mixtures. In the second step, 2-level factorial design was employed for selection of the factors that significantly affect the extraction efficiency. The impact of the following factors was examined: ultrasonic power, herbal material/solvent ratio, temperature, lactic acid content and glycerol content. In the third step, Box Behnken design was used for the fine-tuning of the significant extraction conditions needed to achieve the maximum number of bioactive compounds (total phenols, total flavonoid and total phenolic acid content). The extracts were analyzed using the HPLC, GC-MS and spectrophotometric methods. The results, presented in Fig 1., indicate that ethanol (75%) was the most efficient extraction solvent. Among the tested CDs, hydroxypropyl-β-CD was the most suited for the extraction of immortelle phenolics, reaching the extraction efficiency of the 50% ethanol. Kinetic measurements have shown that the optimal extraction duration was 30 minutes. The employed 2-level factorial design showed that herbal material/solvent ratio, temperature and lactic acid content significantly affected extraction efficiency. The extracts were found to be rich in phenolic compounds, most notably caffeic acid derivatives. In general, high temperature (80 °C) and high drug/solvent ratio (0.89/10 w/w) positively affected the extraction efficiency, while the addition of lactic acid (1.95 %) positively affected total phenolic acid content but not total phenolic and flavonoid content. GC/MS analysis have shown that the most represented volatile metabolite was nearly acetate, followed by γ-curcumene. The results have shown that the CD-based ultrasound-assisted extraction of immortelle phenolics is an acceptable green alternative to organic-solvent based extraction.

KEYWORDS: Helichrysum italicum, hydroxypropyl-β-cyclodextrin, polyphenols, HPLC.

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