



CEST 2025

19

INTERNATIONAL
CONFERENCE ON
ENVIRONMENTAL
SCIENCE &
TECHNOLOGY

3 - 6 September 2025
Kos island / Greece

BOOK OF ABSTRACTS



Prince Sultan Bin Abdulaziz
International Prize for Water

Recognizing Innovation



Winners for the 11th Award (2024)



Creativity Prize

[1] The team of Maria Cristina Rulli (Polytechnic of Milan, Italy) and Paolo D'Odorico (University of California, Berkeley, USA)

for spearheading novel analyses of the water-energy-food nexus that describe how numerous complex factors interact, providing for better freshwater stewardship in a changing, globalised world.



Maria Cristina Rulli



Paolo D'Odorico

[2] The team of Zhiguo He (Zhejiang University, China)

for developing working, versatile soft robots with unprecedented manoeuvrability that have the capacity for numerous underwater research and monitoring applications. Team members include: Pengcheng Jiao and Yang Yang.



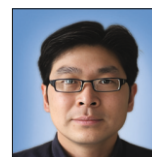
Zhiguo He



Surface Water Prize

Qihua Liang (Loughborough University, UK) and his team

for developing innovative, open-source, multi-GPU hydrodynamic models to support real-time flood forecasting at high temporal-spatial resolutions. Team members include: Huili Chen, Xiaodong Ming, Xilin Xia, Yan Xiong and Jiaheng Zhao.



Qihua Liang



Groundwater Prize

Chunmiao Zheng (EIT, Ningbo, China) and his team

for powerful modelling tools to understand groundwater processes and manage groundwater resources under diverse eco-hydrological and climatic conditions, considering environmental and socioeconomic factors at local and national scales.



Chunmiao Zheng



Alternative Water Resources Prize

Virender K. Sharma (Texas A&M University, USA) and his team

for the effective removal of antibiotics and pharmaceuticals from wastewater through advanced oxidative processes by activated ferrate, which work at high, even enhanced, efficiency in water containing commonly occurring natural organic matter. Team members include: Ching-Hua Huang, Chetan Jinadatha and Radek Zbořil.



Virender K. Sharma



Water Management & Protection Prize

Joseph Hun-wei Lee (Macau University of Science & Technology, China)

for developing unique and highly effective hydro-environmental modelling systems for the sustainable water management of smart cities.



Joseph Hun-wei Lee

Invitation for Nominations 12th Award (2026)

Nominations open online until 31 December 2025

www.psipw.org

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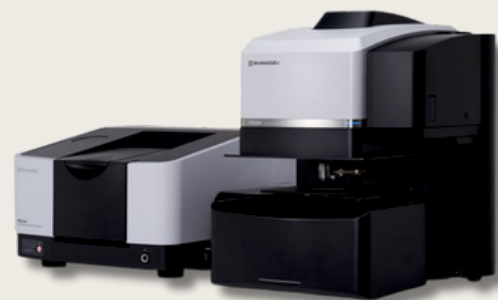
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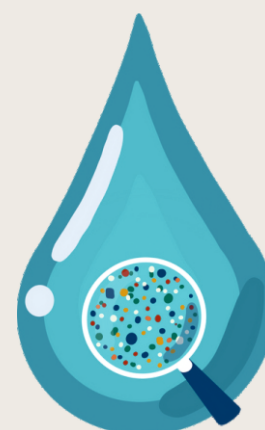
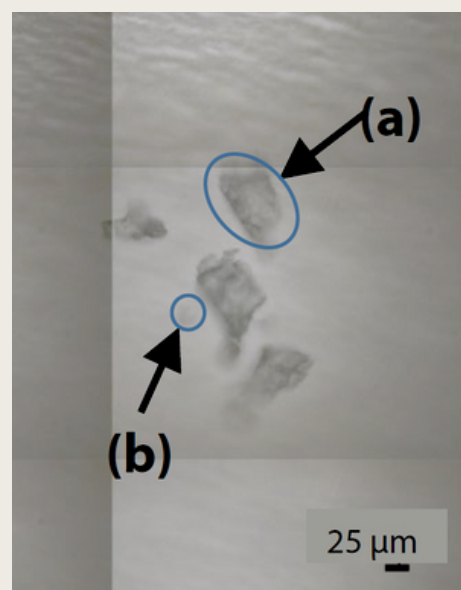
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PART A: ORAL PRESENTATIONS

SESSION 1 – OPENING CEREMONY (1)

Wednesday 3 September - afternoon

Climate Change, Water Scarcity, Emerging Contaminants and Microplastics: Global Vision and Local Solutions in the Mediterranean region: The Need for Advanced Water Treatment and Management

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ABSTRACT

Most ecosystems are exposed simultaneously to several stressors, in the so-called multiple-stress situation. Key stressors like climate change and water scarcity can limit biodiversity and economic activities in entire regions. One example will be intermittency in water flow with implications for hydrologic connectivity, negative side effects on biodiversity, water quality, and river ecosystem functioning. Water scarcity can amplify the effects of water pollution by reducing the natural diluting capacity of rivers. Interactions between stressors may be exacerbated by climate change.

Water Scarcity and Climate Change are going hand in hand in most cases. The relevance of water scarcity as a stressor is most important in semi-arid regions such as the Mediterranean basin, characterised by highly variable river flows and the periodic occurrence of low flows and even no-flows. Climate change previsions forecast an increase in the frequency and magnitude of extreme events. Although extremes are part of the normal hydrologic behaviour in Mediterranean-type rivers, many already show a consistent trend towards decreased discharge. In this respect, the Mediterranean basin is one of the most prominent “hot spots” for potential changes in water availability. Most climate change models conclude that Mediterranean regions will be more affected by summer drought, higher flood frequency and higher temperatures. These changes will probably not be limited to catchments draining into the Mediterranean Sea but will affect all Mediterranean-type regions worldwide, like certain parts of California and Australia, among others.

This presentation will describe in the first part the main threats associated with climate change related to global warming and temperature increase around the planet. Strategies for mitigation and adaptation to climate change with a focus on capturing greenhouse gases (GHG) will be reported. Among them, afforestation and carbon neutrality using phytocapture with algae, as well as the use of biochar for environmental remediation and GHG reduction, will be mentioned. Examples from the European projects SCARCE and GLOBAQUA on of several river basins: Ebro, Llobregat, Guadalquivir and Júcar as well as other European rivers like Adige, Evrotas and Sava will be reported (1). As main conclusion of the reconnaissance study in Spain was that pesticides like azoxystrobin, imidacloprid, carbendazim, propiconazole, permethrin and azinphos-ethyl were identified as most toxic to aquatic biota as compared to other chemical groups like pharmaceuticals or industrial pollutants. Water scarcity has increased in general the risk of emerging contaminants presence in rivers. New types of pollutants like antimicrobial resistance genes (ARG) and microplastics (MPs) are expected to be relevant under a climate change scenario. Examples from Europe, China and Saudi Arabia will be presented (2).

To overcome pollution problems in rivers under climate change effects, new solutions are required to improve river water quality and quantity, like the use of advanced water treatment options. The

thing is that conventional WWTPs were not designed to remove some organic compounds such as emerging pollutants. A wide array of micropollutants is usually found in WWTP effluents, so there is a need to develop and evaluate alternative treatments which could be efficient for their elimination. In short, several advanced treatments such as membrane bioreactors (MBR), nanofiltration/ ultrafiltration, reverse osmosis, eco-friendly- technologies like algal-based solutions and advanced oxidation processes like photocatalysis could improve the removal of many emerging pollutants and microplastics, thereby diminishing their presence in surface waters. An overview of the different water treatment technologies with practical examples will be reported (3,4). In the case of Spain, we will report recent examples of water scarcity in the metropolitan area of Barcelona, in the Catalonia region of Spain, where still reservoirs are the main source of drinking water supply. In the last few years, water reuse and desalination technologies have been developed becoming increasingly important in the coming years in order to overcome the permanent problem of water scarcity in this region.

Lastly, by improving the water treatment, the river water will be of better quality an additional source for different reuse options, like agriculture or groundwater recharge, being one of the mitigation strategies against climate change and water scarcity. Direct potable reuse is already being considered in Catalonia, following the steps of California under the new regulation recently published last October 1st, 2024.

KEYWORDS: wastewater reuse; climate change; micropollutants; desalination; river basin

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Resilience by design through water and nature: levers for change in the current policy landscape

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ABSTRACT

The EU water resilience strategy was presented in June 2025 with the aim to restore the current broken policy cycle. Nature and the catchment restoration of functions are strong levers to help build back resilience in the Mediterranean, a climate change hotspot. The keynote will reflect at the emerging concept of resilience by design through water and nature, by doing a tour the table in relation to some of main thematic areas of the conference in particular exemplifying the concept through circularity, water and wastewater treatment and reuse. environmental policies, environmental change and management, hydrology and water resources, artificial intelligence in environmental applications. environmental health & well-being and climate change. This “tour de table” will be designed to highlight and learn from the complex, systemic nature of these thematic areas.

KEYWORDS: climate change; water resources; water resilience

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SESSION 2 – WASTEWATER TREATMENT (1)

Thursday 4 September - morning

AI Applications in Wastewater Quality Monitoring for a full-scale Sequencing Batch Reactor Plant

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ABSTRACT

Recent advancements in computing power and the availability of online resources have fueled the increasing popularity of machine learning in modeling wastewater treatment plants. This study capitalizes on this trend by developing neural networks and ensemble models for predicting influent BOD using real data from a Sequential Batch Reactor (SBR) plant in the Philippines. The study employed a series of preprocessing techniques and introduced the Yeo-Johnson transformation, which improved the distribution of the data and significantly decreased bias while lowering variance. Through this process, three influent optimal features—COD, NH₄-N, and PO₄-P—were identified. Subsequently, DNN, LSTM, and CNN models were developed and fine-tuned using Bayesian optimization. The DNN model demonstrated superior generalization compared to LSTM and CNN models, achieving an R² score of 0.35. Additionally, XGBM emerged as having better generalization than LGBM, with an R² score of 0.25. Despite the success in model development, these models present opportunities for further improvement and may eventually be integrated into real-time operation for proactive decision-making to optimize performance and resource allocation in municipal wastewater treatment plants utilizing SBR technology in the Philippines.

KEYWORDS: BOD prediction, neural networks, ensemble models

PAPER ID: cest2025_00139

Nanobiotechnology for the removal of heavy metals from industrial wastewater

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ABSTRACT

Nanobiotechnology offers promising techniques to treat and clean industrially wastewater. Past reports on wastewater particularly from textile industries, have shown significant levels of harmful and toxic heavy metals including chromium, lead, zinc and cadmium. Removal of such toxic heavy metals from wastewater are generally carried out with physical and chemical techniques that are expensive and non-environmental friendly. At present, it is important to explore potential techniques that are eco-friendly with low carbon footprint and cost-effective. Therefore, in the present study, ZnO nanoparticles synthesized through green techniques were analysed for their potential to remove or degrade chromium (VI) ions to chromium (III) ions to lower the toxicity of heavy metals in water. The nanoparticles were synthesized using *Bacillus subtilis* and were characterized by FTIR and zetasizer to identify the shape, size and average particle size. Further, biologically synthesized ZnO nanoparticles were used to remove the chromium ions confirmed by the spectroscopic analyses. The study showed that biologically synthesized nanoparticles have significant potential to remove and/or degrade chromium ions. It is concluded that Nanobiotechnology is an efficient technique to clean waste water and biologically synthesized nanoparticles presents environmental friendly and cost effective method that must be explored in future for other toxic heavy metals also.

KEYWORDS: Industries, wastewater, nanobiotechnology, heavy metals, green synthesis

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PhotoBioValue project: Linking N:P Ratios and Nitrogen Sources to Microalgae-Based Wastewater Bioremediation and Biomass Valorisation

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ABSTRACT

Microalgae-based systems offer potential for wastewater bioremediation by extracting nutrients while producing biomass for various uses. However, variations in wastewater properties, particularly the source of nitrogen and phosphorus, their concentration, and the N:P ratio, impact treatment efficiency. This study aimed to evaluate the combined effects of different N:P ratios and nitrogen sources on biomass composition, wastewater treatment, and *Chlorella vulgaris* growth. Three sources of nitrogen (NO_3^- , NH_4^+ , and both) have been studied alongside four N:P ratios (9, 14, 20, and 27). All synthetic effluents were suitable for *C. vulgaris* growth, and the N:P ratio of 9 with NH_4^+ as the only nitrogen source had the greatest specific growth rate. Nitrogen was entirely removed at a N:P ratio of 9, with NH_4^+ being the preferred source. When both sources were available in the media, NH_4^+ was consumed first. The removal of phosphorus reached 99 %. Nitrogen constraints reduced the biomass's protein concentration while increasing its lipid and carbohydrate contents. Combining NO_3^- and NH_4^+ boosted protein content compared to the use of NO_3^- and NH_4^+ alone. These results show that the microalga can effectively treat diverse wastewaters with different compositions, reaching optimum growth and nutrient removals at a N:P ratio of 9.

KEYWORDS: Biomass composition; *Chlorella*; Nitrogen to phosphorus ratio; Nutrient removal; Wastewater treatment.

the combination of NO_3^- and NH_4^+ led to higher protein content ($p < 0.05$).

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Acknowledgements

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Pure vs. hybrid moving bed technology: How aeration strategies affect nitrification kinetics and Comammox bacteria?

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ABSTRACT

The study compared the impact of different aeration strategies on nitrification kinetics and population size of canonical nitrifiers (AOB, NOB) and Comammox bacteria in two variants of sequencing batch reactors using moving bed technology: pure (MBSBBR) and hybrid (IFAS-MBSBBR). The results showed that in both reactor types highly efficient, stable nitrification process was achieved, regardless of aeration started modifications. In both reactors, increasing the ratio between nonaerated and aerated subphases time (R) led to a decrease in the ammonia oxidation rate (AOR), while lowering the dissolved oxygen concentration (DO) promoted the activity of ammonia oxidizing bacteria. Additionally, in both reactors, the biofilm served as an environment where NOB bacteria were more active. In MBSBBR, NOB were the most numerous group of nitrifiers. Despite similarities, several differences were observed between the analysed technologies. In MBSBBR, NOB were the dominant nitrifiers in all samples, whereas in the biofilm of IFAS-MBSBBR, AOB and Comammox bacteria were more prevalent. Another significant difference is how the change in aeration strategy from continuous to intermittent affected the abundance of Comammox bacteria. In MBSBBR, an increase in the Comammox bacteria population was observed, whereas, in the biofilm from IFAS-MBSBBR, this change led to a sharp decrease in their number. Interestingly, a parallel increase in Comammox bacteria was observed in the activated sludge form of IFAS-MBSBBR. Furthermore, the response of Comammox bacteria to changes in DO levels varied. In MBSBBR, their frequency increased, while in the biofilm from IFAS-MBSBBR, no significant effect was noted. However, a decrease in the Comammox population was observed in the activated sludge of IFAS-MBSBBR. These findings highlight both commonalities and significant differences between the two technologies. However, it is important to note that the reactors were not operated under identical conditions, which likely influenced the observed differences.

KEYWORDS: moving bed technology, pure moving bed technology, hybrid moving bed technology, biofilm, activated sludge, Comammox bacteria

PAPER ID: cest2025_00042

PhotoBioValue project: Microalgae-bacteria consortium for the bioremediation of urban wastewater in pilot-scale photobioreactors

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ABSTRACT

Two innovative pilot-scale channel photobioreactors (PBRs) were used to culture a microalgae-bacteria consortium in primary urban wastewater. The abundance of total heterotrophs and faecal coliforms, and the concentrations of nitrogen, phosphorus and seven volatile methylsiloxanes (VMSs) were evaluated. Microalgae grew effectively in these PBRs with high nitrogen and phosphorus removal efficiencies. Cultivable faecal coliforms decreased significantly in both PBRs. Promising results are expected on the capacity of these systems for VMS removal.

KEYWORDS: contaminants of emerging concern; photobioreactor; siloxanes; urban wastewater; wastewater treatment.

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Aeration Matters: Optimizing Wastewater Treatment While Minimizing N₂O Emissions

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ABSTRACT

Nitrous oxide (N₂O), a potent greenhouse gas with a global warming potential 300 times greater than CO₂, is increasingly recognized as a critical environmental challenge in wastewater treatment. Accurate measurement and mitigation of N₂O emissions are essential to minimize the climate impact of these systems. One of the factors influencing N₂O emissions is the aeration strategy. Aeration strategy plays a pivotal role in the efficiency and environmental footprint of wastewater treatment processes. This study explores the effects of three distinct aeration regimes—continuous aeration, intermittent aeration with 10-minute cycles (10 min aerated/10 min non-aerated), and intermittent aeration with 30-minute cycles (30 min aerated/30 min non-aerated)—on nitrogen removal efficiency and N₂O emissions. The experiments were conducted on activated sludge and wastewater samples collected from municipal WWTP designed for simultaneous carbon, nitrogen, and phosphorus removal.

The results revealed significant differences in nitrogen removal efficiency and N₂O emission factors between the strategies. Continuous aeration achieved a nitrogen removal efficiency of 25% but resulted in the highest N₂O emission factor of 4.79%. The 30/30 intermittent aeration strategy improved nitrogen removal efficiency to 49%, with a lower emission factor of 3.35%. In contrast, the 10/10 strategy achieved a nitrogen removal efficiency of 39%, with an emission factor of 4.11%. These findings highlight the trade-offs between nitrogen removal efficiency and N₂O emissions under different aeration strategies. The 30/30 strategy demonstrated the most balanced performance, offering higher nitrogen removal efficiency and reduced emissions compared to the other strategies. By minimizing N₂O emissions, WWTPs can significantly reduce their carbon footprint while maintaining compliance with stringent effluent quality standards. This research offers valuable insights into operational adjustments that municipal treatment facilities can adopt to align with global sustainability goals.

KEYWORDS: N₂O emission, wastewater treatment plant, aeration

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Application of Cell Immobilization in the Batch Activated Sludge Treatment of Domestic and Poultry Wastewater Using Carbonized Coconut Shell and Carbonized Rice Hull

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ABSTRACT

Domestic wastewater (DWW) and poultry wastewater (PWW) are some of the primary sources of pollution that affect receiving surface and marine waters, potentially causing eutrophication and other environmental concerns. This study aimed to evaluate the effect of cell immobilization in the performance of batch activated sludge treatment (BAST), particularly nitrification and organic matter removal, in DWW and PWW. Two kinds of cell immobilizers were tested: carbonized coconut shell (CCS) and carbonized rice hull (CRH), both of which are produced from biowaste that are abundantly available in the Philippines. The cell immobilizers were applied in batch reactors seeded with activated sludge (AS) from a sewage treatment facility. Ammonia-nitrogen ($\text{NH}_3\text{-N}$) and chemical oxygen demand (COD) concentrations were measured hourly over 6-hour periods via spectrophotometry. Application of CCS in two batches of AS-seeded BAST of DWW showed a 10.12% increase in average COD removal from 341.27 ± 4.97 mg/L to 375.79 ± 3.79 mg/L and an 18.55% increase in average $\text{NH}_3\text{-N}$ reduction from 23.49 ± 7.77 mg/L to 27.85 ± 4.30 mg/L. On the other hand, application of CRH in two batches of AS-seeded BAST of PWW showed a 10.69% increase in average COD removal from 483.00 ± 28.56 mg/L to 534.65 ± 59.69 mg/L and a 19.92% increase in average $\text{NH}_3\text{-N}$ reduction from 83.06 ± 12.48 mg/L to 99.61 ± 14.63 mg/L. Comparing the performance between the two immobilizers over three batches of BAST, results showed that CCS-immobilization had higher COD removal of 383.34 ± 7.86 mg/L (DWW) and 605.35 ± 34.37 mg/L (PWW) and higher $\text{NH}_3\text{-N}$ reduction of 32.10 ± 4.92 mg/L (DWW) and 144.03 ± 3.25 mg/L (PWW) compared to CRH-immobilization with COD removal of 351.90 ± 29.27 mg/L (DWW) and 557.05 ± 41.10 mg/L (PWW) and $\text{NH}_3\text{-N}$ reduction of 29.44 ± 1.86 mg/L (DWW) and 115.36 ± 17.87 mg/L (PWW). This study has demonstrated that aerobic treatment of DWW and PWW can be improved using cell immobilization, with CCS-immobilization substantially outperforming CRH-immobilization in terms of COD removal and $\text{NH}_3\text{-N}$ reduction.

KEYWORDS: biological wastewater treatment, domestic wastewater, poultry wastewater, cell immobilization, carbonized coconut shell, carbonized rice hull

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Acknowledgment

The researchers extend their appreciation to the Department of Science and Technology – Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD) for funding the program titled “Removal of Excess Nitrogen and Endocrine Disruptors in Wastewater” (RENEW), of which this study is a part of.

Benchmarking Sustainability in Tissue Manufacturing: Evaluating Bleaching and Effluent Treatment Practices

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ABSTRACT

Sustainable production in the tissue paper industry requires careful assessment of environmental performance, particularly in areas such as bleaching methods and effluent management. This article compares current bleaching and effluent treatment practices across the industry and assesses their compliance with environmental standards and sustainability indicators. The focus is on the environmental impact of bleaching technologies - including total chlorine free (TCF) processes and the use of optical brighteners - and the effectiveness of different wastewater treatment strategies used by tissue manufacturers. Both regulatory requirements and voluntary industry standards are analysed to understand how they influence environmental outcomes. The study highlights the importance of adopting advanced, low-impact technologies and aligning production practices with broader sustainability goals to improve the overall environmental footprint of tissue production.

KEYWORDS: bleaching process; optical brighteners, Chlorine-Free bleaching; wastewater treatment; sustainability indicators; tissue industry

PAPER ID: cest2025_00310

SESSION 3 - SOLID WASTE MANAGEMENT

Thursday 4 September – morning

The Evolution of End of Life Clothing in the Waste Management Sector considering Circular Economy

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ABSTRACT

The global trends of the fashion industry are projected to expand in value from 1.5 trillion \$ in 2020 to about 2.25 trillion \$ by 2025, presenting that the fashion request is on continual growth. In addition, fast fashion, characterized by the rapid production and turnover of low-cost clothing, has a significant impact on global water resources. Direct and indirect impacts of fashion on water pollution must be considered examining the entire lifecycle of clothing production, from raw material extraction to post-consumer disposal. The presentation makes an overview considering the relationship of the buyers and the clothes starting from 1920 until today. Moreover, recent data regarding per capital spending on clothing, raw materials (eg. Cotton) production, clothing water foot print, carbon dioxide projection from apparel industry, textiles generation from EU households are presented. Moreover, the existing state of the art concerning the management systems that are being applied taking into account the profile of the end-of-life clothing that are disposed of, green washings effects etc. Furthermore, new business models considering digitalization, metaverse, are presented taking into account circular economy initiatives as for example recovery of high added value products from end-of-life clothing as well as to how to produce alternative raw materials from biomass.

KEYWORDS: fashion waste, end of life clothes, circular economy

PAPER ID: cest2025_00336

Impact of biodegradable bioplastics on anaerobic co-digestion of household organic waste and wastewater sludge

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ABSTRACT

The growing adoption of biodegradable bioplastics, such as Mater-Bi (MB) and Crystalline Polylactic Acid (CPLA), as substitutes for conventional plastics has raised questions about their environmental behaviour. This research investigates how these two materials degrade during anaerobic co-digestion with organic fractions of municipal solid waste (OFMSW) and thickened sewage sludge (TWAS). Laboratory-scale semi-continuous tests were carried out to evaluate biomethane production, process performance, and the extent of degradation at different bioplastic concentrations. Results showed that both materials degrade only partially, with MB showing greater weight loss (23%) than CPLA (15%) over six weeks. The degradation of MB was mainly attributed to abiotic mechanisms rather than microbial activity. Additionally, increasing the concentration of bioplastics in the feed negatively influenced process stability, causing a drop in methane yield and a rise in volatile fatty acids. Despite these effects, phytotoxicity tests suggested the digestate might still be usable in agriculture. However, the influence of bioplastics on the final digestate quality needs further investigation. Overall, the findings highlight the need for better-performing biodegradable materials and improved strategies for managing bioplastics within anaerobic digestion systems, especially when aiming for sustainable waste treatment and safe agricultural reuse.

KEYWORDS: Anaerobic digestion; Biodegradable plastic; Crystalline polylactic acid; Mater-Bi; Organic fraction of municipal solid waste

PAPER ID: cest2025_00032

Impact of Straw Substrate Particle Size on the Mechanical Properties of Mycelium Based Composite Materials

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ABSTRACT

This research investigates the application of fungi to the existing linear agricultural and forestry economies to create more circular economic models, reduce CO₂ emissions, and produce building materials aligning with action plans of European governments, towards climate neutrality by 2050. In this context, biomaterials in the built environment are considered a critical way forward. The research studies mycelium-based materials for panel boards in buildings. Mycelial structure was proven to be an effective material binder, but there are potential improvements to product quality and stability in production. After identifying specific fungi for use as material binder, laboratory tests assessed salient mechanical properties of the mycelium-based composite materials on pelletised vs. chopped/chipped substrate materials. The results show that pelletised substrate materials produce composite materials with isotropic characteristics that are more resistant to compressive loads than composite materials made from chopped substrates. This gives promise that pelletised substrates can improve strength, consistency, and reliability of mycelium products while offering an industrial solution to biomass waste management with the production of standardised pellets as an ingredient of mycelium composite materials. The production process thus has the potential to create a circular economic model for agriculture, forestry, and the built environment, while off-setting biomass incineration.

KEYWORDS: Biomaterials, fungi, mycelium-based materials, circular systems, forestry and agriculture waste chains

PAPER ID: cest2025_00075

Indigenous systems of solid waste management: A Perspective of the African continent rural areas

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ABSTRACT

Lack of formal waste management systems and practices results in different indigenous systems of solid waste management emerging. These systems are not regulated because of lack of policies and regulations. The aim of this paper is to evaluate the indigenous systems of solid waste management in the rural areas of the African continent. To achieve this aim, the objective was to assess different practices of indigenous solid waste management in the rural communities of the African continent. This study was conducted in the rural areas of Maseru, Lesotho with 465 participants, and the researcher used literature review to include some areas of the African continent. This paper employed quantitative findings (expressed in numbers), qualitative findings (expressed in words), and observation data collection methods. Primary and secondary data were used, self-developed questionnaire was used. This study utilized a descriptive, ethnographic and direct observation research design. The unit of analysis was the communities residing in the rural areas of Maseru, Lesotho. Data were analysed in terms of indigenous systems practices of solid waste management and waste characteristics. International Business Management Statistical Package for Social Science Version 29.0 was used to analyze data. The results were presented in two phases of quantitative and qualitative analysis. The knowledge gaps emphasize the connection between waste, the environment and health in rural communities. Laws and environmental policies contribute to indigenous disposal of waste. Culture, norms, tradition, habit, values and beliefs of the rural communities support the indigenous disposal of solid waste. Similar disposal systems in most countries. Regulatory measures, specifically municipal by-laws must be established to control the effects of inappropriate handling and disposal of solid waste in the rural areas of African countries. This paper will contribute information and knowledge towards rural planning in solid waste management and sustainable development in rural areas of Africa.

KEYWORDS: Indigenous, practices, rural communities, waste, waste management

PAPER ID: cest2025_00021

Recovery of aged plastics from waste stored in bales

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ABSTRACT

Since 1994, baled waste has symbolized the waste management crisis in the Campania Region (Italy). In response to the long-term environmental burden caused by their storage, a regional strategy was launched in 2015, leading to the construction of two dedicated treatment facilities in Caivano and Giugliano municipalities. This study focuses on the recovery and recycling potential of plastic fractions obtained from the treatment of these bales. Through comprehensive chemical-physical and mechanical analyses, the work aims to evaluate the quality, degradation, and recyclability of different types of plastics (PET, PE, PP) considering end-of-waste criteria and circular economy targets. The results provide insights into the feasibility of valorizing plastic waste streams via mechanical recycling.

KEYWORDS: circular economy, recovery, recycling, urban mining, waste management

PAPER ID: cest2025_00109

Valorisation of Marine Polypropylene Waste: Integrity Assessment and Recycling Performance

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ABSTRACT

Marine plastic pollution represents a persistent global environmental challenge, with polypropylene (PP) being a prevalent component among marine litter. Building on CEST 2023, this study advances PP debris classification and recyclability assessment, introducing a systematic approach for assessing the recyclability prospects of marine-degraded PP. This study establishes a refined integrity categorization of PP debris using Ultraviolet (UV) spectroscopy, tensile testing, and morphological assessment. Subsequently, a comprehensive analysis of mechanical performance was performed by blending different categories of PP debris with virgin PP, applying controlled injection moulding processes. Results confirmed that blending ratios significantly impact the mechanical properties of the final products. Specifically, blends incorporating 50 % lightly damaged PP (LDPP50-VPP50) and 30 % moderately damaged PP (MDPP30-VPP70) yielded the most efficient performance, maintaining mechanical properties within acceptable thresholds for practical applications. This methodology highlights the importance of debris integrity assessment as a decision-making tool in recycling strategies, promoting the valorisation of marine plastic waste and contributing to circular economy models.

KEYWORDS: Marine pollution; Plastic debris; Polypropylene; Mechanical recycling

PAPER ID: cest2025_00358

Acknowledgements

This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, for the implementation of Action 5 with Code 5045851 and title Center for Sustainable and Circular Bioeconomy [Aegean_BIOECONOMY] within the framework of Call with Code 111 (A/A OPS NSRF 3525) and title "Support of Regional Excellence".

Circular Economy in Textiles: Evaluating Mechanical Separation Techniques for Recycling Poly-cotton Blends

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ABSTRACT

The textile industry is a major contributor to global pollution, responsible for 20% of water pollution, 10% of annual carbon emissions, 35% of ocean microplastics, and the disposal of 92 million tons of waste in landfills annually. Notably, 35% of textile waste is generated before products even reach consumers, while less than 1% of clothing materials are recycled into new garments. A critical challenge in textile recycling is the separation of blended materials, such as polyester-cotton fabrics, which require distinct processes due to their combined natural and synthetic composition. Effective separation is a prerequisite for efficient recycling of textile waste. Existing separation technologies include spectroscopic methods, chemical treatments, and thermal processes. Spectroscopic techniques, such as near-infrared spectroscopy, allow for material identification but are costly and challenging to scale. Chemical treatments can dissolve or selectively degrade specific components but often involve high chemical usage and energy demands. Thermal processes, while effective for certain applications, risk compromising material quality. These limitations underscore the need for more sustainable and scalable alternatives. This study explores mechanical separation techniques as an environmentally friendly and cost-effective strategy for preparing textile waste for recycling, focusing on their effectiveness in separating polyester and cotton fibers from blended fabrics. Density separation employs saline solutions like NaCl to segregate materials by density, while froth flotation uses air bubbles and surfactants to elevate hydrophobic particles, leaving hydrophilic particles in the solution. By addressing the critical issue of material separation, this research advances circular economy practices in the textile sector, presenting practical solutions to reduce waste, improve recycling rates, and foster sustainability within the industry.

KEYWORDS: Textile waste, Separation techniques, Recycling, Circular economy, Sustainability

PAPER ID: cest2025_00058

A model for calculating required equipment for introduction of waste source separation system at municipal level – Case Study of Serbia

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ABSTRACT

The introduction of municipal solid waste (MSW) source separation is a key step toward achieving sustainable waste management and complying with European Union directives. Source separation improves the quality and quantity of recyclables, reduces landfill waste, and fosters environmental awareness. However, its implementation presents challenges in terms of financial, technical, and institutional planning, particularly in transition countries like Serbia. This paper develops a systematic model for calculating the required equipment - bins, containers, and collection vehicles for the introduction of waste source separation at municipal level across four waste management regions in Serbia. The proposed model is based on a 2-bin system, where dry co-mingled recyclables and residual waste are collected separately, with glass collected via bring points. The calculation methodology for bins/containers considers key parameters, including waste composition and generation rates, households' type and size, bin/container capacity and waste density. In addition, the total number of required waste collection vehicles included parameters such as: vehicle capacity and efficiency, collection frequency, average time needed for transport and unloading of waste per one required "trucks cycle", average distance from settlements in municipality, etc. Developed calculation model and structured methodology supports decision-makers for estimating equipment needs and investment requirements in designing and introduction of a scalable, cost-efficient waste separation infrastructure.

KEYWORDS: Source separation, model, calculation, recyclables, equipment

PAPER ID: cest2025_00237

Assessing Public Awareness and Environmental Impact of Solid Waste Disposal in Duhok Governorate, Kurdistan Region of Iraq

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ABSTRACT

This study investigates public awareness of solid waste disposal and its environmental and health impacts in the Duhok Governorate, Kurdistan Region of Iraq. Solid waste generation in the governorate has risen due to rapid urbanization and population growth, overwhelming waste treatment facilities and causing environmental and health risks. The research involved 500 households chosen randomly, and the data was collected through structured interviews and questionnaires. The research examined the awareness of the participants on waste management, environmental pollution, and health risks of improper waste disposal. The findings indicate that the majority of respondents (92%) had no knowledge about waste management, and only a small percentage had general knowledge about waste hazards and environmental pollution. There were gender disparities, with men slightly more knowledgeable than women. Public awareness campaigns are needed, according to the research, to expand knowledge and encourage sustainable waste management in the Duhok Governorate. Bridging this knowledge gap is necessary to mitigate the environmental and public health risks of unsanitary waste disposal.

KEYWORDS: Public awareness; Health impacts; Environmental pollution; Solid waste disposal; Educational campaigns; Duhok Governorate

PAPER ID: cest2025_00450



SESSION 4 – AIR POLLUTION

Thursday 4 September – morning

Detox NH₃ Textiles - Clean Air for Pig, Man & Environment

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ABSTRACT

The DTNW has been working successfully for many years on the development of so-called adsorber textiles, which are suitable, for example, for the enrichment and recovery of precious metals from industrial process waters, where they can make a significant contribution to improving circulation flows and sustainability. Our latest investigations focus the use of the functional textiles in the adsorption from gaseous phase - namely the adsorption of ammonia. Ammonia has a negative impact on the environment and health. The most important pollution emitter is the farming industry, where ammonia is produced during animal husbandry by excretions from pigs, cattle and chickens, for example. Bound in liquid manure, it is then mostly spread on arable land, where it contributes significantly to overfertilization and contamination of groundwater. In addition, gaseous ammonia is the basis for the formation of long-lived particulate matter, which can lead to severe respiratory diseases and it plays an important role in global warming because it can be transformed to climate-damaging nitrous oxide. Here, we present our results on the direct adsorption of ammonia in pigsties. In our pilot plant, the gas can be removed from the ambient air of the pig house in continuous operation and at the same time converted into a valuable mineral fertilizer that is easy to transport and therefore no longer needs to be applied directly at the point of origin.

KEYWORDS: textile, polyelectrolyte, ammonia, farming industry, fertilizer

PAPER ID: cest2025_00003

Mitigating VOCs and Odor with Activated Biochar from Woody Waste

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ABSTRACT

Activated biochar derived from municipal woody waste presents a promising solution for mitigating volatile organic compounds (VOCs) and odors from cattle manure emissions. Biochar was produced via slow pyrolysis at 450 °C and activated using physical and chemical methods, including phosphoric acid (H₃PO₄), to enhance adsorption properties.

Activation significantly increased the biochar's surface area, microporosity, and functional groups, improving its ability to adsorb VOCs, including odorous compounds like indole, p-Cresol, skatole, and dimethyl sulfides. Advanced characterization confirmed the biochar's structural and chemical modifications, demonstrating improved adsorption efficiency.

Batch adsorption experiments, using headspace gas chromatography-mass spectrometry (HS-GC-MS), showed VOC reductions exceeding 95%, highlighting the activated biochar's effectiveness in odor control. The process was successfully scaled up in a semi-pilot kiln, ensuring product consistency between laboratory and larger-scale production.

These findings position activated biochar as a sustainable solution for manure management, providing significant environmental and agricultural benefits. Its long-term performance and broader applications in odor and air quality management are expected to further enhance its impact in these sectors.

KEYWORDS: Activated biochar, VOCs reduction, Odor control, Cattle manure management, Sustainable agriculture.

PAPER ID: cest2025_00072

Acknowledgments

The project (RE-GreenVOCs, CODEVELOP-REPowerEU/1223/101) is funded by the European Union Recovery and Resilience Facility of the NextGenerationEU instrument, through the Research and Innovation Foundation.

Multiyear monitoring of ultrafine particulate matter emissions from a modern full scale WtE plant at real operating conditions

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ABSTRACT

Monitoring campaigns for addressing quantitative and qualitative characteristics of emitted ultrafine and nanoparticles during real operating conditions from waste to energy were performed on a modern plant with a specifically designed instrumental protocol. Results are summarized for number concentrations and size distributions of particles during sampling conditions representative of both primary particles at stack flue gas and of those arising from dilution and cooling techniques, for identification of variations theoretically expected immediately following immissions in the receiving atmosphere.

KEYWORDS: Emissions, ultrafine particles, field measurements, waste to energy plant.

PAPER ID: cest2025_00141

Exploring the patterns of particle-bound PAHs in ambient air of an urban agglomeration (first results)

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ABSTRACT

This study examines the occurrence of polycyclic aromatic hydrocarbons (PAHs) in PM₁₀ atmospheric particles in an urban environment, Ioannina, Greece (population: ~114.000). A one-year sampling campaign, spanning from March 2022 to April 2023, was conducted. Fifty-seven 24-hour samples representing both warm and cold periods were collected and sixteen PAHs, including those regulated by the revised Ambient Air Quality Directive (EU) 2024/2881, were quantified. The winter-to-summer PAH concentration ratio was calculated, and correlation analysis was conducted with PM₁₀-bound PAHs and other pollutants to identify potential common sources. Molecular diagnostic ratios of PAH isomers were employed to assess the impact of well-characterized emission sources such as vehicular traffic and biomass burning. Compounds within each ratio share identical molar masses, suggesting similar environmental behavior and fate. Low-temperature processes, such as wood burning, produce low molecular weight PAHs, while high-temperature processes, like fuel combustion in vehicles, release higher molecular weight PAHs. Meteorological parameters, including temperature, relative humidity, atmospheric pressure, precipitation and wind velocity, were also considered. The first results of the sampling campaign are presented aiming to offer insights into air quality in non-industrialized urban areas affected by PM pollution episodes during cold, steady and calm atmospheric conditions.

KEYWORDS: PM₁₀-bound PAHs; seasonal variation; molecular diagnostic ratios; meteorology

PAPER ID: cest2025_00212

Acknowledgments: The authors sincerely acknowledge the University of Western Macedonia for its financial support and funding of this research.

Factors Influencing Particulate Matter Variability in an Urban Street in Chios

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ABSTRACT

This study examines how traffic flow, suburban PM_{2.5} concentrations, noise and meteorological factors influence particulate matter levels in an urban street. Spearman's correlation analysis reveals that urban PM₁₀ concentrations are moderately and significantly correlated with traffic flow ($\rho=0.574$, $p<0.001$), highlighting vehicular non-exhaust emissions as an important source of coarse particles. Traffic flow also shows a weaker but positive relationship with urban PM₁ ($\rho=0.312$, $p=0.05$), indicating more complex sources for finer particles. The correlation between urban PM fractions and suburban PM_{2.5} varies by particle size and source: Urban PM₁ strongly correlates due to regional combustion sources; urban PM_{2.5} shows a moderate correlation; urban PM₁₀ shows no significant correlation. Meteorological variables further modulate urban PM levels: wind direction moderately correlates with PM concentrations ($\rho\approx 0.400$), reflecting directional pollutant transport patterns; wind speed negatively predicts PM levels (ρ between -0.415 and -0.455), consistent with dispersion effects; and relative humidity positively influences PM concentrations ($\rho=0.420-0.495$), likely due to hygroscopic growth and secondary aerosol formation. These findings underscore the combined influence of traffic, regional pollution, and weather on urban particulate matter variability.

KEYWORDS: Urban Air Pollution, PM sources, Particulate Matter, meteorological parameters, traffic flow

PAPER ID: cest2025_00176

Low-cost smart sensors for PM monitoring in ambient air: analysis and comparisons

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ABSTRACT

Air pollution remains a major global concern, causing around 400,000 premature deaths annually in the EU. Particulate matter (PM), especially PM₁₀ and PM_{2.5}, is one of the most harmful pollutants due to its association with cardiovascular and respiratory diseases; it is classified as a Group 1 carcinogen by the IARC. In Europe, PM concentrations are officially measured via gravimetric analysis (EN 12341:2023), which ensures high accuracy but lacks real-time data and requires significant resources. This study evaluates the performance of two low-cost sensors (SEN55 and SDS011) and one optical reader (MPC1), compared to the reference method over a 30-day campaign in multiple environmental conditions. Results are analyzed using R², bias, and RMSE to assess inter-sensor variability and agreement with standard methods, aiming to support the integration of low-cost technologies in air quality monitoring networks.

KEYWORDS: particulate matter, monitoring, air quality, sensors

PAPER ID: cest2025_00184

Comparative Risk Assessment of Commuting Traffic Congestion in Dubai

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ABSTRACT

The traffic congestion related to peak commuting hours can create multiple effects on public health, environmental conditions and economic stability. Because of the unique nature of Dubai in terms of urban planning, population expansion, car dependence in addition to being a tourist and economic hub in the Gulf, Dubai's suffers regular traffic congestions during peak commuting hours. In this study we applied used Comparative Risk Assessment (CRA) framework to evaluate and rank five selected major congestion related threats. The five identified threats are traffic related air pollution, commuter stress, noise pollution, productivity loss and transport greenhouse gas emission. The CRA relied on the published data by Dubai's Roads and Transport Authority (RTA), the world air index data (AQICN) and other previously published studies. Our analysis shows that air pollution exposure and commuter stress share the highest composite scores (more than 4/5). This signals urgent need for integrated mitigation straggles. The study discussed some evidence based innovative solutions such as congestion responsive low emission zones, flexible work policies and micro mobility expansion and propose phased implementation to maximize the overall benefits for health, environment and carbon footprint. The study demonstrates how CRA can guide urban mobility policy in rapidly growing cities like Dubai.

KEYWORDS: comparative risk assessment, traffic congestion risks, Dubai Traffic, environment

PAPER ID: cest2025_00345

Odour monitoring as an unconventional tool for sewage sludge management in wastewater treatment plants

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ABSTRACT

The management of sewage sludge generated by wastewater treatment plants (WWTPs) must comply with stringent regulations to prevent adverse impacts. Selecting appropriate sludge treatment is highly dependent on accurate sludge characterization, which traditionally involves comprehensive laboratory analyses of physical, chemical, and biological parameters. These analyses are time-consuming, costly, and do not allow for real-time decision-making. Furthermore, sewage sludge represents one of the main odour emission sources, posing potential nuisances. This research explores the use of odour emission monitoring as a rapid, non-conventional approach for supporting sewage sludge management decisions. To validate the methodology, experimental analyses were conducted on a full-scale WWTP. Sludge samples were characterized through conventional parameters, including chemical oxygen demand (COD) and biochemical oxygen demand (BOD₅). Simultaneously, odorous emissions were quantified in terms of odour concentration, according to EN 13725:2022. The comparison between chemical and sensorial analyses demonstrate statistically significant correlations between odour concentration and key COD and BOD₅ of sewage sludge. The findings suggest that odour monitoring can serve as a practical, rapid, and cost-effective proxy indicator for sludge stability assessment, offering a complementary tool to conventional laboratory analyses. This approach can facilitate timely management decisions, optimize sludge treatment processes, and mitigate odour related impacts.

KEYWORDS: Dynamic olfactometry, Total suspended solids, Odour impact, Biological stability, Environment protection

PAPER ID: cest2025_00185

SESSION 5 - CLIMATE CHANGE ADAPTATION AND RESILIENCE

Thursday 4 September – morning

Climate Change in UAE: Evaluating Mitigation Effectiveness and Social Dimensions in Adaptation Strategies

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ABSTRACT

This study discusses climate change challenges in the United Arab Emirates by evaluating both technical implementation and social equity aspects of adaptation strategies through comparative analysis. The research evaluated greenhouse gas emissions while assessing the effectiveness of major mitigation projects operating in the UAE. The study discussed how the UAE produces 0.5 % of global emissions while maintaining the highest per capita emission rate at 22 to 26t CO₂ per person. The Mohammed Bin Rashid Al Maktoum Solar Park reduces annual CO₂ emissions by 6.5 million tons/year, yet this represents only 2.6% of the UAE's total emissions. The study suggested a qualitative conceptual framework for UAE climate vulnerability including (i) extreme heat and humidity, (ii) urban flash flood, (iii) Coastal storm and sea level rise, (iv) socioeconomic vulnerability, and (v) governance and economic capacity. Thus, more additional measures may be needed in future to cope with increasing heat waves during summer.

KEYWORDS: climate change in UAE, GHG emissions, renewable energy, social equity, adaptation to climate change, vulnerability assessment

PAPER ID: cest2025_00341

Biomass-related issues and potential windfall profits in the European Union Emissions Trading System

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ABSTRACT

Recent European Union Emissions Trading System (EU ETS) legislation amendments elaborate on biomass-related issues, by (1) introducing sustainability and greenhouse gas (GHG) savings criteria (Renewable Energy Directive (EU) 2018/2001; RED II-criteria) applicable in energy production and restricting the scope of the term “biomass” (Commission Implementing Regulations (EU) 2018/2066, (EU) 2020/2085 and (EU) 2022/388) and (2) excluding, during the forthcoming 5-year-long period 2026-2030 and subsequent such ones, stationary installations with GHG emissions mainly (over 95% as a, currently retrospective, preceding 5-year average) from biomass (Directive (EU) 2023/959, relaxing the previously holding 100% provision). Along with broadly planned, on-going decreasing share of free allowances (for GHG emissions) in favor of auctioning, concurrence of the above measures indicates room for windfall profits (contrasting the exclusion rationale) for installations that, being temporarily excluded, would not surrender potentially increased (due to combustion of materials not considered biomass, any more) emission allowances, while being deprived of (potentially curtailed) free ones. Based on the content of an explanatory numerical example in a non-legally binding Guidance Document (provided by the European Commission) on the Interpretation of Annex I (listing regulated activities) in Directive 2003/87/EC (EU ETS Directive), the present work considers issues in the above-mentioned framework, regarding such potential for installations with energy-intensive processes, using biomass-based raw materials and recovering energy from pertinent waste, as in pulp and paper manufacturing. Free allowance and verified emissions data from the (EU ETS-related) European Union Transaction Log combined with Carbon Dioxide emissions data from the European Industrial Emissions Portal (European Environmental Agency) indicate relevance of the above-mentioned, evidently unintended, inconsistency to a small number of pulp manufacturing installations, with potential for manifestation in additional EU ETS installations (especially ones that carry out combustion with rated thermal input exceeding 20 MW, not shielded against Carbon leakage).

KEYWORDS: EU ETS, Free allowances, Biomass, Exclusion, Windfall profits

PAPER ID: cest2025_00102

Author comments

Although the paper content is considered to be valid, an in depth review would hopefully contribute towards eliminating possibilities of inadvertent misinterpretation of provisions of the legislation involved.

Steps to Promote Agrifood Twin Transitions: From Identifying Innovation Paths to Enhancing Future Competencies

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ABSTRACT

Twin transitions aim to address grand challenges, such as climate change and food insecurity, through simultaneous systemic shifts toward more sustainable and digitalized production models. In this work, we present three key steps for supporting twin transitions. The first concerns the determination of the digital technologies that can enhance the process. The second is about anticipating potential futures. The final step involves equipping actors who undergo transitions with key competencies.

KEYWORDS: twin transitions, agricultural digitalization, sustainability, innovation, climate change

PAPER ID: cest2025_00383

Acknowledgment

This study was conducted within the framework of the project “Promoting responsible twin transitions in European agrifood systems through innovation and learning alliances.” The project is funded by the European Union through the Erasmus+ program (Grant number: 101187101)

Urban settlements adaptation. Measures for neighbourhood plans

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ABSTRACT

Urban areas are particularly vulnerable to climate change due to the presence of a high proportion of population, economic activities, real estate and water, energy and transport infrastructure; extreme weather events climate events such as heavy rainfall, droughts and heat waves, cause impacts whose severity varies according to local vulnerabilities, thus putting the health and safety of inhabitants at serious risk. Faced with these growing risks, cities are increasingly looking to adaptation as an integral part of urban development to increase resilience to climate change and promote urban sustainability. Undoubtedly, urban planning processes can effectively address climate adaptation objectives by incorporating a multi-dimensional approach. They can link adaptation policies with local transport, biodiversity and health-related policies to determine the scale, mix and design of development to ensure resilience to climate impacts. As part of an ongoing research project, the contribution aims to investigate solutions that can be used at the neighbourhood scale to support climate resilience. In particular, it focuses on neighbourhood-scale developments, incorporating principles such as mixed land use, social diversity and the creation of green spaces to address climate challenges. It then considers solutions for sustainable urban drainage such as watersquare, water collection and reuse system and permeable surfaces. Acting on adaptation targets, the research aims to promote efficient use of urban space.

KEYWORDS: Climate change, adaptation, urban planning

PAPER ID: cest2023_00037

EU Climate Law, Recovery and Resilience Policy: Outcomes for Greece First Energy Transition Steps

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ABSTRACT

In view of the fast energy transition implementation, communities depending on fossil fuel exploitation activities are facing structural economic disruptions. This is the case for West Macedonia (W.M.) and Megalopolis (central Peloponnese) regions in Greece, which are severely affected by the rapid decommissioning of lignite-based power stations. Also, the North and South Aegean (N&S A) Non-Interconnected Islands (NIIs), traditionally relied on Autonomous Power Stations (APS) for covering their electricity needs, operating on oil products, are going to face also the consequences of the implementation of zero-carbon energy policy. This study supports the argument that financial and regulatory boosts build resilience only if they are providing reliable and solid prospects for the post-carbon local economy, while the gradual (and not violent) abandonment of fossil fuels utilization, serving as bridge towards a low-carbon economy, may be a realistic option for the near future.

KEYWORDS: Regulatory Framework, Decarbonization, Energy Policy, Electricity Generation, Vulnerable Area

PAPER ID: cest2025_00201

Acknowledgement

This research has been funded under the Investment Support Action: Resilience, Inclusiveness, and Development: Towards a Just Green and Digital Transition of Greek Regions – TAEDR-0537029

Innovative Energy Projects and Policies for the Energy Transition of Small Greek Islands

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ABSTRACT

Many islands around the world, particularly Non-Interconnected Islands (NIIIs), use oil products to meet their electricity needs. Several of these islands enjoy excellent renewable energy potential. This potential of NIIIs encourages actions to maximize the integration of Renewable Energy Sources (RES) as part of the energy transition (ET) process. Furthermore, community-based renewable energy projects and equitable access to energy for citizens are critical issues on the global political agenda to support ET, especially at the local level. Sustainable ET for NIIIs is a challenging task. Technological, economic, social, regulatory and environmental issues arise during the process. The issues of respecting the cultural heritage and natural beauty of the islands, addressing insularity and national security problems create a complex field. In addition, the decentralization of the electricity system constitutes the greatest technical challenge for islands' energy supply. The current research work examines innovative projects related to the ET of Greek small NIIIs. A framework according to energy transition indicators is developed, in order to study the results at the local level. Using the experience obtained by the analysis presented, one may schedule and implement socially acceptable and successful ET projects in the context of the GR-eco islands initiative.

KEYWORDS: Climate Change, Green House Gases, Social Acceptance, Renewable Energy Sources

PAPER ID: cest2025_00204

Acknowledgments



The research work was supported by the Hellenic Foundation for Research and Innovation (HFRI) under the 3rd Call for HFRI PhD Fellowships (Fellowship Number:6824).

Nature-based Solutions: evolution through time in the Mediterranean Basin

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ABSTRACT

The Mediterranean basin may be one of the few bioregions on earth where the steep environmental gradients and the biota are so tightly intermixed and interrelated within diverse ecological niches, ecosystems and landscapes. However, several natural or human-induced challenges threaten this unique ecosystem, such as climate change, exacerbating droughts, habitat and biodiversity losses. Nature-Based Solutions (NbS) represent a new concept, including old and new practices (i.e., green roofs), inspired by nature in harmony with humans to face contemporary societal and environmental challenges. EU-funded projects such as the DRYAD aim to bring upfront, upscale and highlight such practices in Mediterranean agroecosystems. This article presents a literature review on NbSs since 2000 with special emphasis on the Mediterranean basin.

KEYWORDS: climate change, DRYAD, environment, water

PAPER ID: cest2025_00273

Acknowledgment

This research was performed within DRYAD Project, funded by the European Union's Horizon Europe research and innovation program under grant agreement 101156076

From site-specific to the next day: transferring local knowledge to climate resilient management – NECCA paradigm

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ABSTRACT

Constructive local participation is crucial for the effective governance of protected areas (PAs) in Greece, for which NECCA is the competent authority. In the framework of the H2020 ARSINOE project, NECCA has conducted workshops in the area of Prespa Lakes, focusing on climate adaptation challenges in water resources management, attended by stakeholders representing all environmental, economic and social sectors related to water use. Common mental mappings of the issues discussed led to drafting innovation pathways that generated important insights into the complex interconnections between various domains, the areas where intervention is required, as well as local community equilibria. Although current work focuses on the Prespa Lakes case, its scope can be extended to address the needs of “the next day” for NECCA. Successful transfer of gained experience and knowledge can enhance the management of protected areas with similar ecosystem characteristics and challenges. These methods could be used both for the Local Management Committees (LMCs) as well as the informal engagement of local stakeholders, ensuring regular monitoring and input to common expectations for shaping climate resilience.

KEYWORDS: Protected Areas, ecosystems services, participatory processes, stakeholders, Prespa Lakes

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Acknowledgment:

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SESSION 6 – PLENARY SESSION

Thursday 4 September – morning

Climate Law implementation: challenges and barriers

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ABSTRACT

European Climate Law (ECL), adopted by the European Union in 2021, set the ambitious goal for climate neutrality by 2050 for EU countries, aiming to ensure that all EU policies contribute to zero net carbon emissions and all sectors of society and economy are involved (ECL, 2021). Towards this direction the Greek national climate law enacted in 2022, provides a coherent framework for improving Greece's adaptive capacity and climate resilience. Its main scope is to ensure the transition to climatic neutrality by 2050 and adaptation to climate change, in an environmentally sustainable, socially just and cost-effective way. Present work focuses on the implementation of the climate law in practice, examining its alignment with the European Climate Law mainly on adaptation and resilience and the tools provided by Natural Environment and Climate Change Agency (NECCA) to support it.

KEYWORDS: Climate neutrality, participatory processes, adaptation and mitigation actions

PAPER ID: cest2025_00478

SESSION 7 - WASTEWATER TREATMENT (2)

Thursday 4 September – morning

Design and Evaluation of a Scalable Shock Wave Electrodialysis with Multi-Cell Stack for Efficient Desalination

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ABSTRACT

Shock Wave Electrodialysis (SWED) is an innovative separation technology that integrates microfluidic principles into electrodialysis stacks, pioneered by MIT's Bazant Research Group. By operating under over-limiting current conditions, SWED enhances ion separation through the formation of shock waves in charged porous media. While previous studies have focused on small, single-cell devices, scaling SWED for industrial use requires the development of multi-cell stacks. In this study, we present the first scalable SWED device with multiple cell pairs, designed for desalination. The system features an active membrane area of 4000 mm² and a flow rate of 2.5 mL/min—offering over ten times the capacity of earlier models. Experimental results show continuous salt rejection exceeding 90%. Energy consumption is about 46 kWh/m³ depending on operating conditions and stack design. We also explore strategies to optimize the trade-off between separation efficiency and energy use, based on data from performance, water recovery, and energy metrics. This work represents a significant step toward realizing SWED as a practical, energy-efficient solution for large-scale water treatment and resource recovery.

KEYWORDS: Electrokinetics, Desalination, Ion separation, Limiting current, Ion concentration polarization

PAPER ID: cest2025_00285

Exploitation of industrial wastewater streams through bipolar electrodialysis for NaOH and HCl production

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ABSTRACT

In recent decades, the production of saline wastewater has increased significantly as various industries, including tanneries, the food industry, oil and gas, and pulp and paper, contribute to its generation (Alam et al., 2022). However, saline wastewater can have a negatively impact on coastal ecosystems and the microorganisms employed in wastewater treatment plants. Therefore, the EU has adopted strict disposal regulations and the Scientific Committee has focused its research efforts on methods to utilize this wastewater that align with the EU's circular economy strategy. Bipolar Electrodialysis (BED) is an innovative separation process in which electricity drives the exchange of anions (Cl⁻, SO₄²⁻, etc.) and cations (Na⁺, K⁺, etc.) through positively and negatively charged membranes, respectively, whereas bipolar membranes (BPM) are applied with the aim to split H₂O molecules into H⁺ and OH⁻, enabling the production of alkaline and acidic solutions from saline wastewater. In this study, a bipolar electrodialysis system (BED) was used to produce NaOH and HCl from saline wastewater, originated from a pulp & paper industry and a steel industry, as well. Initially, a two-chamber BED system (BED1-2, PCCELL GmbH) was employed to evaluate the performance of commercial cation (CEM) and anion exchange membranes (AEM) with respect to the production of NaOH and HCl from synthetic NaCl solutions. Subsequently, the primary operating parameters of the process were optimized and finally, the BED1-2 system was scaled up to a three-chamber system (BED1-3), in which the simultaneous production of HCl and NaOH from synthetic and real wastewater was examined. This work was performed in the context of the CORNERSTONE project that received funding from the European Union's Horizon Europe Research & Innovation framework programme under Grant Agreement No 101138504.

KEYWORDS: bipolar electrodialysis, cation exchange membranes, anion exchange membranes, effluent valorization, NaOH and HCl production

PAPER ID: cest2025_00258

Anaerobic/Aerobic Membrane Bioreactors for Wastewater Treatment of Pulp and Paper Industry

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ABSTRACT

The pulp and paper (P&P) industry consumes significant amounts of fresh water and produces wastewater that should be treated effectively to minimize environmental impact. Conventional treatment methods based on aeration and sedimentation tanks are energy-intensive and pose a serious environmental problem. Membrane bioreactors (MBR) are a promising and efficient treatment technology. Therefore, this study focuses on the treatment of wastewater streams from the pulp and paper industry using a laboratory pilot unit with an integrated anaerobic and aerobic membrane bioreactor (an/ae MBR) unit. Experimental tests were conducted to determine the optimal operating conditions and evaluate process efficiency by determining the physicochemical properties of feed and permeate streams and estimating the biogas production rate and its composition. The results of a six-month demonstration phase of the an/aeMBR pilot unit showed an overall promising system performance. Despite the significant differences in feed stream characteristics, the an/ae MBR unit showed high organic load removal (>94% in the anMBR and ~99% overall of the integrated an/aeMBR unit), resulting in water suitable for safe disposal or reuse. In addition, complete removal of suspended solids was achieved thanks to the ultrafiltration membranes (turbidity removal efficiency >99%). The biogas production rate was continuously increased up to 480 ml/day, keeping the methane content high and approaching about 70% v/v, while the methane production capacity was in the range of 0.02–0.16 Nm³/Kg COD. Finally, a chemical cleaning of the UF membranes was performed during the laboratory tests for both membrane bioreactors to restore their original permeability.

KEYWORDS: ultrafiltration, anaerobic membrane bioreactor, aerobic membrane bioreactor, biogas production, pulp and paper industry, wastewater treatment

PAPER ID: cest2025_00262

Effect of Iron(II) on Nickel Removal via Fluidized-Bed Homogeneous Crystallization Technology

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ABSTRACT

This study determines the effect of Iron(II) on the granulation and removal of Nickel(II) using Fluidized-Bed Homogeneous Crystallization (FBHC), an innovative technology for metal recovery from wastewater. A face-centered Box Behnken Design was employed to evaluate the effects of three key variables: Carbonate-to-Nickel(II) molar ratio (1.5–2.0), pH (8.5–9.5), and Iron(II) concentration (0.36–1.07 mM). Nickel, a highly regulated heavy metal due to its toxicity and potential for bioaccumulation and biomagnification, was simulated in a synthetic wastewater system and operated for 168 hours per run, with a flow rate of 20 mL/min and a reflow rate of 60 mL/min. Atomic Absorption Spectroscopy (AAS) was used to quantify Nickel and Iron removal and granulation efficiencies. Results indicate that increasing Iron(II) concentration slightly enhances both Nickel removal efficiency (from 94% to 96%) and granulation efficiency (from 92% to 93%), likely due to Iron providing additional active sites that facilitate Nickel precipitation. Similarly, increasing the carbonate-to-Nickel molar ratio improves Nickel removal (93–96%) and granulation (92–94%) by increasing the availability of carbonate ions essential for crystallization. Furthermore, increasing pH levels increases the availability of carbonate and hydroxide species, leading to higher Nickel removal (90–98%) and granulation efficiencies (88–93%). X-ray Photoelectron Spectroscopy (XPS) analysis confirmed the oxidation states of the metals, with Nickel primarily existing as Ni(II) and Iron oxidized to Fe(III). Scanning Electron Microscopy (SEM) revealed that the presence of Iron disrupts the crystallinity of the precipitates.

KEYWORDS: Nickel, Iron (II), Carbonate, Molar Ratio, pH, Fluidized-bed homogeneous crystallization process

PAPER ID: cest2025_00277

Nanofiltration for the Treatment of Bleaching Effluents from the Pulp and Paper Industry: A Case Study

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ABSTRACT

The present study explores the application of commercial nanofiltration (NF) membranes for the treatment of bleaching effluent from the pulp and paper (P&P) industry, within the framework of the RESURGENCE project, funded by the European Union's Horizon Research and Innovation Programme (Grant Agreement No. 101138097). The P&P industry is a major user of water, generating effluents characterised by high organic load, elevated temperature, intense colour, and the presence of priority pollutants, all of which pose significant environmental risks. The NF process was evaluated using a lab-scale plate-and-frame membrane unit operated in full recirculation mode. Three different commercial membranes were tested under identical conditions ($P = 10$ bar, fixed temperature, 4-hour filtration time). The results demonstrate stable permeate flux and promising separation performance, with colour removal exceeding 99%, COD reduction above 85%, and retention (or partial retention) of key pollutants such as Cl^- and Ca^{2+} . This is particularly relevant in the context of water reuse within the industrial process. These findings confirm the potential of NF membranes for advanced industrial wastewater treatment, enabling both improved effluent quality and the potential for water reuse, thereby reducing the environmental impact and freshwater demand in the P&P sector.

KEYWORDS: P&P industry, nanofiltration membrane, industrial wastewater treatment, water reuse.

PAPER ID: cest2025_00315

Acknowledgements: This work was funded by the European Union through the project RESURGENCE - Embracing Circularity in Industrial Water Use, Grant Agreement N. 101138097.

Analysis of the PFAS treatment, regulation and experimental investigation

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ABSTRACT

PFAS, which stands for Per- and Polyfluoroalkyl Substances, are a group of human-made chemicals that have been used in a wide range of products for their water- and grease-resistant properties. These chemicals have been used in products like non-stick cookware, water-repellent clothing, food packaging, and in firefighting foams. They are often referred to as "forever chemicals" because they do not break down easily in the environment. Incineration process represents a valid solution for Per and Poly-FluoroAlkyl Substances (PFAS) treatment. In this work a comprehensive investigation was conducted to analyze the temporal evolution of limits established for Perfluoroalkyl Substances (PFAS) in various environmental matrices and the actual treatment possibilities. After this using a laboratory-scale bubbling fluidized bed combustor running at 850°C, the study examines the thermal degradation of PFAS during the incineration process of civil sludge from a municipal wastewater treatment plant. The research achieves heightened analytical sensitivity by using samples of sludge spiked with a known PFAS combination. This allows for a thorough assessment of PFAS combustion efficiency. Initial findings clarified the distribution of fluorinated compounds in the combustion leftovers, providing insight into the processes by which PFAS are degraded during incineration.

KEYWORDS: PFAS, sewage sludge, combustion, wastewater, incineration

PAPER ID: cest2023_00133

Performance of sequencing batch reactors for the treatment of high ammonium concentration landfill leachate

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ABSTRACT

The contaminated liquid produced from rainfall seeping through the layers of waste in domestic landfill sites is known as leachate. Leachate from landfills is high in nitrogen content, mostly as ammonium, and is typically disposed of by transportation to a domestic wastewater treatment plant at a cost. Sequencing batch reactors (SBR) are compact fill-and-draw activated sludge systems that facilitate treatment in a singular reactor, including ammonium removal through nitrification. This study examines the viability of on-site SBRs nitrifying the high ammonium concentrations found in landfill leachate in New Zealand instead of transportation off-site. Two 1 litre volume SBRs were operated for over 6 months with increasing concentrations of ammonium in the feed to determine ammonium removal. The reactors achieved significant ammonium removal at influent ammonium loading as high as 720 mg/L. pH control was required at higher influent ammonium loadings above 300 mg/L to prevent inhibition of the nitrifying bacteria by acidification. These results suggest that onsite SBR system can be made a viable option for leachate treatment in New Zealand.

KEYWORDS: landfill leachate, sequencing batch reactor, ammonia, nitrification

PAPER ID: cest2025_00333

Adsorption of Ciprofloxacin by Sugarcane Bagasse Activated Biochar in Aqueous Solution

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ABSTRACT

Antibiotics such as ciprofloxacin (CIP) in wastewater pose a significant and pressing concern as an emerging contaminant. Conventional wastewater treatments are not optimized to effectively remove antibiotics, resulting in their persistence in bodies of water and significantly contributing to a global health threat, antimicrobial resistance (AMR). This study investigated the potential for removing CIP from aqueous solution through adsorption using phosphoric acid (H₃PO₄) activated biochar derived from sugarcane bagasse (SBAB). The removal percentage of CIP reached 45.37% at an equilibrium time of 60 minutes with a 0.8 g L⁻¹ SBAB and an initial CIP concentration of 25 mg L⁻¹. The experimental equilibrium capacity, q_e is 14.45 mg g⁻¹. The adsorption kinetics followed the pseudo-second order (PSO) model, which primarily assumes chemisorption, with a q_e of 14.68 mg g⁻¹. The Freundlich isotherm best describe the adsorbent-adsorbate relationship, suggesting a multilayer adsorption process. The SBAB will be used to produce 3D-printed adsorbents, which will be installed in a laboratory-scale packed-bed adsorption column.

KEYWORDS: Emerging Contaminants of Concern, Ciprofloxacin, Antimicrobial Resistance, Activated Biochar, Adsorption

PAPER ID: cest2025_00395

Acknowledgement

This research is funded by the Department of Science and Technology – Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD). It is under the program titled “Detection, Treatment, and Detoxification System for Emerging Contaminants of Concerns in Wastewater (DETOXS)” with project number 11224.

SESSION 8 - ENERGY RECOVERY FROM WASTE

Thursday 4 September – morning

Turning Plastic Waste into Power: Pyrolysis for Sustainable Industrial Energy

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ABSTRACT

The research describes the creation of a basic pyrolysis system which industrial facilities can use to generate energy from their plastic waste. The system transforms 360 tons of plastic waste yearly into 160 tons of synthetic pyrolysis oil which powers a Combined Heat and Power (CHP) system. The annual production of this process reaches 500 MWh of electricity together with 60 MWh of heat. The transformation of waste into energy relies heavily on pyrolysis which functions as a thermochemical process that converts plastic waste into refined pyrolytic oil ready to use in diesel generators. The research describes an economic investment approach of a unit which works for Small and Medium-sized Enterprises (SMEs) with potential annual revenue of up to €45,000 yearly through net metering. The system operates as a self-sustained waste-to-energy system which promotes circular economy principles through material recycling into energy products. The study proves that industrial pyrolysis-based CHP systems are both environmentally sound and economically viable, which leads to energy sustainability and resource management.

KEYWORDS: Pyrolysis, Energy Autonomy, Plastic Waste, Combined Heat and Power, Circular Economy

PAPER ID: cest2025_00374

Optimized hydrodynamic cavitation-based Pretreatment Strategies to enhance residual Biogas Yield from Solid Digestate and Struvite Recovery from Liquid Fraction

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ABSTRACT

Digestate valorisation is essential for improving the sustainability and efficiency of anaerobic digestion systems. This study explores an integrated approach combining hydrodynamic cavitation (HC) pretreatment of the solid fraction with struvite precipitation from the liquid fraction to enhance energy and nutrient recovery. Solid and liquid fractions of digestate were separated and processed independently. HC pretreatment of the solid fraction significantly improved biochemical methane potential (BMP), increasing methane yield by over 95% and reducing the lag phase during anaerobic digestion. Kinetic modeling indicated accelerated biodegradation rates, and the energy output from additional methane production exceeded the input required for cavitation, confirming the process as energy positive. In parallel, the liquid fraction was subjected to struvite precipitation by adjusting pH and dosing magnesium chloride. The precipitate was characterized using X-ray diffraction and scanning electron microscopy, confirming the formation of crystalline struvite with high purity. Nutrient recovery efficiencies exceeded 80% for both ammonium and phosphate. A mass and energy balance revealed that the integrated HC and struvite processes achieved efficient conversion of residual organics into biogas and dissolved nutrients into fertilizer. The results demonstrate a feasible and scalable strategy for digestate valorization, offering a dual benefit of enhanced biomethane recovery and nutrient recycling. This approach contributes to the circular economy and improves the sustainability of biogas plants.

KEYWORDS: Digestate valorization, hydrodynamic cavitation, struvite precipitation, residual biogas enhancement

PAPER ID: cest2025_00392

Microwave plasma pyrolysis for the valorization of VFA extracts from HTC process water

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ABSTRACT

Volatile fatty acids (VFAs) in HTC liquors are a promising but underutilized resource for energy production. This study examines the recovery of VFAs from HTC process water via liquid–liquid extraction and the co-pyrolysis of the recovered stream with methane in a microwave plasma reactor to produce syngas. Experimental analysis at the HYDROPYR pilot of the BioFairNet project, has provided the real VFA composition in the HTC liquor. The experimental results are used as input in a newly-developed thermodynamic model (implemented in MATLAB-Cantera) and simulation were performed for 1000–2500 K. The model results at 1500 K, simulate syngas production with >99.9 mol% of H₂/ CO in the gaseous phase, and the simultaneous production of carbon black. Ongoing work will incorporate reaction kinetics and techno-economic analysis to inform scale-up for municipal wastewater-treatment applications.

KEYWORDS: Waste-to-Energy; HTC; Plasma Pyrolysis

PAPER ID: cest2025_00431

Modelling of Hydrogen Generation from Woody Biomass in a Novel Modular Downdraft Gasifier–WGS–PSA System

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ABSTRACT

An advanced model was developed in Aspen Plus to simulate and optimize hydrogen-rich syngas production from a PP30-scale downdraft biomass gasifier integrated with Water-Gas-Shift (WGS) and pressure-swing adsorption (PSA). The adiabatic model combines equilibrium RGibbs blocks with corrective RStoic char–gas reactions and was validated against four independent experiments, predicting H₂ and CO within ± 1 % error. Sensitivity analysis identified an optimum “window” of T_{pyrol} at 700 °C, T_{gas} at 900 °C, and equivalence ratio of 0.25, which double H₂ molar fraction to 40 wt % after a two-stage WGS system (S/C = 3, T_{LT} = 200 °C). Replacing air with pure O₂ as the gasifying agent effectively eliminates N₂ dilution, increasing H₂ concentration to 59 wt % raising the LHV from 4.5 to 6.7 MJ Nm⁻³. A dual-column, four-step PSA (P_{ads} = 9.8 bar) delivers 98 % purity at 56 % recovery, while halving the purge stream improves recovery to 64 % with negligible purity loss. The combined interventions provide a realistic pathway for decentralized, biomass-derived clean hydrogen production, which competes with electrolysis on energy density and cleanup requirements. Future work will automate methane correction within Aspen and extend the flowsheet for full techno-economic assessment.

KEYWORDS: Biomass gasification; Downdraft gasifier; Hydrogen production; Aspen Plus modelling; Water-Gas Shift

PAPER ID: cest2025_00463

The synergistic effect of H₂ injections and applied potential on biogas production during the treatment of industrial potato processing wastewater in a Microbial Electrolysis Cell-assisted Anaerobic Digestion system

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ABSTRACT

This study deals with the synergistic effect H₂ supply and applied potential, during the treatment of industrial potato processing wastewater in a Microbial Electrolysis Cell-assisted Anaerobic Digestion (MEC-AD) system, in order to enhance the quality of the produced biogas. The MEC-AD reactor was equipped with carbon felt electrodes and operated for 80 d at a constant Hydraulic Retention Time of 15 d. The results showed that when H₂ was supplied in excess, the MEC-AD reactor failed, due to the inhibition of hydrolysis, acid accumulation, pH increase and enrichment of hydrogen sulfide producing bacteria. Nevertheless, when H₂ was supplied through saturating the feed, the reactor operated stably, leading to a COD removal of 92.6% and exhibited enhanced biogas quality, producing a CH₄:CO₂ ratio of 2.9, relative to 1.1 when no H₂ was supplied. Overall, the combined effect of hydrogenotrophic methanogenesis and electromethanogenesis represents a promising strategy for enhancing biogas quality, while simultaneously enabling the synergistic integration of bioelectrochemical and anaerobic processes to mitigate failure mechanisms associated with elevated H₂ partial pressures.

KEYWORDS: Applied potential; Bio-electrochemical systems; Electromethanogenesis; Hydrogen; MEC-AD

PAPER ID: cest2025_00098

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A Microbial Electrolysis Cell-assisted Anaerobic Digestion process for enhanced treatment of industrial potato processing wastewater

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ABSTRACT

This study deals with the treatment of an industrial potato processing wastewater, using a Microbial Electrolysis Cell-assisted Anaerobic Digestion (MEC-AD) system. For this purpose, two identical reactors were constructed, a control (AD) and a MEC-AD reactor. The MEC-AD reactor consisted of three anodic and three cathodic carbon felt electrodes. Both reactors operated for 160 d at a constant Hydraulic Retention Time of 15 d, whereas the effect of the applied voltage was evaluated on organic load degradation and biomethane production. The results showed that the MEC-AD reactor achieved increased particulate organic content degradation by 0.02 gCOD/(L d), and the increased hydrolysis rate of organic content led to a tenfold increase in the biogas production of the MEC-AD (0.2 L/d relative to 0.02 L/d for the AD). Furthermore, the MEC-AD demonstrated enhanced biogas quality (average CH₄ content being over twice that of the AD), as well as mitigation of hydrogen sulfide producing bacteria which are antagonistic to methanogens. The results showed that the MEC-AD reactor outperformed the AD, achieving enhanced waste treatment and higher CH₄ yield.

KEYWORDS: Bio-electrochemical systems; Carbon electrodes; Electromethanosynthesis; MEC-AD

PAPER ID: cest2025_00096

Acknowledgements: The research project “GREENUPGRADE: Valorization of green energy for enhancing the robustness and upgrading the performance of anaerobic digestion systems (61401400)” is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union – NextGenerationEU (H.F.R.I. Project Number: 15522).

Biohydrogen production through dark fermentation of organic waste: evaluation of pretreatment methods

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ABSTRACT

Pretreatment of organic substrates is a critical step in enhancing the efficiency of biological hydrogen (bioH₂) production via dark fermentation. This research presents and discusses the effects of different pretreatment methods on a selected substrate, spent coffee grounds (SCGs), aiming to evaluate their influence on hydrogen yield and productivity. In addition to a control condition referred to as "non-pretreatment," all tested substrates underwent preliminary size reduction and dilution as standard treatments. The study investigates and compares the application of chemical agents (acid hydrolysis with H₂SO₄) and physical processes (ultrasound). The results show a significant influence of pretreatment on substrate biodegradability and hydrogen production. Surprisingly, the highest cumulative hydrogen volume (~280 mL H₂) was observed for the non-pretreated substrate, suggesting that the combination of size reduction and dilution alone was sufficient to enable efficient fermentation. The ultrasound-treated substrate demonstrated faster kinetics and an earlier peak in hydrogen production, though with a slightly lower total volume (~240 mL H₂). Conversely, acid hydrolysis resulted in poor hydrogen yields, likely due to the formation of inhibitory by-products or limited hydrolysis efficiency under the tested conditions. These findings highlight that not all pretreatments enhance biohydrogen production: in some cases, mild or no pretreatment may outperform more aggressive methods. The results underscore the importance of tailoring pretreatment strategies based on the specific substrate characteristics and process goals, providing valuable insights into sustainable hydrogen production from organic residues.

KEYWORDS: biohydrogen, nutrient availability, pretreatments, residual biomass valorization, substrate biodegradability

PAPER ID: cest2025_00193

A Metal-Assisted Circular System for CO₂ Utilization and Methane Enhancement in Anaerobic Digestion

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ABSTRACT

This study presents a waste-to-energy strategy that integrates CO₂ capture and biological methanation, contributing to renewable energy production from waste streams. The system combines zero-valent iron (ZVI) and anaerobic granular sludge (AnGrSl) to biologically convert CO₂ to CH₄ under mild conditions. Sodium bicarbonate (NaHCO₃), formed via CO₂ absorption in NaOH, enhances both buffering and soluble carbon availability, facilitating microbial uptake and methanogenesis. Two ZVI dosing strategies were tested: a single 50 g/L dose and a staggered 10 g/L × 4 addition. Results showed that the one-time high-dose maintained consistent CH₄ yields, while staggered additions showed initial gains but limited long-term performance. The process supports a closed-loop cycle by regenerating NaHCO₃ through re-flushing the NaOH solution with CO₂, making it a promising example of circular bioenergy production. This system exemplifies environmental biotechnology by enhancing methane yields through microbial and chemical synergy. Its low-energy demand and resource recovery potential make it well-suited for decentralized applications in wastewater and sludge treatment. The process aligns with circular economy principles and climate action by converting captured CO₂ into renewable methane, reducing emissions while producing valuable energy.

KEYWORDS: CO₂ utilization, methane, biogas upgrading

PAPER ID: cest2025_00473

Valorization of Sewage Sludge through Hydrothermal Carbonization for the Synthesis of Zinc Oxide Nanoparticles

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ABSTRACT

Hydrothermal carbonization (HTC) is an effective treatment method for sewage sludge, enabling the recovery of valuable metals such as zinc. This study investigates the effect of HTC on zinc partitioning between the solid and liquid phases at two temperatures (180°C and 200°C) and two reaction times (1 and 2 hours). The results indicate that increasing the temperature and prolonging the reaction time enhance zinc dissolution in the liquid phase, although a significant portion of zinc remains in the solid phase. Notably, the solid concentration is higher at 200°C compared to 180°C, suggesting that higher temperatures facilitate greater zinc retention in the solid matrix. ANOVA results confirmed that both temperature and time significantly influence zinc partitioning, with p-values below 0.0500 for main effects and their interaction. These findings highlight the potential of HTC to optimize zinc recovery from sewage sludge while reducing waste volume, contributing to more sustainable sludge management practices.

KEYWORDS: hydrothermal carbonization, zinc recovery, sewage sludge, solid-liquid partitioning, HTC valorization

PAPER ID: cest2025_00276

SESSION 9 - ENVIRONMENTAL MANAGEMENT AND POLICY

Thursday 4 September – morning

Bridging the gap between sustainability and engineering: Challenges and Perspectives

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ABSTRACT

Engineering is the driving force for sustainable development, a vital element for quality of life and longevity of humanity. Sustainability presupposes economic development by ensuring both compliance with environmental standards and social cohesion. Closing the loop between sustainability and engineering, thus promoting the concept of Sustainability Engineering (SusEng), involves integrating sustainable alternatives/solutions into engineering design, processes, and application in order to address environmental, social, and economic challenges simultaneously. On this basis, SusEng focuses on the development of practical solutions to promote sustainable development i.e. circularity of resources for sustainability, thus it depicts a strong practical dimension. However, these practical solutions need to be the output of an equilibrium between economic, environmental and societal considerations, thus SusEng needs a balanced decision support making towards consensus and realistic implementation of the practical solutions promoted.

Addressing and balancing environmental, social, and economic challenges simultaneously is based on sustainable design. This is the main future perspective for the research community to bridge the gap between sustainability and engineering and it is characterized by a decalogue (ten commandments): to promote, support and if possible maximize (i) environmental friendliness, (ii) rational use of resources, (iii) renewability, (iv) processes interconnectivity, (v) life cycle thinking and assessment, (vi) assembly to disassembly, (vii) sustainable costing (both internal and external costs), (viii) optimal time of life cycle, (ix) preventive waste management and (x) social benefits. However, the research society has to overcome important challenges in order to achieve the engineering framework transformation, from traditional engineering's focus on economic efficiency and technical solutions to a more holistic approach that considers the social and environmental consequences of engineering ventures. Main challenges to overcome are the lack of interdisciplinary amalgamation, the tools and approaches to balance economic, environmental and societal considerations and the lack of information to deploy holistic approaches, especially when Life Cycle Assessment is adopted. By addressing these challenges, view them as opportunities and embracing the decalogue of perspectives, engineering can play a vital role in creating a more sustainable future. On this basis, the “tale of two fields” may have a parallel happy end, both for engineering transformation and sustainable development.

KEYWORDS: Sustainability Engineering, circularity, resources, decalogue, engineering transformation, sustainable development

PAPER ID: cest2025_00460

The correlation of NEP scale score to energy consumption attitudes

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ABSTRACT

Climate change is one of the most important issues of the contemporary world. The main reason of the phenomenon seems to be the greenhouse gases, a high quantity of which are due to energy production by using fossil fuel either for domestic use or transportation of the public. Scope of this research is to investigate the correlation of the “ecological” opinions, attitudes and practices according to answers for the New Ecological Paradigm (NEP) scale, to the energy consumption habits and practices of Cypriots for domestic use like air-conditioning, cooking and lighting as well as for transportation. A structured questionnaire was used to collect answers by a sample that was selected by implementing the non-random convenient sampling method. A statistical analysis was used in order to investigate if there is a relationship between environmental awareness of Cypriots and their relevant NEP scale score and the energy consumption habits and practices that they follow at their home and when they move either for business or personal reasons. The findings of this work will be useful for policy making, while the need for further education of the public for environmental and energy sustainability issues will also be evaluated and further research opportunities will be identified.

KEYWORDS: NEP scale, energy planning, energy consumption, energy conservation, environmental attitude.

PAPER ID: cest2025_00041

Impacts of Quarry Blasting on Water Sustainability: Assessment of Social Acceptability in the Municipalities of Camalig and Guinobatan, Albay

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ABSTRACT

Quarry blasting is perceived as a risk to groundwater sustainability by rural communities in Camalig and Guinobatan, Albay, Philippines. The Ibalong Resources and Development Corporation (IRDC) has conducted blasting operations since 2013 across three quarry sites. As many residents rely on deep wells, often shared by multiple households, concerns arise over potential groundwater depletion and contamination linked to these activities. The problem of water sustainability can be addressed through a preliminary assessment to evaluate the extent of the negative effects of blasting activities on the deep well groundwater levels near the quarry sites as perceived by the community. Survey tools and spatial analysis methods using Quantum Geographic Information System (QGIS) and GeoDa were used to assess local concerns. Results show that 51.6% of respondents observed no change or decline in their groundwater levels during blasting. Still, 38.5% perceived negative impacts, with 48.4% linking effects to blasting vibrations. Despite these concerns, spatial analyses—including z-tests, Moran's I, and regression—revealed no significant clustering or correlation between well proximity to the quarry and perceived water level changes. While there appears to be no measurable impact of blasting on groundwater levels, shared wells remain points of vulnerability. The reported presence of unusual substances like worms and sand, believed by locals to be caused by blasting, underscores the need for deeper investigation. These findings highlight the importance of considering water sustainability and equitable access in environmental management, particularly where communal groundwater sources are involved. Further research into hydrogeological variation, well construction, and seasonal patterns is essential to fully understand and safeguard water resources in quarry-affected areas.

KEYWORDS: quarry blasting, water sustainability, social acceptance, spatial analysis

PAPER ID: cest2025_00158

Assessment and Mapping of the Drainage Status of Ireland's Peatlands

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ABSTRACT

Peatlands are an important part of ecosystems that provide benefits for biodiversity conservation, water regulation, and carbon sequestration. However, human activities such as land drainage, peat extraction, and agricultural conversion have significantly degraded these peatlands. This degradation has transformed peatlands from carbon sinks into sources of greenhouse gas emissions, mainly when converted to grasslands. In alignment with the EU Paris Agreement to reduce greenhouse gas (GHG) emissions, various initiatives have been implemented to manage, restore, and monitor emissions from Ireland's peatlands. A lack of comprehensive information about peatland drainage conditions poses a challenge for accurately mapping Ireland's peatland. This research accesses and maps the peatland's drainage status (shallow or deep) through remote sensing technology (i.e., drones), on-field vegetation surveys, and hydrological monitoring. The peatland site was surveyed to assess and map the vegetation and drainage changes. Peat depth and scorecard results classified the site fields in terms of wet vegetation species and hydrology. The outcome of the research gives baseline to indicate peatland site shallow or deeply drained based on drone and on field surveying.

KEYWORDS: Peatlands, Drainage Status, Remote Sensing, Peatland Vegetation, GHG emissions

PAPER ID: cest2025_00123

Acknowledgement

This research project is funded by the Department of Food, Agriculture, and the Marine (DAFM), Ireland, and the Environmental Protection Agency (EPA), Ireland.

Restoration and protection actions of the Priority Habitat 9370* “Palm groves of Phoenix” in Crete - LIFE PHOENIX

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ABSTRACT

Endemic palm groves of the *Phoenix* genus in Europe form vital natural and semi-natural ecosystems with exceptional ecological and socio-economic significance. These unique habitats are found only in Spain (*Phoenix canariensis*) and Greece (*P. theophrasti*). Their rarity has led to their inclusion in Annex I of the EU Directive 92/43 and their designation as Priority Habitat 9370*, “Palm groves of Phoenix,” with just 53 Natura 2000 (N2K) sites allocated for their conservation at the EU level.

Both species, face similar conservation challenges. Key threats include the impacts of climate change, pest infestations, and Invasive Alien Species (IAS). Additionally, region-specific issues arise from human activities: in Gran Canaria, past poor practices have led to hybridization with *P. dactylifera*, while in Crete, overgrazing and tourism pressures are primary concerns. Hybridization and pest control in Crete are currently managed with a precautionary approach.

The overarching goal of the LIFE Phoenix project is to enhance the conservation status of Priority Habitat 9370* in by implementing a comprehensive strategy. This includes mitigating major threats such as droughts, wildfires, overgrazing, visitor pressure, and hybridization; restoring natural palm groves through proper management techniques; preventing and controlling pests and IAS; promoting reforestation; and fostering environmental governance and awareness.

KEYWORDS: Endemic palm groves, *Phoenix canariensis*, *Phoenix theophrasti*, Priority Habitat 9370*.

PAPER ID: cest2025_00190

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Subjective and Objective Weights in Renewable Energy Sources Siting Problems

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ABSTRACT

Criteria weighting methods contribute significantly in decision making processes. Criteria-weighting procedures include two essential categories: objective and subjective strategies. Prior to setting up the weights of the criteria, subjective methods request that decision-makers supply preparatory information based on their skills, expertise and judgments. On the other hand, objective strategies eliminate any conceivable subjectivity-related bias, boosting objectivity, as they do not depend on the decision-makers' judgment or any earlier information and just assess how the information is organized within the assessment matrix to set up the weights. Numerous criteria can affect the site selection of a renewable energy sources (RES) project, and the application of multi-criteria decision-making (MCDM) methodologies is a prerequisite in assessing the criteria involved in the deployment of RES projects. The aim of this study is to investigate how the use of different subjective and objective weighting strategies contributes to the decision on solar farm siting issues, with the island of Rhodes (Greece) being used as an example. Five assessment criteria (Distance from Residential Areas (AC1), Distance from Road Network (AC2), Distance from the Existing High Voltage Electricity Grid (AC3), Solar Radiation (AC4), Installation Site Area Limitations (AC5)) are included in the analysis. Four subjective methods (Analytic Hierarchy Process (AHP), Rank Order Centroid (ROC), SIMOS, Best – Worst method (BWM)) and two objective methods (CRiteria Importance Through Inter-criteria Correlation (CRITIC) and Entropy Weight Method (EWM)) are applied to compute the weights of the selected assessment criteria. Nine eligible sites of solar farm siting in the island of Rhodes island are evaluated and ranked using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The results showed that the assessment criteria obtained the same ranking in all subjective methods. Regarding the objective methods, three (3) out of five (5) criteria obtained the same position in ranking. The best alternative rated according to AHP-TOPSIS, ROC-TOPSIS, SIMOS-TOPSIS, BWM-TOPSIS and Entropy-TOPSIS is site (S4) in the Central-West part of the island, whereas according to CRITIC-TOPSIS is the site (S8) in the North-East part of the island. In energy siting challenges, using multiple MCDM methods at the same time could be beneficial since it can contribute to choosing the most sustainable sites, avoiding the drawbacks and utilizing the benefits of each method.

KEYWORDS: multicriteria analysis; assessment criteria; criteria weighting; AHP; ROC; SIMOS; BWM; CRITIC; ENTROPY; TOPSIS; solar farm siting

PAPER ID: cest2025_00265

Impact of environmental sustainability course on enhancing environmental knowledge among university students in UAE

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ABSTRACT

This study evaluated how introduction of a university course on environmental sustainability can promote environmental responsibility among students. The research used a cross-sectional survey of 790 university students to study how formal environmental education together with demographic factors affect environmental knowledge and attitudes and practices (KAP). The research shows that students who attend university environmental courses develop better environmental awareness and female students consistently show higher environmental literacy. The study revealed that the main source for students to obtain environmental information is the social media platforms (52%) leading to doubts about the scientific accuracy of such content. The research aims to develop educational strategies for curriculum development that will merge traditional learning methods with new information channels to create environmentally aware graduates.

KEYWORDS: Environmental education, environmental extracurricular activities, volunteering, sustainability, Knowledge, Attitude, practices

PAPER ID: cest2025_00353

Strategic Environmental Management in Mount Athos under Climate Change - LIFE STEMMA ATHOS

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ABSTRACT

Mount Athos (MA) is a unique cultural and natural heritage site, characterized by high biodiversity, extensive forest cover, and significant historical value. Its ecological integrity is increasingly threatened by climate change (CC) due to factors such as geographic isolation, widespread chestnut monocultures, fragmented forest governance, and limited water resources. With each of the 20 self-governed monasteries managing its own forest independently, the absence of coordinated environmental planning heightens the area's vulnerability to climate-induced risks, particularly wildfires, drought, and pest outbreaks.

This project aims to develop a strategic and integrated environmental management framework for MA, with a dual focus on climate change adaptation and mitigation. Core objectives include reducing susceptibility to CC-related disturbances, enhancing ecosystem resilience, implementing adaptation and carbon sequestration strategies, and modeling the impacts of these practices on wildfire behavior and carbon dynamics. The initiative also seeks to establish long-term institutional mechanisms for environmental governance, tailored to the unique administrative and spiritual context of MA.

By combining scientific planning with local engagement, the project contributes to safeguarding MA's environmental and cultural legacy. Furthermore, it will promote knowledge exchange within the monastic community and across the EU, serving as a model for sustainable management in similarly sensitive and self-governed landscapes.

KEYWORDS: climate change, ecosystem resilience, strategic adaptation plans, Carbon stock, Mount Athos

PAPER ID: cest2025_00191

Acknowledgements

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Transformation of Developmental Housing Towards SDGs in Saudi Arabia

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ABSTRACT

This paper discusses the transformation of developmental housing towards SDGs in Saudi Arabia. The paper adopts the descriptive approach and in-depth analysis of housing theories, previous studies, and government statistical reports. The paper concludes that transforming developmental housing towards SDGs requires reforming housing policies, including community participation, social justice, partnerships, diversifying subsidy programs, and community empowerment.

KEYWORDS: Developmental Housing, Sustainability, SDGs, Saudi Arabia

PAPER ID: cest2025_00300

Decomposition analysis of ASEAN countries CO₂ emissions from electricity generation

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ABSTRACT

ASEAN is a group of countries in the south east asia that promotes economic political and security cooperation among its members. The demand for energy has increase by approximately 60% in the last 20 years. About 4 % of the Global carbon dioxide emission was emitted from the region in 2014 and there is an expectation that it will rise. Economy, population and share of energy mix has an effect to the carbon dioxide emission therefore understanding the driving factor is vital to have a preparation and planning for the development of the right policies. Using LMDI method, the study aims the identification of the main driving factors of carbon dioxide emission of the ASEAN during the 1974 to 2014 period. The results show that the growth in the economy have the largest impact for the increased carbon dioxide emissions followed by the energy structure and the population, however, the energy intensity helped to reduce the carbon emission. The results suggest that to have a change to cleaner energy would decrease emission. A proper management of energy through the improvements of technology would potentially be able to reduce the emissions.

KEYWORDS: Decomposition analysis, ASEAN, CO₂, Emissions, Philippines

PAPER ID: cest2025_00014

The use of indicators as a tool in environmental impact assessment studies of Renewable Energy Sources projects

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ABSTRACT

Indicators have been considered as an effective tool for data collection through quantitative and qualitative methods. They provide valuable insights and serve as a useful guide for decision-making, promoting social well-being and environmental protection. The present research focuses on the use of indicators as a tool for Environmental Impact Assessment (EIA) of Renewable Energy Source (RES) projects, highlighting their application as well as their contribution to sustainable development. The main categories of RES projects are examined, including hydroelectric, photovoltaic, wind, and biomass power stations, considering their environmental, social, and economic impacts. The methodology includes the following steps: (i) identification of the main environmental impacts of RES, (ii) definition of appropriate indicators (economic, social and environmental), (iii) deployment of indicators sheet and (iv) implementation of indicators in EIA studies of real RES projects to verify their applicability. 34 indicators consist the indicators' set (8 economic, 7 social and 19 environmental) and relevant indicators sheets are deployed. The study concludes that indicators, as a tool for multifactorial analysis, are suitable for the comprehensive depiction of the impacts of RES projects and the improvement of regulatory frameworks. Therefore, their application can support the energy transition, making them an integral tool for sustainable development.

KEYWORDS: indicators, environmental impact assessment, indicator sheet, renewable energy sources projects

PAPER ID: cest2025_00083

SESSION 10 - CLIMATE CHANGE IMPACTS, VULNERABILITY AND RISKS

Thursday 4 September – morning

Elevated temperature impact on toxicological effects of pesticides, antimicrobials and their mixtures to duckweed *Lemna minor*

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ABSTRACT

Anthropogenic chemical pollution has the potential to pose one of the largest environmental threats to humanity, but global understanding of the issue remains fragmented. Water pollution becomes alarming since anthropogenic activity results in the contamination of water bodies with various contaminants, which in turn reduces ecosystem functioning and poses human health risks. Pesticides and pharmaceutical and personal care products (PPCPs) stand out for their widespread occurrence and highly diverse biological effects and are considered as emerging contaminants (ECs). Despite frequent detection in surface waters, the mixture effects of these emerging contaminants on the aquatic organisms remain unclear. In addition, there is a need to understand how changing environmental factors impact on joint effects of emerging contaminants as they often occur in the environment. To address the knowledge gap of the effects of emerging contaminants and their mixtures in a changing climate, we aimed to test the elevated temperature effect on mixed exposures of frequently detected pesticide Terbutylazine (TBA) and antimicrobial Triclosan (TCS) to duckweed *Lemna minor*. Duckweeds *L. minor* were exposed to TBA and TCS individually and in mixtures (TCS+TBA) under different temperature regimes (23 °C and 27 °C). *L. minor* morphological indicators (frond area), biochemical indicators as well as oxidative stress damage were measured. Results showed elevated temperature exacerbated negative effects of terbutylazine, triclosan and their mixture.

KEYWORDS: Triclosan, terbutylazine, climate change, *Lemna minor*

PAPER ID: cest2025_00069

Acknowledgements: This project has received funding from the Research Council of Lithuania (LMT), agreement No. P-PD-24-179.

Geocoding of fire events in the mountainous region of Ymittos using GIS

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ABSTRACT

Wildfires in Greece constitute a major environmental challenge with significant ecological, economic, and social impacts. In recent years, their frequency and intensity have increased due to climate change, urban expansion, and lack of integrated planning, making effective management a critical priority. This study develops a comprehensive geodatabase based on official Fire Service records, aimed at analyzing the characteristics of fire events. It includes data on fire causes, behavior, meteorological conditions, topography, and consequences. The study focuses on the mountainous region of Ymittos near Athens, which is highly vulnerable due to dense vegetation and urban proximity. Fire events in this area were geocoded and maps were generated using Geographic Information Systems (GIS) to analyze spatial parameters and estimate fire risk. The analysis explores contributing factors such as temperature, seasonality, land use and proximity to roads. Special emphasis is placed on the number, duration, and spatial distribution of fire events across high- and low-risk zones. Fire frequency maps were, also, created to highlight susceptibility areas. The outcomes aim to enhance understanding and preparedness, offering a valuable decision-support tool for authorities in forest fire prevention and response.

KEYWORDS: wildfires, GIS, geocoding, database, spatial analysis

PAPER ID: cest2025_00394

Storm Daniel extreme flood event in Thessaly, Greece: Assessing the pollution status of the impacted coastal marine areas through extended screening of emerging contaminants using LC-TIMS-QTOF MS

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ABSTRACT

Extreme weather events, exacerbated by climate change, pose a severe threat for the society, the economy and the environment. Major floods constitute one of the most destructive consequences of extreme weather events. Besides their effects on the wider socioeconomic specter, floodwater run-offs carry a wide range of organic contaminants at sea, inflicting hazardous implications for marine life. On September 3-8th, 2023, Storm Daniel caused extreme rainfall in Thessaly region, Greece. Rainfall exceeded 400mm in most areas and 900mm in the central/eastern regions. With a flooded area of 1,150km², the phenomenon had devastating environmental/economic impact resulting in 18 casualties, destroying households/industrial/agricultural facilities, wastewater treatment plants (WWTPs) and ports, causing an extreme run-off at the Pagasitikos Gulf. Following the event, a comprehensive high resolution mass spectrometry (HRMS)-based wide-scope target screening of more than 2,300 LC-amenable emerging contaminants (ECs) and their metabolites/transformation products was carried out utilizing the technique of LC-VIP-HESI-TIMS-QToF MS, in order to assess the chemical burden in seawater and sediments of the impacted coastal marine areas, also incorporating a pre-/post-flooding comparison. Results highlight the fact that the extreme floodwater run-off resulted in an extensive transportation of terrestrial-derived material from the impacted areas and a major transport of plant protection products, pharmaceuticals, including even illicit drugs, surfactants, industrial chemicals and PFAS at sea, as a result of the overflowing of local WWTPs and the extensive destruction of agricultural/industrial/port facilities. The phenomenon resulted in a major alteration of the classification of the determined ECs in seawaters and most importantly in sediments of the area, with potential implications for its environmental quality status. Understanding the impact of extreme flood events on the marine environment is of critical importance on a global scale, related to the effective adaptation of management plans for the protection and restoration of the marine ecosystem under a changing climate.

KEYWORDS: Pagasitikos Gulf, Aegean Sea, pharmaceutically active compounds, PFAS, industrial chemicals, plant protection products, climate change

PAPER ID: cest2025_00177

Measuring climate data in school environment: Analysis of Climatic Trends on the island of Chios (2014–2025)

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ABSTRACT

Teachers of natural sciences theoretically have the ability and privilege to conduct their lessons in a laboratory. In this way, students develop a special interest in the subject of science and acquire additional skills. However, these experiments are typically focus on the syllabus and examinations of secondary schools, without particularly attracting the students' interest. Experimental practice, as a broader concept, includes not only the typical laboratory environment in vitro but also the space, the nature (in situ, in vivo). Such subjects can easily be found if our planet, the environment in which we live, and the understanding of its condition become active laboratory spaces, through experiments where students are active and study and understand the phenomena of climate change, then propose solutions to change the current situation. There are national and European programs available through which students carry out daily experiments within their own school, in a natural environment, process the data, and come to conclusions. This is also a great benefit for teachers, who improve their daily practices while learning to exchange views and interact with colleagues. Students use online applications to share (Internet of Things, IoT), collaborate, and work as a team, trained in soft skills. Case study: Measurements inside and outside of the 1st Lyceum of Chios. Students perform measurements and experiments on basic climate parameters (temperature, humidity, atmospheric pressure, particle concentration, etc.) especially under extreme conditions (heatwave, frost, storm, high dust concentration), using apart their school lab equipment the Davis meteorological station of National Observatory of Athens (NOA), that is situated in school's roof.

KEYWORDS: climate, school, measurements, science, IoT

PAPER ID: cest2025_00251

Restoration of burned forest areas in Galicia (NW Spain)

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ABSTRACT

Climate change has a wide-ranging impact on ecosystems, economy, human health and well-being. Therefore, the adaptation to climate change of both forest and agricultural sectors providing solutions to accelerate forest regrowth after extreme events, such as forest fires, by creating a more stable and resilient forest structure is needed. The objective of this study was to evaluate the establishment of different perennial (*Taxus baccata*, *Quercus ilex*, *Quercus suber*, *Pinus pinaster*) and not perennial (*Castanea sativa*, *Quercus robur*, *Sorbus aria*, *Betula alba*, *Quercus pyrenaica*, *Acer pseudoplatanus*, *Prunus avium*) forest trees and medicinal/aromatic plants (*Rosmarinus*, *Lavandula* sp, *Laurus nobilis*, *Origanum vulgare*, *Thymus vulgaris*, *Salvia officinalis*, *Sambucus nigra*, *Ruta graveolens*, *Vaccinium myrtillus*) in a forest area located in Galicia (NW Spain) which was destroyed by a forest fire in August 2021. Results showed that one year after the planting, in general, medicinal/aromatic plants had a lower mortality rate than trees. Therefore, under edaphoclimatic conditions similar to those of this study, it is recommended to use small plants, such as medicinal/aromatic plants, for the initial restoration of degraded areas. In any case, successive monitoring is necessary to evaluate the evolution of the vegetation in the area over time.

KEYWORDS: climate change, forest fires, trees, medicinal, aromatic, degraded areas

PAPER ID: cest2025_00059

Acknowledgements

This work is supported by the LIFE VAIA project (LIFE20 CCA/IT/001630) funded by the European Union's LIFE Programme.

Geotechnical Parametric Estimation and Susceptibility Analysis of Bicol University East Campus, Legazpi City, Albay, Philippines

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ABSTRACT

Natural calamities and geotechnical hazards pose a major risk in maintaining an area's public safety and its ability to develop economically. Infrastructures must be built sustainably and robustly for sustainable, disaster-resilient structures. Engineering structures must be studied considering geotechnical aspects and risk assessments to comprehend the substrata. This study aims to assess the susceptibility of an area against liquefaction potential or settlement based on geotechnical characterization. Field and laboratory tests were conducted to obtain soil samples and analyzed the susceptibility to liquefaction potential and settlement. The soil was consistently silty sand (SM), with varying shear strength values in each borehole. Results revealed that, BH04, had the highest liquefaction potential and lowest Factor of Safety. Settlement analysis demonstrated that the settlement for BH04 was high compared to other boreholes, which gave the lowest N-Value. This study emphasizes the significance of thorough geotechnical studies for infrastructure sustainability and disaster resilience. The integration of laboratory analyses, field testing, and geotechnical analyses, will enable a thorough understanding of soil behavior and engineering design.

KEYWORDS: *Geotechnical, borehole, soil properties, settlement, liquefaction*

PAPER ID: cest2025_00160

Fast Fashion and Sustainability Challenges: A Critical Review with Insights from Cyprus

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ABSTRACT

The main aim of this article is to review the impact of the fast fashion industry on the environment, using Cyprus as a case study. Fast fashion exacerbates the environmental crisis through excessive carbon emissions, water pollution, and textile waste, driven by a culture of rapid and excessive consumption. In this article, the significant environmental impact fast fashion has on the environment will be discussed, along with related research from Europe, focusing mainly on Cyprus, an island where consumer habits increasingly align with global trends. In Cyprus, many people seem to be aware of the negative effect fast fashion has, yet not many changes have been implemented to minimize the unconscious and unsustainable shopping habits, contributing to the aggravation of climate change. Further research is needed to better determine the consumer habits in Cyprus, yet by fostering a culture of sustainability and responsible consumption, Cyprus has the potential to reduce its environmental footprint and lead by example in the fight against environmental degradation.

KEYWORDS: Fast fashion, textile waste, environment, Cyprus

PAPER ID: cest2025_00118

Author comments

This article is a case concerning a spread of awareness to this severely underrated and rarely discussed topic which most people have little to no knowledge of, especially in an island like Cyprus.

SESSION 11 – PLENARY SESSION

Thursday 4 September – afternoon

Advanced Analytical Strategies for Investigating Biomagnification of Organic Micropollutants Across Food Webs

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ABSTRACT

The complexity and diversity of organic contaminants in the environment demand innovative analytical tools to investigate their fate, transport, and biomagnification potential. Recent developments in high-resolution mass spectrometry (HRMS), combined with enhanced data workflows, have enabled a comprehensive approach to chemical monitoring in apex predators and their food webs.

A multi-technique platform based on both liquid and gas chromatography coupled to HRMS (LC-ESI-QTOF and GC-APCI-QTOF) has been applied to characterize a wide range of organic pollutants, including legacy priority substances and contaminants of emerging concern (CECs). Wide-scope target screening enabled the quantification of over 2,400 chemicals across multiple compound classes (e.g., PFAS, pesticides, pharmaceuticals, industrial compounds), while suspect and non-target screening workflows expanded the chemical space, supporting identification of unknowns through fragmentation pattern libraries, retention time models, and ion mobility-derived collision cross section (CCS) values.

This approach has been applied to extensive wildlife samples from both terrestrial and marine ecosystems. In apex species such as raptors, marine mammals, and top fish predators, significantly higher levels of perfluoroalkyl substances (PFAS) were observed. PFOS and long-chain PFCAs (e.g., PFUnDA, PFDoDA) exhibited strong biomagnification potential in both environments, often exceeding thresholds for ecological concern. Other frequently detected substances included legacy chlorinated pesticides, current-use biocides, and transformation products of pharmaceuticals. These patterns were consistent across sample types (e.g., liver, egg, muscle), species, and trophic levels.

By integrating wide-scope HRMS capabilities with advanced data processing pipelines, this analytical strategy provides deep insights into environmental chemical exposure and supports the prioritization of substances for regulatory consideration. These results highlight the importance of harmonized chemical surveillance across environmental compartments to assess chemical risks under real-world exposure conditions and trophic dynamics.

KEYWORDS: Biomagnification; organic pollutants; environmental health

PAPER ID: cest2025_00464

SESSION 12 - WASTEWATER TREATMENT (3)

Thursday 31 August – afternoon

Optimizing biological consortia for mining wastewater treatment

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ABSTRACT

Industrial processes, such as the mineral extraction of raw materials, have been in crucial focus because of the current drive towards greener and more sustainable energy sources. Hence, the production workflow of critical elements, such as rare earth elements (REEs), is reassessed to identify less toxic and degradable reagents, while also identifying the challenges associated with the emissions of not yet regulated elements (i.e. Li, B, Tb). Innovative biological wastewater (WW) treatment options are studied to effectively remove contaminants and recycle industrial water in a low-cost and lowered carbon-equivalent emissions manner. This work aims to use aquatic plants and phytoplankton to remove regulated and unregulated contaminants (i.e. flotation chemicals, heavy metals, REEs) from mining WW outlets. A thorough screening of different species has been done to identify the potential to decontaminate the water effluent by promising biological entities in batch experiments. The study assessed removal potential of toxic elements, including the REEs, and greener flotation agents by the species selected. Preliminary results show promising element-specific removal by some species, allowing us to suggest potential synergetic biological treatments that will provide low-cost and sustainable WW treatment alternatives.

KEYWORDS: Phytoremediation; Mining wastewater; Biological process

PAPER ID: CEST2025_00398

Acknowledgements

This study is supported by the European Union's Horizon Europe Research and Innovation Program through the REESOURCE Project under Grant Agreement number 101138460.

Development of 3D-Printed Permeable Reactive Barrier Adsorbents Utilizing Zeolite Composites for Copper (II) Removal in Acid Mine Drainage

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ABSTRACT

Zeolite-based ceramic structures was fabricated using a viscous solution 3D printing (3DP) technique to demonstrate their effectiveness in removing heavy metal ions from acid mine drainage (AMD) runoff. Zeolite, a low-cost hydrated aluminosilicate clay, is widely used in water treatment due to its excellent ion-exchange and adsorption capabilities. In the Philippines, abundant reserves of natural zeolite (Philippine Natural Zeolite, PNZ) have been utilized in various separation and purification applications. However, traditional forms of zeolite—such as loose granules or powders—are difficult to deploy and recover from environmental systems. This study employed a Direct Ink Writing (Eazao Bio) – a commercially available benchtop multi-material 3D printer to create custom, structured zeolite composite devices that are deployable, retrievable, and reusable. These 3D-printed structures offer improved efficiency in extracting heavy metals from AMD. Furthermore, surface modification and functionalization of the 3D-printable ink significantly enhance the adsorption performance of the final product, making it a promising sorbent material for use in permeable reactive barriers (PRBs).

KEYWORDS: Adsorption, 3D printing, Acid Mine Drainage, Heavy Metals

PAPER ID: cest2025_00403

Acknowledgement

This work was funded by the UP System Enhanced Creative Work and Research Grant (ECWRG-2022-1-10R).

Treatment of High-Strength Domestic Wastewater in Anaerobic, Aerobic and Anoxic Fed-Batch Process System

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ABSTRACT

For treatment of high-strength domestic wastewater, this study explores a fed-batch bioprocess system consisting of anaerobic (AD), aerobic (AER) and anoxic (ANX) processes in this order and each run at 24 h hydraulic retention time (HRT) and 0.8 g COD/L/d in the first bioreactor. The largest COD removal occurred in the anaerobic process, followed by the aerobic process. The overall removal in the last 6 cycles with three bioprocesses in series, was $1,222.19 \pm 213.14$ mg/L or average $83.82 \pm 9.73\%$ based on influent levels. Of this COD removed, 546.15 ± 102.00 mg/L (ca. 38%) was removed in the AD, while 541.37 ± 227.13 (ca. 37%) was removed in the aerobic bioreactor. Biogas production accounts for $64.48 \pm 27.83\%$ of the COD removed in the AD process. Much of the ammonia-N removal occurred in the aerobic bioreactor ($84.08 \pm 18.95\%$ of the influent $\text{NH}_3\text{-N}$ to the aerobic bioreactor). The amount (mg/L) of nitrate-N removed in the ANX process via denitrification is 36.0 ± 33.6 mg/L, which is $63.0 \pm 30.4\%$ of influent nitrate-N to the anoxic bioreactor.

KEYWORDS: ammonia, biogas, biological, methane, nitrate

PAPER ID: cest2025_00135

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Application of Iron Oxide-Coated Membranes in Permeable Block Systems for Advanced Removal of Micro- and Nanoplastics

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ABSTRACT

The increasing prevalence of microplastics (MPs) and nanoplastics (NPs) in aquatic environments has raised significant environmental and public health concerns, necessitating the development of effective removal technologies. This study explores the application of iron oxide-coated membrane structures integrated into permeable block systems for the effective removal of MPs and NPs from aqueous media. Iron oxide nanoparticles (IONPs) were synthesized via a simple and cost-effective chemical precipitation method. In batch experiments, the synthesized IONPs achieved removal efficiencies exceeding 95% within 20 minutes. Afterward, IONPs were uniformly deposited onto membrane surfaces using a spray-coating technique. Removal efficiencies were evaluated for both MPs and NPs across a range of particle sizes and compositions. Results demonstrated that the IONPs coating significantly enhanced the capture efficiency compared to uncoated membranes. Furthermore, the coated membranes demonstrated stable performance over multiple reuse cycles with minimal decline in efficiency. These findings suggest that iron oxide-coated membranes integrated into permeable block systems offer a promising, scalable strategy for mitigating plastic pollution in water treatment and urban runoff management applications.

KEYWORDS: Iron oxide nanoparticles, Microplastics, Nanoplastics, Permeable block systems, Membrane coating

PAPER ID: cest2025_00313

Biochar derived from the invasive aquatic plant *Myriophyllum spicatum*: Characterization via SEM–EDX and application in lead removal

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ABSTRACT

The accumulation of lead (Pb) in aquatic environments remains a significant environmental challenge due to its toxicity and persistence. Meanwhile, invasive aquatic plants, such as *Myriophyllum spicatum*, cause ecological and economic issues due to their rapid growth and extensive biomass production. Converting this problematic biomass into biochar presents an opportunity to address both issues simultaneously. This study investigates biochar derived from *M. spicatum* via pyrolysis at 600°C, characterized using SEM–EDX, for its effectiveness in removing lead from aqueous solutions. Pyrolysis decreased carbon content through the conversion of organic carbon into volatile products, while the non-volatile calcium content increased more than fourfold. Pb(II) adsorption capacities improved significantly, from 73.9 mg/g in raw biomass to 92.4 mg/g in biochar, indicating an enhancement of over 20% in lead removal efficiency. These findings demonstrate the potential of biochar from invasive aquatic plants as a sustainable and effective solution for remediating lead-contaminated water, thus supporting the principles of the circular economy and contributing to ecosystem restoration.

KEYWORDS: biochar, *Myriophyllum spicatum*, SEM–EDX, lead, removal

PAPER ID: cest2025_00179

Acknowledgements: This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (grant number 451-03-136/2025-03/200023)

Unlocking biomethane and biohydrogen potential of lipid-rich wastewater using anaerobic granular sludge

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ABSTRACT

The recovery of biofuels from lipid-rich industrial waste, such as confectionery wastewater, offers a promising path toward sustainable energy. This study investigates confectionery wastewater's methane and hydrogen production potential using anaerobic granular sludge (AnGS) under varying inoculum-to-substrate ratios (ISRs). Methane yields were evaluated at ISRs of 3, 4, and 5, with the highest specific production (313.5 ± 4.3 mL CH₄/g COD_{inf}) observed with an ISR of 5. Methane production followed first-order kinetics with no lag phase, indicating rapid microbial activity and uninhibited degradation of long-chain and volatile fatty acids, particularly caproic acid. Hydrogen production was assessed at ISRs of 0.25, 0.5, and 1. No hydrogen was observed with the ISR set at 0.25, likely due to excessive VFA accumulation (mainly lactic acid) and a significant pH drop (i.e., down to 3.1 ± 0.1). At ISR of 1, a specific hydrogen yield of 44.7 ± 7.2 mL H₂/g COD_{inf} was achieved in two days. AnGS demonstrated strong resilience to lipid-induced inhibition, ensuring stable methane production and manageable VFA levels. These results highlight AnGS as a robust inoculum for treating high-lipid waste, offering new insights into optimising biofuel recovery from industrial wastewater.

KEYWORDS: confectionery wastewater, lipid-rich waste treatment, anaerobic granular sludge, methane and hydrogen production, biofuel recovery

PAPER ID: cest2025_00181

Evaluating the Degradation Potential of Alkaliphilic Bacterial Isolate into the Distillate-Derived Strong Alkaline Wastewater from PGME Processes using Batch Experiments

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ABSTRACT

The rising demand for effective wastewater treatment solutions and technologies has become vital due to increasing industrial activities and the associated environmental and public health risks posed by industrial effluents. Propylene Glycol Methyl Ether (PGME), an organic solvent widely used in semiconductor manufacturing, ink, paint production as a coating agent, contributes to high-pH wastewater, presenting challenges to treatment methods. This study investigates the degradation potential of an alkaliphilic bacterial isolate, initially labeled as SBR-02, cultivated from long-term acclimated SBR set-up in the reduction of chemical oxygen demand (COD) of distillate-derived strong alkaline wastewater (D-DSAW) from PGME processes (pH = 13.5) through batch experiments. A response surface methodology (RSM) using the Box-Behnken Design (BBD) in Design Expert 13 software was employed to examine the effects of initial COD concentration, initial pH, and inoculum size on biodegradation efficiency. The results indicated that SBR-02 effectively reduced COD, achieving an optimal removal efficiency of 68.33% observed under conditions of 3000 mg/L initial COD concentration, pH 10 and 25% v/v inoculum size. ANOVA confirmed the significant influence of these parameters on the degradation performance with initial pH and inoculum size showing the most significant interaction effects (F-value= 72.57, p-value = 0.0001). 16S rRNA gene sequencing identified the bacterial strain as closely related to *Halalkalibacter krulwichiae* strain AM31D with 95.08% identity and 100% query cover, a member of the Bacillaceae family known for its enzymatic degradation capabilities. The findings suggest that alkaliphilic bacteria hold promise for industrial wastewater bioremediation, providing insights into microbial-based treatment approaches for highly alkaline waste streams.

KEYWORDS: Alkaline wastewater, biodegradation, COD reduction, *Halalkalibacter krulwichiae* strain, PGME wastewater treatment

PAPER ID: cest2025_00283

Winemaking Wastewater Treatment: Hydrodynamic Cavitation and Coagulation-Flocculation

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ABSTRACT

Winery wastewater poses significant environmental risks due to high concentrations of organic and inorganic compounds. This study examines the treatment of wastewater from the "Torre di Morro" winery using hydrodynamic cavitation and coagulation-flocculation processes. Cavitation at 3 bar achieved a 33% pollutant degradation, while Fenton's reagents increased this to 60%. The combination of cavitation and Fenton's reagents was most effective, resulting in a 74% reduction. Coagulant dosages of 5 mg/L, 12.5 mg/L, and 100 mg/L led to COD reductions of 50%, 58%, and 60%, respectively. These findings demonstrate that combined methods significantly enhance treatment efficiency, offering a promising approach for winery wastewater purification. Implementing these methods can substantially reduce the environmental impact of winery wastewater, contributing to more sustainable winemaking practices.

KEYWORDS: Hydrodynamic cavitation, Fenton process, Coagulation-Flocculation, winery wastewater

PAPER ID: cest2025_00326

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Machine Learning (ML) Applications in Water Treatment: Possibilities and Advantages

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ABSTRACT

Artificial intelligence (AI), especially machine learning (ML) algorithms, has gained traction in water treatment processes (WTPs) for tasks such as process optimization, operational decision-making, and cost efficiency. Since 1997, at least 91 peer-reviewed studies have documented the use of AI in various WTP operations, including coagulation/flocculation (41 studies), membrane filtration (21), formation of disinfection byproducts (DBPs) (13), adsorption (16), and other aspects of plant management. This paper critically reviews these studies to evaluate how AI technologies have been applied in WTPs, highlighting both advancements and current limitations. AI has contributed significantly to improving the accuracy of predictions related to coagulant dosage, membrane performance (flux, fouling, and rejection), DBP formation, and contaminant removal. Notably, deep learning (DL) approaches have demonstrated strong feature extraction and data mining capabilities. These have enabled the development of image-based DL models capable of correlating floc morphology with coagulant dosages. Moreover, hybrid models—integrating AI with traditional regression or physical/kinetic approaches—have shown enhanced predictive capabilities. The review also identifies key future research directions aimed at further refining AI-based control systems for water treatment processes.

KEYWORDS: Artificial intelligence; machine learning; water treatment process; coagulation & flocculation; disinfection byproducts

PAPER ID: cest2025_00235

Kinetics and Isotherm Studies of Methyl Orange Adsorption using Metal Organic Framework-based Composite Beads Functionalized with Polyethyleneimine

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ABSTRACT

To further improve the adsorption performance of our synthesized metal organic framework (MOF)-based composite beads, components with favorable functional groups are introduced. In this study, polyethyleneimine (PEI), a suitable polymer with plenty of amine functional groups in its structure, was incorporated to increase the number of active sites for methyl orange (MO) adsorption. The effects of operating parameters such as pH and initial MO concentration on the MO adsorption performance of our previously optimized beads composed of chitosan (CS), MIL-101 (Fe), and PEI were investigated. In addition, kinetic and isotherm modelling using adsorption equilibrium data were performed using non-linear regression. High MO removal of at least 93% was achieved across a wide range of pH, while kinetic data followed a pseudo-second order equation with a coefficient of determination (R-squared) of 0.981, suggesting that chemisorption limits the rate of the reaction. Furthermore, isotherm studies revealed that the adsorption equilibrium data were best described by the Sips isotherm model (R-squared = 0.993), suggesting MO adsorption on the heterogeneous surface of the beads. With a maximum adsorption capacity of 1253.44 mg/g, results showed superior performance of the beads in removing MO from water. Finally, regeneration studies proved that the beads have a high regenerative ability, being able to maintain MO removal of over 98% throughout five cycles of adsorption and desorption.

KEYWORDS: Polymer Composite Beads, Chitosan, MIL-101 (Fe), Polyethyleneimine, Metal Organic Framework, Methyl Orange

PAPER ID: cest2025_00010

Acknowledgement: This study was funded by the Engineering Research and Development for Technology (ERDT) program of the University of the Philippines Diliman.

SESSION 13 - ENVIRONMENTAL BIOTECHNOLOGY AND BIOENERGY

Thursday 4 September – afternoon

Syngas/CO₂ fermentation as a sustainable way forward: the case study of biomethanation in trickle bed reactors

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ABSTRACT

Biomass gasification (thermal decomposition in the presence of limited amount of oxygen) and production of a gaseous mixture of mainly CO, H₂ and CO₂ (syngas) was discovered in the beginning of the 17th century and syngas was already used in internal combustion engines and street lighting systems towards the end of the 18th century. Following the discovery of Fischer-Tropsch process in the beginning of the 20th century, the development of various routes for chemical catalytic synthesis of fuels and chemicals from syngas bloomed during the last century. The biological conversion of syngas came in the forefront only recently, following important advances within biotechnology discipline. It was just in the beginning of the 21st century that the scientific community experienced an exponential growth in research studies dealing with biological conversion of syngas to mainly alcohols, organic acids and methane. This thermochemical biomass conversion combined with the gas fermentation route for production of low-value products like fuels can be considered competitive and advantageous compared to the thermochemical/catalytic route when small-scale installations are concerned. Production of higher value products via the carboxylate platform is also a promising, and certainly worth investigating route.

The presentation will summarize the status of the technology and will highlight recent advances within syngas bio-transformations for addressing the main process challenges, i.e. the low solubility of the gaseous substances and the relatively low growth rates of the microbes. As a case study, the presentation will focus on syngas and CO₂ biomethanation in trickle bed reactors from lab-scale to pilot-scale. We will show how the scale and different reactor geometry and operating conditions may affect the efficiency of syngas biomethanation, and how modelling of variable volumetric mass transfer coefficient may result in the optimal up-scaling of a rather complex reactor system. Predicting and controlling the volumetric mass transfer coefficient is valuable, not only for maximizing the mass transfer rate, but also for preventing inhibition phenomena. Temperature, pressure, reactor geometry and gas and liquid flow rates can be adjusted to secure maximum efficiency of the gas fermentation process. The presented approach and modelling tool may be adjusted to different reactors and microbial systems, and thus it can be very useful for designing new as well as revisiting established processes in the field.

KEYWORDS: Biomass gasification; biotechnology; circular economy

PAPER ID: cest2025_00290

Optimized Biomethanation of Hydrogen and Carbon Dioxide via Inoculum Selection and Pre-processing in a Thermophilic Trickle-Bed Reactor

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ABSTRACT

To improve the energy efficiency of biological methanation of CO₂ and H₂, this study evaluates the performance of a thermophilic (55 °C) anaerobic trickle-bed reactor (700 ml). A novel inoculation strategy is presented, involving the use of unfiltered and uncentrifuged anaerobic sludge from a municipal wastewater treatment plant (WWTP) as a mixed microbial culture for methanation. The results demonstrate rapid, stable, and complete conversion of H₂ and CO₂, achieving methane (CH₄) concentrations exceeding 95%. This level of purity enables direct injection into existing natural gas infrastructure without the need for extensive biogas upgrading. Furthermore, a high specific methane production rate of 10 Nm³/m³·day was achieved, indicating strong potential for system scale-up.

KEYWORDS: Biomethanation, trickle bed reactor, inoculum pre-processing.

PAPER ID: cest2025_00302

Biogas upgrade with green hydrogen in a semi-pilot trickle bed reactor

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ABSTRACT

The current study investigated the performance of biological methanation of CO₂ using green H₂ in a mesophilic (37°C) trickle bed reactor (TBR) (0.051m³) at ambient pressure. For both phase A and phase B a synthetic gas feed (60/40 CH₄/CO₂) was used to simulate biogas. Nitrogen was used in phase A for better monitoring of the system. For phase A the average productivity of methane was $3.2 \text{ m}^3_{\text{CH}_4} / (\text{m}^3_{\text{trickle bed}} * d)$ at methane content of 71.3% with 10.3% N₂. For phase B no Nitrogen was used, and the average productivity of methane was $1.3 \text{ m}^3_{\text{CH}_4} / (\text{m}^3_{\text{trickle bed}} * d)$ at methane content of 97.9% with less than 0.1% residual H₂.

KEYWORDS: TBR, Biogas, Biological methanation, mesophilic

PAPER ID: cest2025_00436

Acknowledgements: The research project “GREENUPGRADE: Valorization of green energy for enhancing the robustness and upgrading the performance of anaerobic digestion systems (61401400)” is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union – NextGenerationEU (H.F.R.I. Project Number: 15522).



Assessing the Effect of Temperature and Biomass Composition for Hydrogen Production through Gasification

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ABSTRACT

Sustainable forest biomass management is essential for ecological balance, rural economies, and climate change mitigation. Biomass residues—branches, thinnings, and wood waste—can enhance forest health and reduce fire hazards, promoting regeneration, and enabling renewable energy production.

Gasification, a thermochemical process that converts organic material into syngas, offers an efficient and cleaner alternative to traditional combustion, supporting low-carbon heat, electricity, and biofuel generation. This study examines the gasification of biomass waste—including miscanthus, peach stones, *Pinus pinaster*, and wood chips—for syngas production, with H₂ as the target fuel. Plasma gasification was also explored for peach stones.

KEYWORDS: biomass management, gasification, syngas, H₂

PAPER ID: cest2025_00018

Acknowledgements: This work is funded by national funds through the FCT – Fundação para a Ciência e a Tecnologia, I.P. and, when eligible, by COMPETE 2020 FEDER funds, under the Scientific Employment Stimulus - Individual Call (CEEC Individual) - 2021.03036.CEECIND/CP1680/CT0003

Optimization of advanced bio-based carbon capture and utilization system through technological development and comparison

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ABSTRACT

Algae-based biological carbon capture and utilization (Bio-CCU) systems represent a promising approach to reduce atmospheric CO₂ concentrations while generating valuable bio-products. The study presents and investigates the optimization of an advanced algal photobioreactor (aPBR), through the development and performance comparison of different technological configurations. Three different configurations were studied and compared in terms of CO₂ capture efficiency. The configurations differ in terms of key design and operational variables. The results highlight the influence of technological aspects on key parameters of system efficiency and productivity. The CO₂ detected removal efficiencies ranged from 81% to 92%, depending on the technological setup, with the lighting system (in particular the use of purple LEDs) and the presence of a membrane-based harvesting unit emerging as the most influential variables affecting CO₂ bio-fixation performance. The research demonstrates the potential of Bio-CCU technologies to contribute to climate emergencies, circular economy objectives and bioenergy production.

KEYWORDS: biological systems, Photobioreactor (PBR), environmental sustainability, climate change, circular economy, CO₂

PAPER ID: cest2025_00225

Biogas upgrade to biomethane in trickling bed reactors: Process optimization under mesophilic conditions

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ABSTRACT

The biomethane sector is rapidly expanding due to the compelling advantages of renewable biomethane, which closely resembles non-renewable natural gas. In this work, we present a novel study on trickling bed reactors (TBR) under mesophilic conditions, demonstrating their robustness in producing biomethane with a content of 96% in methane (CH₄) at low gas retention times of 1 h. Our research brings a fresh perspective to the field of biomethane production.

KEYWORDS: biogas, biomethane, trickling bed reactor, biological upgrade, *Methanobacter*

PAPER ID: cest2025_00414

Acknowledgments: The research project was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the “2nd Call for H.F.R.I. Research Projects to support Faculty Members & Researchers” (Project Number: 3209).

Simulation-based design of pressure swing adsorption for methane and nitrogen separation in biogas upgrading

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ABSTRACT

This study evaluates the performance of three adsorbents, ETS-4, MSC 3K 172, and Norit RB3, for a 68/32 %vol CH₄/N₂ separation in biogas upgrading, using a two-stage Pressure Swing Adsorption (PSA) system modeled in Aspen Adsorption. Sensitivity analysis indicated that adsorption pressure, desorption pressure and adsorption time significantly influence methane recovery and product purity. Among the materials tested, ETS-4 demonstrated the highest N₂ selectivity and most favorable breakthrough behavior, followed by MSC 3K 172 and Norit RB3. Under optimized conditions, ETS-4 achieved up to 85% CH₄ recovery at 81% purity. These results provide a robust benchmark for the development of high-efficiency PSA-based upgrading systems.

KEYWORDS: PSA cycle optimization, Biogas upgrading, CH₄/N₂ separation, Kinetic-selective adsorbents

PAPER ID: cest2025_00400

Biomethanation of Syngas with a Focus on CO Conversion Using Mixed Microbial Cultures in a Thermophilic Trickle bed Reactor

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ABSTRACT

Biomethanation of syngas offers a sustainable route for renewable methane production. However, CO-rich gas streams pose challenges due to microbial inhibition. This study evaluated a thermophilic trickle bed reactor (TBR) operating for 180 days with mixed microbial cultures and varying syngas compositions. Peak methane production of 6.8 Nml/ml·d and high elimination capacities of 85% H₂, 60% CO, 99% CO₂ were achieved during syngas feeding, while CO-only phases showed reduced performance. The findings highlight TBR as a viable system for syngas upgrading and provide insight into optimizing CO biomethanation.

KEYWORDS: Trickle bed reactor, syngas, biomethane, carbon monoxide, conversion, inoculum.

PAPER ID: cest2025_00297

Optimization of Biogas Production and In-Situ Upgrading via Hydrogenotrophic Methanogenesis in a Lab-Scale UASB Reactor

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ABSTRACT

The increasing demand for sustainable bioenergy has strengthened interest in biogas upgrading technologies that aim to produce pure CH₄ by separating CO₂ and all other impurities. This study investigates the in situ biomethanation of CO₂ by feeding H₂ into a 7 L UASB anaerobic digester treating synthetic and potato-processing wastewater. Initially, the reactor operated under varying HRT and OLR to assess baseline performance. Following stabilization, H₂ was introduced either into the feed line or the recirculation line via a microbubble generation system. Hydrogen addition to the feed increased biogas production by 18%, methane concentration to 70.9%, and reduced CO₂ to 5.2%. Transitioning hydrogen injection to the recirculation line improved methane purity (78.8%) and TOC removal (74.3%), while doubling hydrogen flow further enhanced biogas production (4.6 ± 0.7 L/day) and increased TOC removal to 83.97%, despite a slight drop in methane content (73.1%). Across all conditions, hydrogen feed minimized VFA accumulation and supported syntrophic stability. Overall, in-situ hydrogen injection proved effective for enhancing methane yield and biogas quality, highlighting its potential for sustainable biogas biomethanation from industrial wastewaters.

KEYWORDS: Hydrogenotrophic methanogenesis; In-situ biogas upgrade & biomethanation; Microbubbles; UASB

PAPER ID: cest2025_00175

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SESSION 14 - HYDROLOGY AND WATER RESOURCES

Thursday 4 September – afternoon

Achieving the twin transition in industrial water use: Challenges and breakthroughs

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ABSTRACT

Eco-efficient and sustainable industrial water management is one of the most important focus areas for environmental protection in many countries. Innovation in water treatment can bring close loops to at almost 100% for important industrial water users and enable new multi-billion-euro markets in saved or recovered and reused resources.

The delivering of compact solutions for industrial applications necessitates (i) multiple state-of-the-art (SotA) water treatment and re-use technologies, (ii) diverse closer-loop practices regarding water, energy and substances, (iii) a cyber-physical-system controller in the form of a system for real-time monitoring, assessment and optimization of water (re-) use at different interconnected levels and (iv) an effective methodological, regulatory and business framework.

Cyber-Physical Systems, specialized to enhancing water efficiency in the Process Industry, follow a three-direction approach: (a) diagnostic (monitoring water efficiency, diagnosing problems, estimating improvement margins); (b) production chain enhancement (application of SotA water recovery technologies & practices); and (c) optimization (of water use/recovery/reuse processes). The WaterCPS, the core outcome of the AquaSPICE Innovation Action, consists of a physical part and a cyber (digital) part. The physical part comprises of the industry's existing production line(s) and value chain(s), plus the new SotA water efficiency technologies & practices deployed. The cyber part consists of the Digital Twin, the Real Time Monitoring system (RTM) and the WaterCPS digital Platform. The RTM plays the role of intermediary between the physical system and its digital twin, with its sensors incorporated as part of the physical system and its data communication & management components incorporated as part of the cyber system. The cyber part of WaterCPS and its integration with the water efficiency technologies & practices, creates significant added value for them and have a measurable impact on water efficiency by supporting the above mentioned three directions to water efficiency enhancement.

KEYWORDS: water management; resources; real-time monitoring; optimization

PAPER ID: cest2025_00470

Optimizing the allocation of bioenergy crops within a typical Greek cropping system to balance sustainable biomass production and nitrates water pollution mitigation

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ABSTRACT

Pinios river basin, located in Thessaly, Greece constitutes the country's greatest agricultural producer, contributing to the quality degradation of surface and groundwater bodies. To mitigate these effects, integrating bioenergy crops into existing cropping systems presents a promising and effective strategy, offering the dual benefit of environmental protection and renewable energy production. Their environmental and economic effectiveness, however, is highly dependent on the specific characteristics of the land in which they are to be installed. Therefore, it is essential to assess bioenergy crops' economic and environmental footprints for informed regional planning. This study employs the Soil and Water Assessment Tool (SWAT) to develop a representative model of Pinios river basin and evaluate its current state with respect to nitrate pollution. A multi-objective, elitist Genetic Algorithm (GA) embedded in MATLAB is then applied to identify optimum spatial allocations of crops, with respect to the net farmers' income, biomass production and quality in rivers and groundwater. The analysis of the resulting two-dimensional trade-off curves revealed highly promising outcomes, demonstrating the potential for enhanced environmental benefits at the river basin scale while generating substantial biomass.

KEYWORDS: Bioenergy crops, hydrologic modeling, land use change, optimization, water quality

PAPER ID: cest2025_00230

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Optimum selection and placement of agricultural best management practices in Pinios river basin for the mitigation of nitrates water pollution and water scarcity

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ABSTRACT

The intensification of agricultural activities, which are crucial for sustaining crop productivity in rural areas, can also lead to the depletion of water supplies and the degradation of water quality. The challenge of addressing nitrates water pollution and water scarcity at a river basin scale requires the consideration of trade-offs between economic and environmental targets. The adoption of Best Management Practices (BMPs) in agriculture to deal with the issue is becoming increasingly widespread. This study implemented the Soil Water Assessment Tool (SWAT) model to evaluate nitrates discharges and water conservation in response to alternative agricultural management practices. The model was embedded within a decision support tool, enhanced by a multi-objective optimization algorithm to analyze the alternatives, suggesting the most efficient allocation of BMPs to address the above-mentioned water objectives at a basin scale. Applying a four-objective optimization process, various mitigation strategies, including individual and combined changes in livestock and farming practices, were examined in Pinios river basin, proving the methodology's resilience and relevance. Through the use of cost-efficient measures, modelers can identify and prioritize appropriate management strategies by combining process-based hydrological models with fast and precise cost estimations.

KEYWORDS: BMPs, optimization, SWAT, water quality, water quantity

PAPER ID: cest2025_00231

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Reclaiming Water: Assessing the Water Resources Released by the Decommissioning of Lignite Facilities in Western Macedonia

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ABSTRACT

The decommissioning of lignite power plants in Western Macedonia is a key point for the energy transition at a national level in Greece but also marks a turning point for the regional resources management. One of the resources of special interest would be water, a central ingredient in the lignite-powered steam plants, used to propel generators, cool the energy production media and suppress the harmful dust byproducts. The present study investigates the potential of reallocating the released water resources used in the lignite plants and investing water in other activities such as agriculture, public use, tourism or ecosystem reinforcement-restoration, aligned with sustainable development and circular economy rules. The water the plants consumed before decommissioning was estimated based on operators and governmental sources. Different scenarios of alternative use are investigated and presented.

KEYWORDS: Water Resources, Management, Natural Resources, Energy, Delignitization

PAPER ID: cest2025_00407

Establishing a Groundwater Monitoring Network in the Drini i Bardhe River Basin, Kosovo: A Focus on Water Level and Temperature Monitoring

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ABSTRACT

Over the past few decades, groundwater has gained global recognition as one of our most important natural resources. Keeping track of groundwater levels helps us better understand how aquifers behave and how they're affected by things like climate change, water use, and land development. That's why setting up long-term monitoring systems is so important for managing groundwater in a sustainable way. Compared to surface water, groundwater has some clear advantages. The Hydrometeorological Institute of Kosovo, which oversees both surface and groundwater monitoring, also played a key role in the project. As part of this effort, 40 monitoring wells were installed across the country's four main river basins: 7 in the Morava e Binçes basin, 8 in the Ibër basin, 8 in the Lepenc basin, and 17 in the Drini i Bardhë basin. The main goal of this network is to keep an eye on how groundwater levels and quality change over time. This information will help improve how water resources are managed, support environmental protection, safeguard public health, and contribute to sustainable development across Kosovo.

KEYWORDS: groundwater, Drini i Bardhe, groundwater monitoring network, groundwater level and temperature

PAPER ID: cest2025_00362

Advanced and integrated multiparametric tool for proactive and continuous environmental monitoring and control of surface water bodies in sensitive areas

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ABSTRACT

Surface water bodies (SWBs) play a crucial role in preserving biodiversity and supporting global environmental health. However, they are increasingly threatened by anthropogenic pressures such as water withdrawals, pollutant discharges, and land-use changes. Currently, there is no globally standardized, integrated approach for continuous environmental monitoring of SWBs in protected areas. Existing methods are typically fragmented, focusing on isolated environmental parameters or assessing the impacts rather than the causes.

The research presents an innovative, multiparametric, and proactive monitoring framework specifically designed for SWBs in sensitive and protected areas. The proposed methodology aims to enable continuous assessment and control of environmental pressures, thereby supporting both ecosystem protection and informed decision-making. The framework is structured into five phases, combining the DPSIR (Driving forces–Pressures–State–Impacts–Responses) conceptual model with the Deming Cycle (PDCA – Plan, Do, Check, Act), ensuring an adaptive and systematic approach.

Experimental analyses were conducted on a real case study of a representative stretch of the Calore river, located in the Cilento Park (province of Salerno, Campania Region, Italy), in order to validate the proposed method. Preliminary findings from the contextual analysis highlight a strong ecological and touristic value of the area. The application of the proposed methodology demonstrated its effectiveness as a proactive management tool, facilitating sustainable development and improving ecosystem resilience. The approach represents a significant step toward integrated, proactive, data-driven water resource governance in protected environments.

KEYWORDS: Environmental monitoring, Ecosystems, Environmental pressure, Water management, Sustainable Development

PAPER ID: cest2025_00335

On-site elemental analysis of environmental waters using portable XRF

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ABSTRACT

Rapid on-site detection of metals in water is essential for timely environmental assessment, especially in remote areas or time-critical situations. In this work, we present a portable measurement system that combines preconcentration filters with a portable X-ray fluorescence (pXRF) analyzer. Filters for Mn, Co, Ni, Cu, Zn, Pb, and U were fabricated using nanoporous silicon or silicon carbide with polymeric binders, while arsenic was captured using ferrihydrite-based filters. Water samples were collected from lakes, boreholes, and wells, and measured on-site. Detection limits as low as 12 µg/L for metals and 1.3 µg/L for arsenic were achieved, depending on sample volume. Results were validated against laboratory ICP-MS analysis. The lightweight, battery-operated setup enables field deployment with total measurement times as short as 15 minutes, offering a practical tool for preliminary screening and environmental monitoring in challenging conditions.

KEYWORDS: On-site metal analysis, Portable XRF, Water quality monitoring, Trace metals detection

PAPER ID: cest2025_00461

Comparative hydrochemical assessment of groundwater quality from different aquifers for irrigation purposes: Study area Armavir Region in Armenia

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ABSTRACT

Groundwater quality is a key parameter in sustainable agriculture and water resource management. Poor groundwater quality directly affects soil properties and crop yields. This research aimed to study and assess the irrigation properties of groundwater in the Armavir region, one of Armenia's major agricultural centers. For the first time, groundwater irrigation suitability in this area has been evaluated using advanced methods, considering both the region's climatic conditions and the impact of anthropogenic factors. Sampling was conducted from 72 wells, 41 of which belonged to unconfined aquifers and 31 to confined aquifers. Often, the same groundwater with different indicators can have significantly different water quality, therefore, it is preferable to use the USSL and Wilcox plots, each of which includes two indicators and gives a more integral assessment. In this case, Electrical conductivity (EC) and various indices (SAR and Na%) were used in the graphical analysis. USSL plot analysis data showed that groundwater from wells in the unconfined aquifer has a high salt and low alkalinity hazard, while groundwater from the confined aquifer is suitable for almost all types of soils. According to Wilcox, most of the wells in both horizons fall into the "good to permissible" category. However, insufficient groundwater quality was observed at some monitoring wells, and long-term irrigation with such groundwater can lead to soil degradation and hinder the implementation of the SDGs.

KEYWORDS: Groundwater quality, Hydrochemical property, Sustainable agriculture, USSL and Wilcox plots

PAPER ID: cest2025_00198

SESSION 15 - ENVIRONMENTAL EXPOSURES AND HUMAN HEALTH

Thursday 4 September – afternoon

Exposome, Ultrafine Particles, and Glioblastoma: A New Perspective

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ABSTRACT

Glioblastomas (GBM) are the most common primary brain tumors in adults, but their causes remain largely unknown. Environmental exposures are suspected to play a role; however, the data is limited due to analytical challenges and the difficulty of obtaining brain samples for cohort studies. This study investigates the chemical exposome in GBM, with a focus on an underexplored source: Ultrafine particles (UFPs), the smallest component of air particulate matter. UFPs are known to penetrate the brain and transport hazardous substances, and previous epidemiological studies suggest a potential link between ambient air UFPs and disease incidence. This study leveraged the Bellvitge Glioma Cohort (BGC) from HUB-IDIBELL, a unique retrospective cohort of 400 patients with high-quality histopathology brain tumor samples collected from 2005 to present. Additionally, non-tumor brain samples from autopsies were analyzed. In this proof-of-concept study, 33 GBM samples and 20 non-tumoral brain samples were examined using a comprehensive HRMS-based wide-scope target and nontarget analysis. We also analyzed 20 UFP samples from the metropolitan area of Barcelona, where cohort patients lived. A total of 49 exogenous chemicals, including various industrial compounds, were identified. While chemical profiles in GBM differed significantly from those in healthy brain tissue, no direct link to disease onset could be established. However, the results underscore the need for thorough assessments of potential chemical contributions to GBM. Notably, several air pollutants linked to road traffic, such as tire additives, were detected, supporting the hypothesis that hazardous chemicals may access the brain via the olfactory pathway. Our UFP analysis from the Barcelona area revealed over 20,000 features, including chemicals previously identified in the brain (e.g., tire additives), further substantiating this hypothesis.

KEYWORDS: Exposure, brain cancer, air pollution, HRMS

PAPER ID: cect2025_00027

Acknowledgments:

This work was supported by the Spanish State Research Agency (Agencia Estatal de Investigación, AEI) through grant CNS2023-143711, awarded under the 2023 call for “Research Consolidation Grants” within the State Programme to Develop, Attract and Retain Talent, part of the Spanish R&D&I Plan 2021–2023, and funded by the European Union through the Recovery, Transformation and Resilience Plan.

N-nitrosodimethylamine (NDMA) in Drinking Water: A Probabilistic Health Risk Assessment in Asia

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ABSTRACT

N-nitrosodimethylamine (NDMA) has been detected in many daily usable items including drinking water, foods, and cosmetics. It can be formed in drinking water during the disinfection process, which has been detected in numerous drinking water systems worldwide, posing significant public health issues. NDMA in drinking water is often linked to disinfection processes such as chloramination, chlorination and ozonation. In this study, multi-pathway human exposure and risk of NDMA in drinking water was analyzed for Asia continent using the probabilistic concept. The major pathways of NDMA exposure include ingestion with drinking water, and inhalation and dermal contact during bathing, showering, swimming in chlorinated swimming pools and house-cleaning. The estimated average lifetime cancer risk for NDMA was 3.42×10^{-5} , exceeding the USEPA's acceptable threshold of 1.0×10^{-6} by 34.2 times, highlighting public health concerns. Several possible strategies were highlighted to control NDMA in drinking water. The findings underscore the need for establishing stricter regulations, improved finished water, NDMA exposure reduction and risk mitigation measures for drinking water.

KEYWORDS: Drinking water; N-nitrosodimethylamine (NDMA); human exposure; cancer risk; loss of disability adjusted life year (DALY)

PAPER ID: cest2025_00234

The pollution before the flood: Microplastics and PAHs in water, sediment and fish from Júcar River basin (E Spain)

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ABSTRACT

In October 2024, Júcar River and its tributary, Magro, were responsible for the fatal floods in the south of the province of Valencia. There is general concern about the environmental pollution by microplastics (MPs) due to their possible adverse effects on organisms and their ability to accumulate various types of contaminants, such as polycyclic aromatic hydrocarbons (PAHs). Thus, the co-occurrence of MPs and PAHs was investigated in superficial water, sediment and fish samples from the Júcar River basin (E Spain) to set the benchmark of pollution before the flood. Extraction protocols were optimized according to matrix and analyte type. MPs were determined by micro-FTIR (μ FTIR) and Pyrolysis coupled with Gas Chromatography-Mass Spectrometry (Py-GC-MS), while PAHs were quantified using GC-MS. Ecological and human health risk was, also, estimated by different indexes. Both MPs and PAHs were detected in the majority of samples with higher concentrations near the river mouth that coincides with the metropolitan area of Valencia and an industrialized zone. A potential ecological and cancer risk would be possible due to exposure to MPs and PAHs. This study provides helpful insight into pollutants and their associated risk a few months before the rivers overflowed.

KEYWORDS: flood, microplastics, PAHs, ecological risk, cancer risk

PAPER ID: cest2025_00284

Trihalomethanes in Swimming Pools: Modern Strategies for Surveillance and Risk Assessments

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ABSTRACT

Trihalomethanes (THMs) are volatile disinfection byproducts formed by the reaction of chlorine with organic and inorganic matter in pool water. The most common compound is chloroform, which can penetrate the body through the respiratory tract, skin and gastrointestinal tract. Long-term exposure to THMs can lead to health problems, including cancer risk. The article discusses modern strategies for monitoring and assessing the risk of THMs in the swimming pool environment. Key measures include regular measurement of THM concentrations in water, exposure modeling and risk assessments for different user groups. The research was based on a case study of 5 public swimming pools in southern Poland. The results indicate the need to adopt new disinfection strategies and sometimes to upgrade ventilation systems. Effective management of water quality in swimming pools is important for the health of users.

KEYWORDS: disinfection byproducts; trihalomethanes; swimming pools; risk assessments.

PAPER ID: cest2025_00334

DLLME: An Innovative Approach for Rapid and Low Cost Determination of Psychoactive Substances and Antibiotics in Wastewater

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ABSTRACT

Wastewater-based epidemiology (WBE) has been demonstrated to be a valuable tool in the assessment of the health and well-being of a community, with the detection of various indicators by analysing the influent wastewater coming in Wastewater Treatment Plants. The accurate identification and quantification of analytes and their metabolites associated with daily life facilitate the extraction of conclusions regarding trends and the prediction of future consumption.

The analysis of wastewater necessitates a methodology that is capable of cleaning the sample and preconcentrating the analytes, which are present in low concentrations. A highly promising pretreatment method is DLLME due to its combination of rapidity and reduced cost. The objective of this study is to reveal the capabilities of DLLME in Wastewater Epidemiology.

An optimized DLLME method was developed for the monitoring of two significant classes of compounds: namely, psychoactive substances and antibiotics. This method was developed through the selection of the most suitable conditions and was subsequently validated. The validated method was applied to real samples from two different periods of time, and the results were statistically compared with the corresponding ones from the validated SPE method.

Keywords: DLLME, Wastewater- Based Epidemiology (WBE), Antibiotics, Psychoactive substances

Paper ID: cest2025_00482

Iodine biofortification of red radish (*Raphanus sativus* L.) cultivating on hydroponic system

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ABSTRACT

Iodine is a crucial micronutrient for producing thyroid hormones, which regulate metabolism, growth, and development, particularly influencing cognitive and physical health in early life stages. Traditional approaches like iodized salt have limitations, especially in reaching remote populations, prompting interest in the biofortification of crops as a sustainable solution to enhance iodine intake. The study examined the physiological characteristics, biomass production, iodine concentration variations, and key nutritional components of red radish (*Raphanus sativus*) plants. Conducted in a hydroponic system, the research utilized varying concentrations of iodine in the form of potassium iodide (KI) and potassium iodate (KIO₃), ranging from 0.01 to 1.0 mg I/L. The findings revealed that iodine supplementation did not significantly impact photosynthetic efficiency or pigment levels; however, it did enhance biomass production, particularly in the swollen taproot, which yielded the highest biomass compared to other plant parts. Iodide treatment was effective only at lower concentrations, while iodate treatment showed positive effects at higher concentrations (0.05 to 0.5 mg/L). Additionally, increased iodine concentrations in the nutrient solutions resulted in elevated iodine levels across all plant parts, with iodide treatment demonstrating 2-10 times greater efficiency than iodate treatment. The type of iodine applied influenced the transport of essential elements differently.

KEYWORDS: Biofortification, Iodine, *Raphanus sativus* L., hydroponic system

PAPER ID: cest2025_00092

Human Health Risk Assessment and Action Plans for PM₁₀ Pollution: a new integrated methodology for Campania Region (Italy)

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ABSTRACT

Air pollution is a global issue with harmful effects on both human health and the environment. According to the World Health Organization (WHO), air pollution causes approximately 7 million premature deaths each year, primarily due to respiratory and cardiovascular diseases. The study presents and discusses a project named ARIA ("Risk Analysis and Action Plans for PM₁₀ Pollution in the Campania Region"). ARIA project addresses the critical issue of PM₁₀ air pollution and its health impacts in the Campania Region (Southern Italy), a territory characterized by dense urbanization. Funded through a regional program in collaboration with MASE (Italian Ministry of Environment and Energy Security), the project aims to assess population exposure to PM₁₀, estimate associated health risks, and develop evidence-based mitigation strategies. To this end, a novel integrated methodology has been developed to implement a multidisciplinary approach, integrating demographic vulnerability analysis, emission estimation, air dispersion modeling, and health risk assessment following WHO guidelines. Emissions from key sources, including industry, traffic, residential heating, and agriculture, have been spatially allocated using a 1 km² grid. The CALPUFF and CALINE models have been implemented for the simulation of pollutants dispersion, while in-field measurements supported model validation. Health risks was evaluated in terms of premature mortality and years of life lost (YOLL), based on population data, mortality rates, and estimated pollutant concentrations. The city of Salerno was selected as a pilot site for methodology validation.

KEYWORDS: air pollution, risk analysis, urban environment, dispersion modelling, emissions inventories.

PAPER ID: cest2025_00457

Environmental Pollution and the Mediterranean Diet: A Study on Health and Fertility

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ABSTRACT

Environmental pollution significantly endangers human health, contributing to premature deaths, chronic diseases, reduced longevity, and declining fertility. While adherence to the Mediterranean diet supports increased lifespan and reproductive health, the influence of environmental quality remains insufficiently explored.

This study adopts a multidisciplinary One Health approach to examine the relationship between environmental quality and health outcomes in two areas of the Campania region (southern Italy). It integrates environmental monitoring, epidemiological data, and assessments of dietary and lifestyle habits. The initial phase involves territorial and demographic analysis to understand aging patterns. Historical data on air, water, and soil quality will be used to assess long-term environmental trends. Disease incidence and mortality rates linked to pollution will also be evaluated. By cross analyzing these datasets, the study aims to identify qualitative associations between environmental conditions and health indicators. These will be further investigated using advanced statistical and mathematical models. Expected results include actionable strategies to mitigate environmental health risks, promote sustainable dietary practices, and support longevity and fertility. Ultimately, this research emphasizes the importance of integrating environmental quality into public health strategies to address health inequalities in contemporary society.

KEYWORDS: One Health, Environmental quality, Environmental Exposure, Environmental medicine, Health risks assessment

PAPER ID: cest2025_00440

Acknowledgements

This work is part of the "Longevity & Fertility Algorithm" (LAFA) project – CUP: E63C22002030007. LAFA project was funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 – Call for tender No. 341 of 15 March 2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU.

Can the Fulton and hepatosomatic indexes be good indicators of charity of the baltic fish according to microplastics pollution?

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ABSTRACT

Pollution with MPs and health condition of herring and by-catch species like cod, flounder, sprat, long-spined bullhead, and lumpfish from the Baltic Sea were assessed. Fish were characterized by varying biometric features and condition indexes (i.e. the Fulton factor (K) and the hepatosomatic index (HSI)). MPs items were identified in all species, with the highest contribution in lumpfish (78.9%) and the lowest in sprats (21.4%). The number of items per fish ranged from 1 to 12, averaging 3.14, with MPs observed in the gills (46%), liver (16%), and digestive tract (38%). Multidimensional analysis showed a relationship between fish pollution with MPs and health condition indexes. It revealed that the shoals of Baltic herrings could be assessed based on condition indexes according to fishing zones and, in general confirms, that there is a link between pollution of MPs and fish health condition. The analysis showed that Baltic herring less contaminated with MPs were characterized by a higher K value, indicating better health in comparison to individuals more contaminated with MPs. Proposed methodology can be considered as important tool in monitoring of ecological risks for fish exposed to MPs pollution and other environmental stressors.

KEYWORDS: plastic pollution, health condition factors, the Baltic Sea, multidimensional PCA, biometric features

PAPER ID: cest2025_00082

SESSION 16 – ADVANCED OXIDATION PROCESSES

Friday 5 September – morning

Nanotechnology advances in photocatalytic reactors for water treatment and wastewater reuse

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ABSTRACT

Innovative and scalable photocatalytic reactors have been developed for the degradation of pesticides in agro-industry and the disinfection of effluents from municipal waste water treatment plants. The reactors (slurry batch reactor, or membrane reactor) are working under continuous flow conditions, can incorporate novel, environmentally friendly photocatalytic materials and be powered by solar light, a key factor for the reduction of energy requirements for water treatment. They represent a cost-effective cutting-edge application of nanotechnology for enhancing water quality.

KEYWORDS: photocatalysis, water treatment, reactor engineering

PAPER ID: cest2025_00321

Acknowledgements

This work was funded by the EC, Environment Programme (EU: H2020 LIFE17 ENVGR 000357 PureAgroH2O Project). The Greek Green Fund is also co-financing the partner NCSR "Demokritos" in the frame of the implementation of the LIFE program. P.F. acknowledges funding by Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW)-Alternative Water Resources Prize 2014.

Treatment of water contaminants of emerging concern with advanced oxidation processes

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ABSTRACT

Due to anthropogenic activities, a variety of chemicals have been synthesized, depending on different purpose. Pesticides and pharmaceuticals and personal care products are well-known as water contaminants of emerging concern (WCEC) because they remain in the aquatic environment for a long time and demonstrate acute or chronic effects on the health of humans, animals and the ecosystem. Therefore, to protect the environment as well as human health, reliable technologies must be developed for removing WCEC in water.

Advanced oxidation processes (AOPs) have been extensively studied to treat WCEC by employing reactive species, including hydroxyl radicals, sulfates radicals, and chlorine radicals, depending on oxidants. Because the reactive species have high oxidative/reductive potential, they readily attack and break down WCEC in water. To produce the reactive species in AOPs, UV-based homogeneous processes or catalysts-based heterogeneous processes are widely developed and investigated.

For this study, different iron-based catalysts were developed to activate peroxydisulfate or peroxydisulfate for decomposing WCEC. Also, an UV-chlorine process was employed to remove WCEC. The developed catalysts were thoroughly characterized and both processes were carefully evaluated for effective degradation of different WCEC. In this presentation, the results of catalysts characterization as well as the activity evaluation of both processes for the degradation of WCEC will be provided and discussed in detail. Also, degradation pathways of target contaminants will be proposed.

KEYWORDS: Advanced Oxidation Processes, Water Contaminants of Emerging Concern, Oxidants, Radicals

PAPER ID: cest2025_00462

Hydrogen Generation from Wastewater-Derived Organics via Solar Photocatalysis Using Low-Cost Cu-TiO₂ Composites

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ABSTRACT

Recent research has focused on developing Cu-based TiO₂ photocatalysts for sustainable hydrogen production via solar photoreforming of organic compounds typically present in urban and industrial wastewater. Copper, either in solution or integrated into TiO₂, forms heterojunctions that enhance photocatalytic H₂ generation by improving visible light absorption and promoting charge carrier separation.

This study investigates hydrogen evolution from oxygenated organic compounds, such as alcohols and carboxylic acids, using Cu-modified TiO₂-P25 catalysts synthesized via a simple in situ photodeposition method. The incorporation of Cu nanoparticles significantly alters the optical properties of TiO₂, boosting its activity under solar irradiation. Experimental results demonstrate notably higher hydrogen production rates with Cu-TiO₂ compared to bare TiO₂-P25. For instance, glycerol yielded 5.5 μmol H₂/min with Cu-TiO₂, versus 2.1 μmol/min with unmodified TiO₂. However, no enhancement was observed with benzyl alcohol, 2-propanol, or acetic acid, suggesting that hydrogen evolution is substrate-specific and likely influenced by adsorption behavior and oxidation pathways. A mechanism has been proposed to explain these variations based on light absorption and charge transfer dynamics.

KEYWORDS: Photocatalysis; Hydrogen production; Wastewater treatment; TiO₂; Copper.

PAPER ID: cest2025_00384

Synthesis and application of Z-Scheme g-C₃N₄/g-C₃N₅ heterotype homojunction for aquatic pollutants degradation

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ABSTRACT

Advanced oxidation processes (AOPs) are key technologies in wastewater treatment for their effectiveness and low environmental impact. Heterogeneous photocatalysis, particularly using TiO₂, has been extensively studied; however, its wide band gap (~3.2 eV) limits its efficiency under solar light. This has led to interest in visible light-activated photocatalysts, such as g-C₃N₄, which has a band gap of about 2.7–2.8 eV but suffers from high recombination rates of photogenerated e⁻/h⁺ pairs. Recently, nitrogen-rich graphitic carbon nitride (g-C₃N₅) has shown promise with a narrower band gap (~1.9 eV) but still faces recombination issues. Hoping to address these problems, this work evaluates the synthesis of a g-C₃N₄/g-C₃N₅ Z-Scheme heterotype homojunction, which promotes e⁻/h⁺ separation and broadens the catalyst response in the visible spectrum. In this concise presentation of the work, the synthesis of the materials took place through the direct calcination of urea as precursor for g-C₃N₄, and 3-amino-1,2,4-triazole (3-AT) for g-C₃N₅, utilizing water as the mixing agent. The materials were synthesized using different ratios of the two monomers, were characterized using methods such as XRD, FT-IR, and DRS, and the photocatalytic activity is being investigated, targeting Haloperidol, an antipsychotic drug, delivered as an aquatic pollutant in WWTPs.

KEYWORDS: Heterogeneous photocatalysis, Z-Scheme, graphitic carbon nitride, Haloperidol

PAPER ID: cest2025_00239

Acknowledgements

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Mitigating Cyanobacterial Blooms via Ozonation: Insights into Species Sensitivity and Treatment Efficacy

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ABSTRACT

The intensifying climate crisis strengthens freshwater scarcity and water pollution, heightening the urgency for innovative water management solutions. Cyanobacteria, commonly known as blue-green algae, contribute to this challenge by causing eutrophication events and producing harmful cyanotoxins in surface waters, driven by nutrient enrichment from agricultural and urban activities. The globally increasing cyanobacteria blooms threaten drinking water safety, aquatic ecosystems, and recreational water use. Cyanotoxins, such as microcystins and anatoxins, pose severe risks to human health, including liver damage, gastrointestinal issues, and neurological symptoms. Ozonation has emerged as a promising approach in water treatment, effectively disrupting cyanobacterial cells and degrading cyanotoxins simultaneously. This study investigates the sensitivity of different cyanobacteria species (*Microcystis* sp., *Aphanizomenon* sp., and *Cylindrospermopsis* sp.) and a green alga (*Scenedesmus obliquus*) to ozone exposure, determining optimal dosages for biomass disruption and assessing the influence of cell age on treatment outcomes. Experimental results reveal that cyanobacteria exhibit greater sensitivity to ozone than green algae, with a 4 mg/L dose effectively destroying cyanobacterial biomass and preventing recovery. Lower ozone doses impact cell vitality but allow recovery within three days. The age of the cultures also significantly affects their response to treatment, emphasizing the need for tailored ozonation strategies. These findings highlight ozonation's potential as a sustainable and efficient water treatment solution to mitigate cyanobacterial blooms, safeguarding water resources and public health.

KEYWORDS: cyanobacteria. ozonation, emerging treatment, photosynthetic vitality

PAPER ID: cest2025_00157

Coupling artificial neural network and fluorescence spectroscopy to control CEC removal during AOPs

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ABSTRACT

Contaminants of emerging concern (CEC) include anthropogenic compounds frequently detected in natural and engineered water systems at trace concentrations. CEC are relevant due to their high persistence and mobility and adverse effects on humans, wildlife, ecosystems. One of the main challenges is the lack of real-time monitoring systems of CEC and process parameters at wastewater treatment plants (WWTPs). In this study, fluorescence indexes and artificial neural networks (ANNs) were used to track the removal of CEC from secondary and tertiary WWTP effluents during O₃- and UV-based advanced oxidation processes operated at pilot scale. Results show that indexes served as effective surrogate parameters to monitor CEC removal within individual wastewater types. The application of an ANN model improved the correlation ($R^2 = 0.87$) between CEC and fluorescence indexes, highlighting the potential for fluorescence-based monitoring of CEC removal regardless of WWTP effluent type.

KEYWORDS: Contaminants of emerging concern; real-time monitoring; advanced oxidation process; fluorescence indexes; artificial neural network.

PAPER ID: cest2025_00244

Acknowledgements

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Novel Heterostructured Holey Graphene-NiTiO₃/TiO₂ Nanocomposite Enabled Photocatalytic Mixed Matrix Membranes for Effective Antibiotics Removal

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ABSTRACT

Antibiotics are widely used in healthcare, agriculture, and animal husbandry, contributing to their increased presence in water sources through wastewater, agricultural runoff, and improper disposal. This leads to antibiotic-resistant bacteria and poses risks to both ecosystems and human health. Hospital wastewater, in particular, contains antibiotics, amplifying these threats. Photocatalytic membrane reactors (PMRs), which combine photocatalysis and membrane filtration, offer a promising solution to address this issue. This study focuses on synthesizing HGN-NiTiO₃/TiO₂ nanocomposites by integrating NiTiO₃/TiO₂ with holey graphene (HGN). These nanocomposites demonstrate effective photocatalytic degradation of antibiotics when exposed to light. Additionally, mixed matrix membranes (MMMs) were developed using varying HGN-NiTiO₃/TiO₂ loadings to optimize the membranes' performance. The membranes showed an asymmetric porous structure, enhancing water flux, antifouling properties, and photocatalytic efficiency. The best results were achieved with a 2 wt.% HGN-NiTiO₃/TiO₂ membrane, demonstrating excellent antifouling and antibiotic degradation performance. Hybrid ultrafiltration membranes with self-cleaning and photocatalytic properties were also fabricated using the optimal nanocomposite, showing effective self-cleaning ability and enhanced photocatalytic efficiency in decomposing antibiotic solutions. These findings highlight the potential of HGN-NiTiO₃/TiO₂-based membranes in PMRs for effective hospital wastewater treatment and antibiotic removal.

KEYWORDS: HGN, heterostructured HGN-NiTiO₃/TiO₂; photodegradation, antibiotic removal, self-cleaning membranes.

PAPER ID: cest2025_00153

SESSION 17– CIRCULAR ECONOMY AND SUSTAINABLE RESOURCES MANAGEMENT

Friday 5 September – morning

Firm Size and Sustainability Certifications: Understanding Business Economic Drivers in Certification Adoption

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ABSTRACT

This study explores how firm size influences sustainability certification adoption in Italy. Expanding from a regional to a national scope, a two-step methodology is used: web-scraping to assess how firms present certifications online and statistical analysis correlating adoption rates with firm size, revenue, and industry sector. Findings indicate that larger firms are more likely to obtain certifications due to financial resources and stakeholder pressure, while small and medium enterprises (SMEs) face cost and operational barriers. Industry-specific trends show higher certification rates in manufacturing and export-driven sectors. The study highlights the need for policy support, such as financial incentives and streamlined certification processes, to enhance SME participation and promote broader sustainability adoption in Italy's business environment.

KEYWORDS: Certifications; Circular Economy; Economic Drivers; Sustainability; Small and Medium Enterprises.

PAPER ID: cest2025_00064

Innovating pharmaceuticals with sustainable 3D printing for personalized healthcare

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ABSTRACT

The pharmaceutical industry significantly contributes to environmental degradation. Traditional drug manufacturing processes generate substantial waste and consume excessive energy, while the industry's one-size-fits-all approach fails to meet the growing demand for personalized treatments. The 3D-SustainDrugs project addresses the pressing need for sustainable practices in pharmaceutical manufacturing by developing a ground-breaking platform for the 3D printing of personalized drug delivery systems. This initiative integrates sustainability principles with advanced digital technologies to optimize the production of non-steroidal anti-inflammatory drugs (NSAIDs). The project targets significant challenges, including the high environmental footprint of pharmaceutical processes and the need for personalized treatments, aiming to reduce waste, energy consumption, and carbon emissions. By focusing on additive manufacturing, green processes, and circular economy principles, 3D-SustainDrugs redefines drug manufacturing to align with the goals of Industry 5.0. A key innovation of the project lies in the production of tailored 3D-printed drug forms, enabling precise dosage personalization and localized manufacturing, which significantly minimizes overproduction and logistical burdens. The project also emphasizes the use of biodegradable and recyclable materials. Through an interdisciplinary collaboration between academic institutions and industry leaders, 3D-SustainDrugs paves the way for a transformative shift in pharmaceutical production, fostering economic viability, environmental stewardship, and healthcare advancement.

KEYWORDS: Sustainable pharmaceuticals; 3D printing technology; personalized medicine; circular economy

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Customizable and Waste-Free Pharmaceuticals: PLA-Carbon Pills from Biomass Pyrolysis via FDM 3D Printing

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ABSTRACT

The pharmaceutical industry is called to adopt more sustainable manufacturing methods to meet current market needs since traditional drug production creates substantial waste while using much energy and failing to meet individualized treatment requirements. This study investigates circular and environmentally friendly methods to create customizable pharmaceutical forms under the framework of 3D-SustainDrugs project. The proposed method uses dual biomass valorization to produce a mixture filament of polylactic acid (PLA) from amylase-rich biomass and carbon from lignocellulosic pyrolysis biochar. The two bio-derived materials form a composite filament which enables Fused Deposition Modeling (FDM) 3D printing of pill platforms. The method enables drug incorporation following printing operations thus protecting the medication from heat exposure while producing customized pill forms for personalized dosing requirements. The combination of carbon with PLA in the filament provides structural benefits, adsorption properties and biodegradable characteristics. The circular economy principles receive support through this approach which connect waste-derived inputs to local free-waste manufacturing operations to achieve Industry 5.0 sustainability goals.

KEYWORDS: Personalized pharmaceuticals; Pyrolysis; Biochar; FDM 3D printing; Circular Economy

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Acknowledgments

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Sustainable Optimisation of Microalgal Biomass Production: Insights from the PhotoBioValue Project

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ABSTRACT

Microalgae are photosynthetic microorganisms with significant potential for the sustainable production of valuable compounds, including proteins, lipids, carbohydrates, and pigments. Within the PhotoBioValue project, multiple studies were conducted to optimise *Chlorella vulgaris* biomass production and biochemical composition by manipulating operational conditions. In one study, the impact of light spectra (red, blue, orange, and white) was explored, revealing that red light maximised growth rates ($0.509 \pm 0.004 \text{ d}^{-1}$) and carbohydrate accumulation (20.2–23.5% DCW), while blue light enhanced protein content (33.8–39.0% DCW), and white light promoted $\text{NO}_3\text{-N}$ uptake, lipid (21.6–24.5% DCW), and pigment accumulation. Another experiment examined high light intensities ($291\text{--}1107 \mu\text{mol m}^{-2} \text{ s}^{-1}$), demonstrating increased growth rates ($0.54 \pm 0.02 \text{ d}^{-1}$), nutrient removal efficiencies ($>97\%$ for $\text{NO}_3\text{-N}$ and $\text{PO}_4\text{-P}$), and boosted carbohydrate ($30 \pm 3\%$ DCW) and lipid accumulation ($13.0 \pm 0.4\%$ DCW), highlighting the potential for biofuel production. To better the understanding of microalgal growth dynamics different growth kinetic models were compared, focusing on the combined impact of light intensity and biomass concentration. The Bannister and Grima models were identified as effective tools for predicting microalgal growth dynamics, aiding in optimisation. A separate study investigated salinity levels (0–600 mM NaCl), where 150 mM NaCl optimised biomass production ($978 \pm 11 \text{ mg L}^{-1}$) without affecting nutrient removal and 300 mM NaCl promoted lipid ($24 \pm 1\%$ DCW) and carbohydrate accumulation ($32.3 \pm 0.6\%$). Additionally, the combined effects of light irradiance and exposure time were assessed using a solar simulator, identifying conditions that maximise biomass while preventing adverse effects. Together, these studies provided a comprehensive overview for enhancing microalgal biomass production and composition under diverse conditions. The findings have significant implications for biofuel production, bioremediation, valuable compound synthesis and the sustainable management of biomass.

KEYWORDS: Biochemical composition, Biomass valorisation, *Chlorella vulgaris*, Cultivation strategies, Operational conditions

PAPER ID: cest2025_00039

From Necessity to Conscious Choice: Second-Hand Clothing and the Environmental Impact of the Fashion Industry

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ABSTRACT

This paper takes a closer look at how our clothing choices impact the planet—and how a growing number of people are rethinking those choices. Once seen primarily as a last resort for those with limited means, second-hand clothing is now gaining recognition as a smart, sustainable, and even stylish option. As one of the most resource-hungry industries, fashion is responsible for around 10% of global carbon emissions and 20% of wastewater—figures that call for urgent change. By analyzing existing research and data, this study explores how the reuse of clothing fits into the circular economy and contributes to a lower-impact fashion system. It finds that while much of Europe's used clothing is exported to Africa and Asia—where it is reused, downcycled, or discarded—attitudes at home are shifting. Younger generations, in particular, are embracing second-hand not just out of necessity, but as a conscious choice that aligns affordability with environmental responsibility.

KEYWORDS: Second-hand clothing, Circular economy, Sustainable fashion, Consumer behavior

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Integrating ESG and Social Economy Principles into Philippine Curriculum: A Framework for Sustainable Development

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ABSTRACT

The global stress on Environmental, Social, and Governance (ESG) and Social Economy (SE) principles is vital for sustainable development. Integrating these into Philippine education is paramount given national environmental and social challenges, yet a systematic curriculum approach is lacking. This paper proposes a conceptual framework, derived from literature and policy synthesis, detailing core principles, curriculum entry points, key competencies, and action-oriented pedagogies. Its implementation can advance Philippine sustainable development goals by cultivating citizens equipped for responsible, sustainable practices.

KEYWORDS: ESG, Social Economy, Curriculum Development, Sustainable Development, Philippines

PAPER ID: cest2025_00012

The Role of ERP Systems in Supporting the Transition to a Circular Economy

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ABSTRACT

The introduction of Enterprise Resource Planning (ERP) systems is becoming crucial in facilitating the transition to a circular economy. These systems enable the integration and optimization of business processes, leading to more efficient resource management. The circular economy focuses on minimizing waste and extending the life cycle of products, which requires transparency, traceability, and real-time data, capabilities that ERP systems provide. This paper aims to outline the key roles that ERP systems play in supporting the transition to a circular economy, emphasizing how integrated information systems contribute to sustainability and improve operational efficiency. By analyzing the main functionalities of ERP systems, this paper explores how these systems facilitate better planning, control, and reporting in alignment with the principles of the circularity.

KEYWORDS: ERP system, circular economy, transition

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Lithium recovery from lithium-ion batteries: technical and environmental analysis

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ABSTRACT

The increasing global demand for lithium, driven by the transition to renewable energy and electric vehicles, presents significant challenges in meeting materials supply needs. Recycling lithium from end of life (EoL) lithium-ion batteries (LIBs) offers a sustainable alternative to mining. However, current hydrometallurgical recycling methods for lithium recovery from EoL LIBs are limited by the low efficiency and purity of the recovered salts. This study investigates a multi-step process aimed at lithium recovery from LIBs' black mass involving microwave-assisted carbothermal reduction, followed by leaching in deionized water and by direct evaporation to recover lithium salts. The effects of carbothermal reduction and of leaching temperature (25 and 60°C) were explored by assessing lithium recovery as Li_2CO_3 . Results show that microwave-assisted carbothermal reduction enhanced lithium recovery at higher leaching temperatures (60°C) by 8.06%, increasing lithium recovery from $79.78 \pm 2.08\%$ to $86.21 \pm 10.23\%$. However, its effect at 25°C was negligible, recovering $79.94 \pm 7.07\%$ of lithium without microwave-assisted carbothermal reduction and $79.34 \pm 2.44\%$ after microwave-assisted carbothermal reduction. Given the relatively small difference between the results, the alternative approach of avoiding microwave-assisted carbothermal reduction and performing water leaching at 25°C should be explored further. Indeed, a preliminary environmental analysis revealed that greenhouse gasses emissions associated with water leaching at 25°C amount to 12.19 ± 2.23 kg CO_2 eq per 1 kg of Li_2CO_3 , representing a 57% reduction compared to the emissions associated with microwave-assisted carbothermal reduction and water leaching at 60°C (28.47 ± 2.80 kg CO_2 eq per 1 kg of Li_2CO_3). Therefore, despite the technical improvements provided by microwave-assisted carbothermal reduction and water leaching at 60°C, future research efforts should be aimed at optimizing lithium water leaching at low temperatures.

KEYWORDS: lithium-ion batteries, recycling, lithium, water leaching, lithium carbonate

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SESSION 18 – ENVIRONMENTAL POLLUTION

Friday 5 September – morning

Distribution of lithium and fluorine containing compounds in the Hungarian section of the Danube River

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ABSTRACT

Due to the increasing production and recycling of lithium batteries over the world, we can calculate with increasing fluorine contamination in the aquatic environment and drinking water reservoirs. This study was conducted to qualification and quantification of five parameters; elemental lithium, inorganic fluoride, total adsorbable organic fluorine, and selected per- and polyfluoroalkyl substances - perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS) - along the Hungarian section of the Danube River. On the basis of these analytical data, the study aimed to assess the potential environmental risks posed by fluorine-containing compounds. These compounds are introduced into the river through tributaries and emissions from wastewater treatment plants, as well as factories producing lithium-ion batteries and wrapping paper along the Danube River banks. Concentrations were determined by applying the following analytical techniques: inductively coupled plasma mass spectrometer, combustion ion chromatography, ultra-high-performance liquid chromatograph mass spectrometer.

Considering the measured analytical data, it was established, that the total lithium level in the River varied in concentration range of 1-5 µg/L. Concentration of inorganic fluoride amounted to 28-76 µg/L, while the total adsorbable organofluorine was 0.22-12.5 µg/L. The PFOA and PFOS concentrations remained relatively stable, within a narrow range of 0.7-2.3 ng/L and 0.7-1.7 ng/L, respectively.

KEYWORDS: Danube, lithium, fluoride, organofluorine, PFAS

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***Cynara cardunculus* as a sustainable solution for phytoremediation of antimony contaminated areas**

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ABSTRACT

Cynara cardunculus (cardoon) is a promising bioenergy crop, well-adapted to the Mediterranean climate. Recent studies suggest its potential for phytoremediation of soils contaminated with heavy metals such as Cd, Ni, and As. This study explores the potential of cardoon for remediating soils contaminated with antimony. The following aspects were investigated: (i) effect of Sb contamination on phytomass production, (ii) effect of *Cynara* cultivation on the stabilization of Sb in soils and (iii) assessment of Fe(II) addition in enhancing soil remediation and plants growth. Experiments were conducted in 1.5-liter pots containing 1.3 kg of soil. Four-week-old cardoon seedlings were exposed to Sb at concentrations of 10, 20, and 40 mg/kg. Parallel treatments included Fe(II) addition at a fixed Fe/Sb molar ratio 1.5. The results showed that increased levels of Sb in soil had a negative impact on phytomass production, but simultaneous addition of Fe(II) prevailed over the toxicity of Sb and promoted plant growth. On the other hand, the water-soluble amount of Sb was reduced in the soils where cardoon was grown. Furthermore, Fe(II) addition enhanced Sb immobilization and plant growth. The findings highlighted the dual benefits of *C. cardunculus* in sustainable land management and renewable energy production on contaminated sites.

KEYWORDS: Phytoremediation, *Cynara*, antimony, stabilization.

PAPER ID: cest2025_00228

The Anthropocene and the wetlands: Pharmaceuticals and trace elements interactions in a Mediterranean wetland (L' Albufera, Spain).

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ABSTRACT

Trace elements and pharmaceutical products can affect the fragile balance in which Mediterranean wetlands are sustained. A clear example of that is L' Albufera Natural Park (Valencia, Spain), which shows constant pressure derived from high human and industrial occupation. In it, 14 areas were sampled to determine the levels of pharmaceuticals (PHs) and trace elements (HMs) in the soils. 17 drugs were selected, covering the most commonly used, and 12 trace elements of concern. The determination of the organic compounds was performed by Solid Phase Extraction (SPE), the extracts were analyzed by HPLC-MS/MS. The total content of 12 trace elements (As, B, Cd, Co, Li, Ni, Pb, Rb, Se, Sr, Ti and Tl) were extracted by microwave acid digestion, and the extractable fraction was obtained with EDTA, both were determined by ICP-OES. The highest average values were for Ti (518.62 mg/kg) and Sr (379.19 mg/kg), with maximum values of 807.37 and 724.43, respectively.

Thirteen of the pharmaceuticals analyzed were detected in soils, in at least one sample. Carbamazepine was the most frequently detected. The highest concentrations correspond to acetaminophen (17.70 µg/kg). The northern area is the most polluted in all cases. Some interactions have been found between HMs and PHs.

KEYWORDS: Emerging contaminants, Mediterranean wetland, Pharmaceuticals, heavy metals, environmental interactions.

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Biosurfactants and bioemulsifiers: from contaminated soils to remediation via food-waste valorization.

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ABSTRACT

Hydrocarbon-contaminated soils serve as rich ecological niches for the isolation of biosurfactant (BS) and bioemulsifier (BE) - producing microorganisms. This study adopted a waste valorization approach by converting food and agricultural residues into biosurfactants, which can be applied in soil remediation techniques, such as soil washing, soil flushing, and in situ biostimulation.

Real contaminated soil was used as inoculum for BS and BE production under anaerobic conditions, with nitrate and sulfate as electron acceptors. A microemulsion composed of waste frying oil and chickpea powder served as the carbon source, while hydrogen peroxide was added to stimulate microbial oxidative activity.

The effectiveness of the produced biosurfactants was evaluated using oil displacement and emulsification index (EI_{24h}) tests on various hydrocarbons, including gasoline, diesel, fuel oil, and n-hexadecane. Biodegradation and stimulation assessments are ongoing, employing either freshly or aged contaminated soils treated with crude or microfiltered biosurfactant mixtures as biostimulants. Phytotoxicity tests on *Zea mays*, *Lepidium sativum*, and *Sorghum bicolor* to assess the safety of these mixtures, are in progress.

The overarching goal is to demonstrate that waste-derived biosurfactants can enhance sustainable and cost-effective soil remediation strategies, without the need for microbial bioaugmentation.

Keywords: Biosurfactants, bioemulsifiers, waste-to-resource strategies, soil remediation.

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Does the Coexistence of Common Antibiotic and Metal Fuel Resistance Genes and Reshape Bacterial Community in Polluted Rivers?

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ABSTRACT

Surface water often receives effluent discharges from WWTPs, and agriculture runoffs reportedly contribute to sulfamethoxazole (SMX) and its resistance in river environment. SMX is commonly found antibiotics in the environment due to its overuse, causing persistent exposure to aquatic bacteria. SMX and Copper (Cu) can attribute to AMR emergence in the sensitive population, potentially inducing the community shift among the existing riverine bacteria. This study investigated the individual and combined effects of SMX and Cu on antibiotic resistance gene pattern and native populations in mesocosm reactors. Experiments were conducted with distinct conditions to monitor the water quality parameters, *uidA*, *sul2*, *int1*, and bacterial diversity. The findings indicated that *uidA* declined significantly within 24 h in all reactors. Contrastingly, *sul2* and *int1* did not decline drastically within 24 h, exhibiting a different trend, explaining their persistence up to 168 h. The 16S sequencing data across the reactors revealed the community shifts at genus level within 24 h, from predominance of *Arcobacter* (38%), *Bacteroides* (1.53%), and *Cloacibacterium* (1.12%) to *Arcobacter* (6%), *Bacteroides* (0.15%), and *Cloacibacterium* (0.22%). This study emphasizes that water quality parameters are significant determinants for the prevalence of ARGs in a highly contaminated riverine.

KEYWORDS: Sulfamethoxazole; Copper; Antibiotic resistance genes; Aquatic Mesocosm; Microbial Diversity

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Multi-Analytical Investigation of Oil Shale and Its Ash Fractions: Trace Element Partitioning and Environmental Implications

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ABSTRACT

This study presents a comprehensive multi-analytical investigation of oil shale and its combustion ash fractions using XRD, XRF, and LA-ICP-MS techniques. The mineralogical composition is characterized by a transition from carbonate-rich phases in raw shale to silicate-dominated assemblages in ash, accompanied by systematic changes in major oxides. Trace elements such as Cr, Pb, As, Ni, and Cd exhibit distinct partitioning patterns across WHB, Cyclone, and ESP ash fractions, with WHB ash showing the highest enrichment for most elements. Matrix-matched calibration ensures reliable quantification of trace elements. The results highlight the role of mineral transformation and ash morphology in governing element mobility during combustion. Notably, potentially hazardous elements tend to accumulate in coarse ash fractions, raising environmental concerns regarding ash disposal and reuse. These findings provide valuable insights into the geochemical behavior of trace elements during oil shale combustion and offer guidance for environmental risk assessment and waste management strategies.

KEYWORDS: Oil shale, Ash, Mineralogical composition, Chemical composition, Trace elements

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First gravimetric detection of a PFAS contaminant in water

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ABSTRACT

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are pollutants of concern due to their long-term persistence in the environment and human health effects. Among them, perfluorooctane sulfonic acid (PFOS) is very ubiquitous and dangerous for health. Currently, the detection levels required by the legislation can be achieved only with expensive laboratory equipment. Hence, there is a need for portable, in-field, and possibly real-time detection. Here, we report the first gravimetric detection of small-sized molecules like PFOS (MW 500) dissolved in water. A uniquely sensitive 434 MHz two-port surface acoustic wave (SAW) resonator with gold electrodes was used for signal transduction. The PFOS selective sensing layer was prepared from the metal-organic framework (MOF) MIL-101(Cr) using the discreet Langmuir–Blodgett (LB) film deposition method, considered the best method for supramolecular architecture. The measured frequency downshifts of around 220 kHz per 1 $\mu\text{mol/L}$ of PFOS, a SAW resonator-loaded QL-factor above 2000, and reaction times in the minutes' range are highly promising for an in-field sensor reaching the water safety directives. Additionally, we use the micrometer-sized interdigitated electrodes of the SAW resonator to strongly enhance the electro-chemical impedance spectroscopy (EIS) of the PFOS contamination. Thus, for the first time, we combine the ultra-sensitive gravimetry of small molecules in a water environment with electrical measurements on the same device. This combination provides additional sensor selectivity. All measurements were performed with pocket-sized tablet-powered devices, thus making the system highly portable and field-deployable. While here we focus on one of the emerging water contaminants, this concept with a different selective coating can be used for other new contaminants.

KEYWORDS: gravimetry; perfluoroalkyl and polyfluoroalkyl substances (PFAS); PFOS; metal-organic frameworks (MOF); MIL-101(Cr); surface acoustic wave (SAW) resonators; Langmuir–Blodgett (LB) films; chemical sensors; water purity

PAPER ID: cest2025_00189

A preliminary approach for the detection of marine pollutants by UV spectroscopy – application to seawater samples from Mytilene, Greece

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ABSTRACT

Marine pollution is an increasing global environmental problem, with a wide range of adverse effects on ecosystems and human health. Many analytical methods have been developed for the determination of various categories of organic and inorganic toxic pollutants, to assess seawater quality. However, their disadvantages can often include complex and time-consuming processes, use of expensive equipment, exposure to toxic reagents and solvents, non-environmentally friendly techniques. During the present study, an overview of applications of UV spectroscopy for the initial detection of marine pollutants of interest was performed as a possible simple alternative tool saving time, effort and resources. Selected compound categories, including diesel, sunscreens, olive mill wastewater components, as well as dissolved organic matter were tested by UV spectroscopy in seawater samples from the area of Mytilene, Greece. The results provide the basis for a first approach for seawater quality testing, prior to the application of more complicated methods whenever necessary.

KEYWORDS: UV spectroscopy, marine pollutants, sunscreens, dissolved organic matter

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An Extensive Analysis of Salinity Tolerance of *Portulaca oleracea* L. for Sustainable Agriculture

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ABSTRACT

Nowadays, crop insufficiency and decrease in productivity resulting from soil salinization is threatening the world. Thus, it is extremely important to improve crop yield and prevent land degradation process. This study investigated the response of a halophyte, Dandur (*Portulaca oleracea* L.) genotype, to salt stress in different soil mediums. *P. oleracea* plants were grown in the salinized soil of two different texture (clay and clay loam) under different salinity levels: non-saline, slightly saline, moderately saline, highly saline and extremely saline, where salinity is calculated, as the electrical conductivity of a saturated soil paste extract (EC_e , $dS\ m^{-1}$). Physiological, morphological and biochemical analyses collectively affirm the plant's capacity to withstand salinity stress. Various parameters, including stem diameter, shoot length, fresh (FW) and dry weight (DW), chlorophyll content index (CCI), transpiration rate (E), photosynthetic rate (Pn), water usage efficiency (WUE), uptake nutrient content, K^+/Na^+ ratio, and TDS exhibited varying responses to increased salinity in clay and clay loam soils. According to the obtained result plants growing in clay soils demonstrated greater tolerance as compared to plants growing in clay loam soils.

KEYWORDS: soil salinization, salt stress, halophyte, Dandur (*P. oleracea*), electrical conductivity

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SESSION 19 – PLENARY SESSION

Friday 5 September – morning

Zero-waste close-loop biorefinery system for food and yard waste valorization

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ABSTRACT

According to Hong Kong Environmental Protection Department (HKEPD), approx. 1.2 million ton food waste (FW) and 80 kilo ton yard waste (YW), as two typical organic solid wastes, are generated annually in Hong Kong. In fact, both FW and YW are valuable renewable carbon resources or green alternatives to petroleum for energy and chemical production. However, the majority of these resources in Hong Kong are disposed of as wastes at landfills or by incineration, causing not only fast-depleted landfill spaces, but also secondary pollutions (leachate, CH₄, GHG, NO_x, and dioxins). Therefore, it is urgent to develop new technologies for the harmless, reduction, and resourceful treatment of organic wastes for bioenergy and high value-added bioproducts, in order to achieve the goal of zero landfill by 2035 & carbon neutrality by 2050 in the Hong Kong and support China's initiative of promoting the construction of "waste-free cities". Previous efforts in conversion of biomass or organic solid waste (OSW) often focused primarily on specific target bioproducts, but they often overlooked the potential of valorization of the byproducts generated during the biomass/OSW conversion process.

In this talk, research projects including innovative biorefinery approach for conversion of food and yard waste residues into various value-added products such as biobased non-isocyanate polyurethane (NIPU) resin and sustainable aviation fuels (SAF) will be introduced to illustrate how science and engineering can be applied for organic waste valorisation.

The second part of the talk will focus on food waste hydrolysis using commercial enzymes for the mixotrophic cultivation of microalga *Euglena gracilis*. The remaining solids after food waste hydrolysis were mixed with algae biomass as the feedstocks of the hydrothermal liquefaction process for biofuel production.

KEYWORDS: Biopolymer, Biofuels and biochemicals, Circular economy, Organic solid wastes, Microalgae, Waste biorefinery

PAPER ID: cest2025_00437

SESSION 20 – WASTEWATER TREATMENT (4)

Friday 5 September – morning

Direct PHA production from sewage sludge: a scalable strategy for wastewater resource recovery

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ABSTRACT

Polyhydroxyalkanoates (PHA) are biodegradable polymers with wide-ranging industrial applications. Producing PHAs from sewage sludge offers a sustainable waste valorization and biopolymer synthesis strategy. Sewage sludge, a byproduct of wastewater treatment, is rich in organic carbon and thus serves as a suitable substrate for microbial PHA production. This process reduces the environmental burden of sludge disposal and enhances the economic feasibility of biopolymer production by using low-cost feedstock. Despite promising advances, large-scale implementation remains limited due to insufficient economic and ecological validation, as most studies focus on laboratory-scale optimization. This study presents encouraging preliminary results from batch experiments using three types of sludge: conventional activated sludge, integrated fixed-film activated sludge and mixed microalgae-activated sludge. The direct accumulation strategy was employed through controlled pulse-feeding and PHA was extracted using the green solvent 2-methyltetrahydrofuran. Preliminary results show consistent PHA production for activated sludge, achieving 23.1 ± 4.5 gPHA g⁻¹ VSS. The extraction process yielded high purity ($85 \pm 6\%$) and recovery efficiency ($87 \pm 2\%$). Ongoing experimental activities will test the efficiency of different sludge samples, validating the integration of the direct accumulation approach into future water resource recovery facilities paving the way for environmentally sustainable and economically viable biopolymer production.

KEYWORDS: Biosolids; Polyhydroxyalkanoate; Resource recovery.

PAPER ID: cest2025_00306

Investigation of waste-derived adsorbents for removal of NORM and non-regulated elements from mining wastewater

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ABSTRACT

The growing demand for rare earth elements (REEs) has led to an increase in mining activities, raising significant environmental concerns, particularly related to wastewater (WW) management. Mining WW can contain a complex mixture of contaminants, including naturally occurring radioactive materials (NORM), heavy metals, and organic compounds, which pose potential risks to both human health and the environment. Among various treatment approaches, adsorption is widely recognized for its simplicity, cost-effectiveness, and broad applicability. In this study, a range of adsorbents including metal-organic frameworks (MOFs), biochar, chitosan, zeolite, various biomasses, activated carbon, silica gel, and Fe₃O₄ were investigated for their potential to remove these contaminants. The goal is to evaluate and optimize the most effective adsorption process, either individually or in combination, for treating REE mining WW. This work contributes to the development of efficient, sustainable methods for mitigating the environmental impact of REE extraction.

KEYWORDS: Adsorption, NORM, mining wastewater, REE

PAPER ID: cest2025_00397

Acknowledgements

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Testing adsorption properties of natural zeolites for nutrients in wastewater

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ABSTRACT

Low-cost and efficient removal of nutrients in decentralized wastewater treatment plants is still challenging. The installation of supplementary adsorption systems may, in some cases, be appropriate. This work focused on two types of untreated natural zeolites, clinoptilolite and chabasite, with the objective of their characterization and testing of the adsorption properties. Characterization tests were first made on the samples. Inductively coupled plasma analyses showed a Si/Al ratio of 4.09 and 2.40 for clinoptilolite and chabasite respectively. X-ray diffraction tests showed different material purity (93% for clinoptilolite, and 73% for chabasite). The Brunauer–Emmett–Teller (BET) test showed that the specific area of the chabasite was 10-fold than clinoptilolite. Batch adsorption tests were conducted by introducing a known mass of sample in a mixing rotative reactor and measuring the contaminant equilibrium concentration. Column adsorption tests were done by introducing the water-ammonium solution into a PMMA column. Experimental measurements were compared to a general adsorption model. In all tests, the adsorption capacity of clinoptilolite was higher, despite the lower Si/Al ratio and higher specific area of chabasite. Such a result is attributed to the purity of the material. Natural zeolites confirm to be good candidates for ammonium adsorption in decentralized wastewater treatment plants, although their detailed preliminary characterization is fundamental.

KEYWORDS: Wastewater treatment, adsorption, ammonium, zeolites.

PAPER ID: cest2025_00132

Advancing Membrane Distillation: Multi-Channel Designs for Enhanced Energy Efficiency and Performance

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ABSTRACT

Membrane Distillation (MD) is a thermally driven desalination process with high rejection rates for non-volatile contaminants. However, traditional single-channel (SC) modules are limited by severe temperature polarization, reducing energy efficiency and overall productivity. This study explores two novel MD module configurations—Multiple Feed Channels (MFC) and Multiple Permeate Channels (MPC)—designed to improve mass and heat transfer, ultimately enhancing system performance and reducing energy consumption. Experiments were conducted using PTFE and PVDF membranes with and without spacers across a feed temperature range of 30°C to 70°C. The MFC and MPC modules demonstrated significant improvements over SC modules, achieving flux enhancements of up to 86% and reducing specific energy consumption (SEC) by up to 63%. Computational fluid dynamics (CFD) simulations validated these findings, revealing improved temperature distribution, reduced polarization effects, and optimized hydrodynamics. These findings highlight the potential of multi-channel MD designs for scalable and energy-efficient desalination and wastewater treatment applications, particularly when coupled with low-grade heat sources.

KEYWORDS: Membrane Distillation, Multi-Channel Module Design, Energy Efficiency, Computational Fluid Dynamics, Thermal Management

PAPER ID: cest2025_00206

Sustainable Desalination Through Eco-Friendly Membrane Technology: Enhancing Performance with Biodegradable Polymers and Green Solvents

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ABSTRACT

The integration of green concepts into membrane technology remains a key challenge. Among various fabrication methods, non-solvent-induced phase separation (NIPS) is the most widely used technique. However, concerns regarding secondary pollution present significant drawbacks. This study aims to replace the NIPS method with a more sustainable approach by utilizing polylactic acid (PLA) as a biodegradable polymer, dimethyl sulfoxide (DMSO) as a green solvent, and deep eutectic solvents (DES) as environmentally friendly additives.

A full characterization was performed to assess the structural and functional properties of the fabricated membranes. The transition to eco-friendly materials led to physical modifications in the membrane structure while maintaining its chemical integrity. Filtration tests demonstrated that membranes composed of 20 wt% PLA, DMSO, and 1 wt% choline chloride: ethylene glycol (ChCl:EG) (1:2) exhibited significantly enhanced water flux (1138 L/m².h) compared to membranes prepared with conventional solvents (554 L/m².h). Additionally, the modified membranes achieved a high oil rejection rate of 96% and improved anti-fouling properties, with a flux recovery ratio (FRR) of 80%.

These findings confirm that the novel combination enables the fabrication of an environmentally friendly membrane through a sustainable process.

KEYWORDS: Membrane Technology, Sustainable Membrane Fabrication, Biodegradable Polymer, Anti-Fouling Membrane

PAPER ID: cest2025_000207

Recovery of Fluoride using Fluidized-Bed Homogeneous Crystallization Process with Aluminum Sulfate as Precipitant; Validation with Industrial Wastewater

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ABSTRACT

Fluoride pollution from industries such as semiconductors, metal processing, and ceramics poses risks to both human health and the environment (Qiu et. al, 2022). High fluoride levels in wastewater can harm aquatic life and contaminate drinking water sources. This study explores the use of the Fluidized-Bed Homogeneous Crystallization (FBHC) process to remove and recover fluoride from wastewater. Aluminum sulfate was used as a precipitant to promote the formation of cryolite granules, which can be reused in various industries. Building on the work of Quedi et al. (2024), this research replicates and extends their 10-day experiment, optimizing operational parameters such as fluoride-to-aluminum molar ratio (2:1), pH (4.0–5.0), and influent flow rate (8 mL/min). The study further validates the process using actual industrial wastewater over an extended 30-day period. Key performance metrics include fluoride removal efficiency (%FR) and crystallization ratio (%CR), which previously achieved 93% and 91%, respectively, under controlled conditions. Results indicate that the FBHC process consistently maintains fluoride removal above 90%, though efficiency varies when applied to real wastewater due to impurities and fluctuating conditions. Adjustments in flow rate and pH control improved stability over time. Findings support the FBHC process as a scalable and sustainable fluoride recovery method, contributing to circular economy practices by repurposing industrial waste while minimizing environmental impact. This study highlights the potential of FBHC as a sustainable fluoride recovery method, offering industries a practical solution for wastewater management. By recovering fluoride, industries can minimize environmental impact while promoting resource reuse, contributing to circular economy practices and sustainable industrial operations.

KEYWORDS: Fluoride Recovery, Wastewater Treatment, Fluidized-Bed Homogeneous Crystallization, Aluminum Sulfate, Industrial Wastewater, Circular Economy

PAPER ID: cest2025_00210

Use of wastewater-based epidemiology data in an artificial neural network to estimate type 2 diabetes mellitus prevalence

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ABSTRACT

Diabetes mellitus (DM) accounts for 90% of global diabetes cases and is commonly managed using metformin which is detectable in wastewater. Wastewater-based epidemiology (WBE) is the measurement of this biomarker's concentration and consumption from wastewater samples to estimate DM prevalence rates. Artificial neural networks (ANNs) can be utilized to handle complex nonlinear datasets, but limited research exists on using ANNs with WBE for DM monitoring. This study aims to enhance the accuracy of DM prevalence rate estimations using ANNs with WBE, demographic, socioeconomic, and healthcare parameters. Using python, statistical analysis, specifically histograms, box plots, scatter plots and multiple linear regression analysis (MLRA) ($R^2=0.548$), revealed skewed data sets and weak linear correlations, stressing the need for ANN modeling. The provinces of China were randomly split into 21 for training and 10 for testing. In total, 126 models were made with varying combinations of architectures, variables, and inputs guided by SHAP sensitivity analysis. Based on the lowest mean squared error (MSE) from the actual DM prevalence, 12 were selected for optimization with risk factors as additional features. The best model had a MSE of 6.7365 which is lower than 12.8791 obtained from the correlation equation of Zhou et al (2024). Deviating from the control ANN, it only has WBE data and treatment rate as its features with epoch set at 500, which suggests more features create noise and higher epoch causes overfitting. This study demonstrates the huge potential of WBE integrated with ANNs for accurate disease monitoring.

KEYWORDS: Artificial Neural Network, Wastewater Epidemiology, Diabetes Mellitus, Artificial Intelligence, China

PAPER ID: cest2025_00155

Enhanced Long-Term Bioelectricity Production by *Shewanella oneidensis* MR-1 with *Pseudomonas* Strains and Ammonium-Oxidizing Bacteria

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ABSTRACT

Microbial fuel cells (MFCs) represent a promising technology for sustainable electricity generation and wastewater treatment. However, their long-term efficiency is hindered by limited substrate availability for electroactive bacteria such as *Shewanella oneidensis* MR-1. This study introduces a three-layered MFC design incorporating MR-1 with *Pseudomonas* strains and ammonium-oxidizing bacteria (AOB) to enhance bioelectricity production. Extracellular polymeric substances (EPS) produced by AOB strains—particularly *Nitrosomonas europaea* and *Nitrosococcus watsonii*—were found to be rich in proteins and polysaccharides, serving as degradable organic substrates. Introducing *Pseudomonas* strains improved EPS breakdown, promoting MR-1 biofilm development and electron transfer efficiency. Peak power densities of 0.279 W/cm² and 0.204 W/cm² were achieved with *S. oneidensis* MR-1 + *Pseudomonas putida* + *N. europaea* and *N. watsonii*, respectively. In contrast, *P. aeruginosa*-based systems produced lower peaks (0.085 W/cm² and 0.059 W/cm²) but maintained power generation for longer durations—up to 68.5 hours. These results highlight a trade-off between power density and operational longevity, offering insights into tailoring microbial consortia for specific energy and treatment goals. The structured integration of MR-1, *Pseudomonas*, and AOB provides a scalable strategy for enhancing MFC performance in ammonium-rich wastewater environments.

KEYWORDS: microbial fuel cell, *S. oneidensis* MR-1, *Pseudomonas*, ammonium-oxidizing bacteria, extracellular polymeric substances, power generation, wastewater treatment.

PAPER ID: cest2025_00275

Treatment of Greywater from households in Palestine

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ABSTRACT

Palestine faces a real water crisis, as the total available renewable water resources in the country is less than 180 m³/capita/year, which is much below the WHO standard of 1000 m³/capita/year. Treated Greywater can be one of the potential additional sources of water when managed and treated properly. The main objective of this study is to evaluate the technical feasibility of a physicochemical treatment process for treating greywater from various sources in Palestinian households. The treatment process consists of mechanical filtration followed by adsorption with activated carbon. Greywater samples from various sources including shower, cloth washing machine and laundry washing sink were collected from different locations in Palestine. The physicochemical and biological characteristics of the greywater samples were measured. The study investigates the effects of operating parameters, including greywater properties (i.e., COD, pH, NH₃, BOD, PO₄³⁻), mechanical filter characteristics (i.e., filter material, particle size and height), and adsorption bed characteristics (type of activated carbon, particle size and bed height) on the treatment efficiency.

KEYWORDS: greywater, treatment process, adsorption, filtration

PAPER ID: cest2025_00266

Greywater Characterization and Treatment Option in Palestine

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ABSTRACT

Designing and operating efficient greywater (GW) treatment processes demand well known characteristics. These characteristics depend on the GW source that is affected by the socioeconomic behaviors. The goal of this paper to measure and compare GW characteristics from three main sources in the southern part of the West Bank. These include shower, cloth washing machine and dishwashing sink. The study was performed through field sampling and laboratory analysis according to the applicable standard testing of each of the GW parameters. The investigated GW characteristic parameters included turbidity, pH, phosphate, ammonia, total dissolved solids (TDS), electrical conductivity (EC), COD, and phosphorous content and total fecal coliform and E. coli. The results indicate that samples collected from dishwashing sink are highly contaminated with COD and turbidity among other samples. The findings indicate that GW from laundry washing is highly alkaline and more concentrated in dissolved solids and ammonia than the other two source. On the other hand, GW from shower contains more fecal matter than other sources. These parameters are comparable to previously reported values. Based on these findings, mechanical separation followed by adsorption on activated carbon is designed and tested. The technical feasibility of such a treatment option is confirmed.

KEYWORDS: greywater, characterization, biological properties, physio-chemical properties

PAPER ID: cest2025_00267

Simulation of Treatment Process of Greywater from Palestinian Households

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ABSTRACT

A physico-chemical greywater treatment system for Palestinian households was simulated based on mechanical filtration followed by adsorption with activated carbon. The system aims to reduce fresh water consumption and enable the reuse of treated greywater for irrigation. The simulation software GPS-X was used to evaluate the efficiency of greywater treatment process by analyzing the effects of operating parameters, including greywater characteristics (i.e., COD, pH, NH_3 , BOD, PO_4^{3-}), filtration media (i.e., type, particle size), and greywater influent flow rate. The GPS-X system was tested on three main sources of greywater: shower, laundry, and kitchen. The simulation results showed that sand filtration effectively reduced Chemical Oxygen Demand (COD) in all tested samples. Specifically, COD in shower water decreased from 890 mg/L to 560 mg/L, in laundry water from 4,200 mg/L to 4,151 mg/L, and in kitchen water, which had the highest initial contamination, from >15,000 mg/L to 7,155 mg/L. However, the levels of ammonia (NH_3) and phosphate (PO_4^{3-}) remained unchanged after treatment. Ammonia levels stayed at 0.5 mg/L for shower and kitchen water and 2.5 mg/L for laundry water, while phosphate concentrations remained the same in all samples: 0.03 mg/L for shower water, 4.21 mg/L for laundry water, and 4.47 mg/L for kitchen water. Additionally, an improvement in flow rate was observed after treatment, indicating that the system effectively filtered water without causing significant clogging, ensuring a smoother and more consistent water flow. These findings are compared to laboratory testing for validating the simulation. The reduction in COD is attributed to the ability of sand filtration to remove suspended particles and partially degradable organic compounds, thereby lowering the concentration of oxidizable organic matter. However, ammonia and phosphate levels remained unchanged because these compounds are dissolved in water and cannot be easily removed through physical filtration alone. Phosphate removal requires chemical precipitation using coagulants. The improved flow rate indicates that the filtration system efficiently prevents particle accumulation, ensuring continuous water passage and reducing the need for frequent maintenance.

KEYWORDS: greywater treatment, simulation, GPS-X software, efficiently

PAPER ID: cest2025_00268

SESSION 21 – PLASTICS IN THE ENVIRONMENT

Friday 5 September – morning

Microfibers in the Riverine Environment

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ABSTRACT

Both the cellulose-based (CB) natural and petroleum-based (PB) artificial microfibers originating from wastewater treatment plants and atmospheric deposition are characteristic contaminants in the riverine environment. Due to their extremely slow degradation and long resident time, the research interest is focused first of all on the PB-microfibers. However, if we consider the similar harmful effect of the ingested natural or artificial microfibers on the microorganisms, first of all on the zooplanktons (e.g. cladocerans, rotifers, copepods) and the fact, that the biodegradation of CB-microfibers also needs a few months or half a year, it is evident that both type of these contaminants have negative effect on the aquatic ecosystem. Namely, the endangered zooplanktons form the base of the aquatic food web and its stability is threatened by the ingested microfibers. Our investigations in this topic were focused at first on the microfiber emission of a wastewater treatment plant (WWTP) in Budapest studying the microplastic and microfiber concentrations in the effluent.

KEYWORDS: microfiber, WWTP, river

PAPER ID: cest2025_00063

Microplastics and microfibres in marine environments: characteristics and concentrations in submerged sediments

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ABSTRACT

Marine environments are constantly threatened by anthropogenic activities and litter, especially along the coasts. Microplastics (MPs) and microfibers (MFs) are pervasive pollutants of anthropogenic origin in marine environments worldwide. These anthropogenic microparticles (AMPs) pollute water and threat habitats and species. While microplastics are monitored in different environments, very few studies focus specifically on microfibers, even if recent studies highlighted that natural and regenerated MFs can have abundances of up to 4 times greater than synthetic ones. Coastal areas are more vulnerable to pollution due to their location between terrestrial and marine environments and human activities. In this study, AMPs occurrence frequency in submerged sediments was investigated in the Sanremo Port, Italy. Fibres and fragments were the most present shapes. From a first comparison between the water matrices and the solid ones of the submerged sediment samples, the concentration of fragments is higher in the solid ones. Our results enhance understanding of microparticle pollution in coastal environments and its deposition and retention in submerged sediments. Future research is essential to deepen knowledge of microparticle dynamics and ecological impacts in marine systems.

KEYWORDS: microplastics; microfibers; pollution; marine environments

PAPER ID: cest2025_00068

Leachates from Recycled PET Plastic Concrete: Phytotoxicity and Characterization

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ABSTRACT

In the last two decades, several studies reported on plastic pollution worldwide in aquatic and terrestrial environments. Several past studies have presented plastic waste using concrete as one of the most promising solutions in plastic waste management. The most concerning part of using plastic waste in concrete as natural aggregate replacement present the deterioration of mechanical properties and increase of toxic impact in aquatic and terrestrial ecosystems. Therefore, research was done to determine the ecotoxicological potential of concrete in which 5% of recycled PET plastic replaced natural aggregate. A phytotoxicity test was performed according to ISO 20079:2005 using *Lemna minor*. Characterization of leachates used in phytotoxicity test was also made using ICP-OES. A comparison of inhibition of duckweed growth rate in conventional and PET concrete leachates showed no significant differences. The inhibition of growth rate in 100 g L⁻¹ concrete leachates was significantly higher than in 0.1 g L⁻¹ leachates. ICP-OES of concrete leachates showed no significant increase in the content of heavy metals. Based on the results of the phytotoxicity test and leachate characterization, PET concrete can be despite PET plastic content labeled as non-toxic to duckweed in aquatic environment. The presence of PET in concrete did not increase the toxic impact of concrete and its leaching behavior. Therefore, PET concrete presents an environmentally safe solution for plastic waste management and the conservation of natural resources by reducing natural aggregate consumption.

KEYWORDS: concrete, ecotoxicity, leaching, natural aggregate, PET plastic

PAPER ID: cest2025_00087

Influence of microplastics in the bioconcentration and depuration of organic pollutants in European eels

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ABSTRACT

Despite high levels of organic pollutants (OPs) have been found in ecosystems considered as the habitats of European eels, there is scarce information about the bioconcentration and depuration kinetics of such OPs, and only few research has reported them in different eels' tissues. In this research, the bioconcentration and depuration kinetics of a cocktail of 22 OPs in muscle, liver tissue and plasma of silver European eel were studied through a laboratory approach. Eels were distributed in three groups: control, exposed to OPs, and exposed to OPs and microplastics (MPs). The study was carried out for 58 days separated in two stages (i) exposure during days 0–28, and (ii) depuration during days 29–58. OPs in eels' muscle and liver samples were extracted by QuEChERS and dispersive solid phase extraction (dSPE) whereas plasma was extracted by SPE. Then, extracts were analysed via UHPLC-MS/MS. OPs showed increasing concentrations in the three tissues (PFDA, PFOS, PFOA, chlorpyrifos, and terbuthylazine), or in some of them. PFASs' bioconcentration followed the trend plasma > liver tissue > muscle. Two tendencies were observed in the depuration phase. One with OPs concentrations that tended to decrease (chlorpyrifos and terbuthylazine; in all tissues), another one, with concentration values that were similar or even tended to be higher than at the exposure phase (PFDA, PFOS, and PFOA; in all tissues). The presence of MPs seemed to affect the bioconcentration and depuration of OPs in eels' tissues (increased kinetic bioconcentration factor BCF_k). Pollutants are believed to be a key issue in understanding the reasons for the eels' stock decrease and therefore, further research about PFASs, PPCPs and pesticides accumulation, depuration and toxicity on eels is imperative as this may be of great interest for human risk assessment of this widely consumed fish.

KEYWORDS: Pharmaceuticals, perfluoroalkyl substances, pollutants cocktail, endangered species, eels' liver, plasma

PAPER ID: cest2025_00304

Shallow coastal litter in South Aegean Sea islands: abundance and sourcing

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ABSTRACT

The problem of marine litter has garnered increasing scientific, governmental and civilian attention in the last 20 years due to its severe environmental, economic and logistical impacts. Coastal and islandic regions with high touristic value, are particularly vulnerable to said impacts. Diver-led cleanups constitute a common approach to that issue by combining litter collection alongside their monitoring, with community engagement by non-disruptive means. This study showcases the findings of one such effort across 16 islands of the Southern Aegean Sea over a two-year period. The results indicate the dominance of plastic and metallic items, associated with recreational and fishing activities, as well as urban/householding sources.

KEYWORDS: Marine Pollution, Plastic Waste, Aegean Sea, Benthic Litter, Visual Census

PAPER ID: cest2025_00329

Benthic Marine Litter in Three Greek Gulfs: Are Mean Density Estimates Truly Representative?

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ABSTRACT

In this study, seafloor litter loads were compared across three major gulfs in Greece—Saronikos, Thermaikos, and Patras Gulf—by analyzing and synthesizing existing datasets from published research. Particular emphasis is placed on evaluating depth related spatial patterns, methodological differences, and potential sources of bias to provide a clearer understanding of the pollution status, highlight existing data gaps, and underscore the urgency for further research on the topic. Thermaikos appears to be the most heavily polluted, followed by Saronikos, with Patras Gulf showing the lowest litter levels. Plastic materials dominate the composition of marine litter, particularly food and beverage packaging, while a variable proportion of the litter is associated with fishing activities. Litter density tends to decrease with depth, with the dramatically higher concentrations observed in nearshore shallow waters (0–5 m) by scuba divers, whereas the lowest densities are recorded through trawling surveys in deeper areas.

KEYWORDS: benthic litter, scuba dives, ROV, trawlers, gulf

PAPER ID: cest2025_00371

Detection/evaluation tools for plastic pollution: application for coastal areas and streams of Mytilene, Greece

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ABSTRACT

Plastic pollution is nowadays a ubiquitous problem in most coastal areas in the world, as the macroplastics initially released act as precursors for the eventual formation of micro- and nano-plastics with a series of adverse effects on the food chain and on human health. As the determination of the final products (i.e. micro- and nano-plastics) necessitates tedious, time-consuming, expensive, non environmentally-friendly (solvents, reagents) analytical methods, the current work focused mainly on the initial macroplastics identification and characterization. In particular, the development of alternative early identification/estimation methods/tools for plastic pollution was considered, by use of representative parameters-indicators fast and easy to determine, within the framework of circular economy and environmental protection. After a relevant overview and research on alternative methodologies and tools to identify/estimate plastic pollution potential, selected representative parameters, were tested in samples from the coastal areas and streams of Mytilene. The results provided an initial picture of plastic pollution for the area of interest. Moreover, a plastic pollution identification tool was proposed and assessed by GIS spatial analysis and mapping.

KEYWORDS: plastic pollution, coastal areas, streams, GIS, spatial analysis

PAPER ID: cest2025_00410

Microplastics in the Estuarine Area of the Pineios River: Seasonal Trends and Variability

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ABSTRACT

This study examines the concentration and distribution of microplastics in the estuary area of the Pineios River. The results show a clear seasonal pattern, with much higher microplastic levels during the summer. The difference in the shape distribution between sediment and water samples shows that human activities and the physical and chemical properties of microplastics affect where they end up in the environment.

KEYWORDS: Microplastics; Pineios River; Estuarine pollution; sediments samples; water samples

PAPER ID: cest2025_00415

**SESSION 22 – ADVANCING CLIMATE RESILIENCE
THROUGH ENGAGEMENT OF CITIZENS: INSIGHTS
FROM THE CLIMAS PROJECT**

Friday 5 September – morning

Citizen-Collaborative Future Scenario Building Methodology

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ABSTRACT

Future Scenario Building (FSB) is a participatory foresight methodology that enables diverse stakeholders to collectively explore plausible and preferred futures. Grounded in the interdisciplinary field of Futures Studies, FSB supports proactive decision-making under uncertainty by identifying key drivers of change and constructing coherent future narratives. When embedded within Living Labs and Climate Assemblies—real-life, user-centered innovation environments—FSB exercises benefit from strong local engagement, contextual relevance, and collaborative knowledge production.

This paper presents the design, implementation, and outcomes of a participatory FSB process structured around four key phases: preparation, identification of drivers using the STEEP framework (Social, Technological, Economic, Environmental, Political), scenario generation through morphological analysis, and scenario refinement. Emphasis is placed on the methodological strategies employed to ensure inclusivity, clarity, and meaningful engagement, including participant recruitment across the Quadruple Helix, communication tools adapted to local cultural and linguistic contexts, and iterative co-creation techniques.

Critical factors for a successful application of the FSC methodology in Living Labs and Climate Assemblies that were organized in the frame of CLIMAS Horizon project, included early stakeholder engagement, clear methodological guidance, and effective time management. The study highlights the value of participatory FSB in fostering creative, grounded, and actionable visions of sustainability and resilience, offering transferable insights for similar exercises across varied local and regional contexts.

KEYWORDS: Future Scenario Building, Living Labs, Citizen engagement, Climate Assemblies, Key Drivers

PAPER ID: cest2025_00454

Aknowledgement

This work has received funding from the European Union's research and innovation programme Horizon Europe (CLIMAS project) under the grant agreement No. 101094021.

Empowering Participatory Climate Governance: The CLIMAS Toolbox for Citizen-Driven Adaptation Strategies in Europe

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ABSTRACT

Climate change presents increasingly complex and urgent challenges that demand inclusive, adaptive, and democratic governance. Traditional top-down policy making has proven insufficient in addressing the societal impacts of extreme weather events and long-term climate risks. In response, the CLIMAS project (Climate Adaptation and Resilience Toolbox for EU Regions) introduces an innovative, participatory approach to climate adaptation planning through the development of the CLIMAS Toolbox—a suite of seven co-created tools that support citizen engagement in local and regional climate policymaking.

The Toolbox promotes a shift toward a “resilient by design” society by embedding deliberative, values-based, and citizen-driven processes into climate adaptation strategies. It includes: (1) a methodology for participatory future scenario building; (2) guidelines for establishing Climate Assemblies; (3) tools for integrating citizen science; (4) a scenario prioritization framework using Multi-Criteria Analysis (AHP); (5) mechanisms to embed outcomes into dynamic adaptation planning; (6) a Knowledge and Evidence-Based Support (KEBS) tool for agenda setting; and (7) a multilingual digital platform integrating all functionalities. Each tool is designed to enhance inclusivity, knowledge co-production, and long-term policy impact.

Tested in three regional Climate Assemblies (Catalunya, Riga, and Edermünde) and three Living Labs (Ebro Delta, Chios, and Vilnius), the Toolbox demonstrates how structured citizen participation can generate socially relevant scenarios, improve trust in decision-making, and support evidence-informed adaptation policies. The CLIMAS project thus contributes actionable insights and methodologies for scaling participatory climate governance across the European Union.

KEYWORDS: Climate adaptation, Citizen engagement, Participatory governance, Climate Assemblies, Deliberative democracy

PAPER ID: cest2025_00442

Aknowledgement

This work has received funding from the European Union’s research and innovation programme Horizon Europe (CLIMAS project) under the grant agreement No. 101094021.

Evaluation Approach & Impact of Climate Assemblies

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ABSTRACT

Climate Assemblies are structured deliberative processes that bring together a diverse group of citizens to deliberate on complex environmental challenges and contribute to shaping policy responses. This presentation explores the evaluation framework that was developed under the Horizon Europe-funded CLIMAS project. Through targeted surveys, different actors of a climate assembly (participants, observers, experts, organizers and facilitators) experiences, focusing on their understanding of climate issues, engagement during the process, and perceived outcomes of their participation were assessed. Results show that participants generally felt well-informed and supported, appreciated the inclusive nature of discussions, and valued the opportunity to discuss critically on climate adaptation challenges. However, the analysis of the responses indicated areas for improvement, such as enhancing diversity among participants and refining the learning phase to improve accessibility and engagement. This study highlights the importance of ongoing evaluation and feedback to optimize the design of participatory processes. It provides evidence that well-structured climate assemblies can strengthen civic engagement, support critical thinking, and contribute meaningfully to more democratic and effective climate action.

KEYWORDS: climate change, citizens assembly, climate adaptation, participatory governance, deliberative democracy

PAPER ID: cest2025_00443

Acknowledgement

This work has received funding from the European Union's research and innovation programme Horizon Europe (CLIMAS project) under the grant agreement No. 101094021.

Measuring the Impact of Climate Assemblies Through Participant Surveys

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ABSTRACT

Climate assemblies provide a platform for citizens to deliberate and contribute to solutions for pressing environmental issues. Understanding their impact on participants is essential for evaluating their effectiveness and shaping future assemblies. This study presents the findings of surveys conducted among participants of two Climate Assemblies in Riga and Edermunde. The surveys aimed to assess participants' understanding, engagement, and outcomes of their involvement, while exploring opportunities for improvement. Findings revealed that participants generally felt well-supported by the materials provided and valued satisfactorily the inclusivity of the discussions. However, feedback also highlighted areas for improvement, including ensuring balanced representation of underrepresented groups and optimizing the learning phase for greater clarity and engagement. The survey responses also pointed out that participants found the climate assembly useful in helping them understand and think critically about climate issues, suggesting that climate assemblies can significantly empower citizens to engage critically with environmental challenges. This study's findings will inform the design and execution of future assemblies, ensuring they remain effective platforms for citizen engagement in addressing climate change.

KEYWORDS: climate change, citizen assembly, climate adaptation, crowdsourcing

PAPER ID: cest2025_00218

Aknowledgement

This work has received funding from the European Union's research and innovation programme Horizon Europe (CLIMAS project) under the grant agreement No. 101094021.

Estimation of Carbon Footprint using citizen science: Insights from COMPAIR project

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ABSTRACT

Accurate and comprehensive tools are required to estimate individual carbon footprints to address climate change. The COMPAIR project addresses this issue by developing advanced monitoring and simulation tools that integrate data from various sources in order to capture the complexity of air pollution and associated problems, such as traffic, waste management and energy consumption. While electricity consumption, daily transport and travel habits are well recognised as contributors to personal carbon footprints, municipal solid waste management remains underrepresented in most estimations. This study introduces COMPAIR's novel CO₂ calculator, the Carbon Footprint Simulation Dashboard, which uses Citizen Science contributions to help individuals estimate their carbon footprint, understand and compare how changes to their routines could affect their future emissions. The dashboard also features a Scenario Simulation tool that allows citizens to participate in policymaking by offering a variety of personal actions to reduce emissions, as well as government measures they are willing to accept. The calculator provides country-level and EU-wide comparisons across each sector and offers targeted recommendations for high-impact areas. It is also unique in that it integrates waste management strategies into total CO₂ assessments. The results show that building energy consumption accounts for almost 50% of emissions, with transport being another major contributor. Notably, waste management accounted for up to 7% of total CO₂ emissions under advanced recycling and composting conditions, demonstrating the measurable impact of behavioural choices. These findings emphasise the importance of citizen engagement and the inclusion of waste management in carbon footprint modelling for the development of more effective mitigation strategies.

KEYWORDS: citizen science, air pollution, carbon footprint

PAPER ID: cest2025_00451

Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036563.

The “waste management generation” factor: A critical parameter for assessing the carbon footprint of the hospitality industry

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ABSTRACT

Tourism constitutes a cornerstone of both international and Greek national economy; however, it simultaneously exerts significant environmental pressures. International organizations, such as the European Union and the United Nations World Tourism Organization, underscore the imperative for the hospitality sector to transition towards more sustainable operational models. The present study develops a methodological framework for quantifying the carbon footprint of hotel enterprises, incorporating parameters such as energy consumption, propane usage in food preparation, and waste streams, including food waste. A luxury resort located in Thessaloniki was selected as a pilot case for the application of this framework. The findings indicate that the main share of emissions arises from energy use, whereas waste management, food waste, and kitchen fuel contribute comparatively smaller proportions. Identifying the relative distribution of emissions across hotel operations is essential for developing targeted mitigation strategies. Accordingly, the study assesses alternative sustainability scenarios, illustrating that the integration of renewable energy technologies, coupled with improved composting and recycling practices, can substantially reduce the total carbon footprint of hospitality enterprises.

KEYWORDS: hotel's carbon footprint; energy consumption; sustainability; renewable energy sources; waste management practices; food waste

PAPER ID: cest2025_00452

SESSION 23 – PLENARY SESSION

Friday 5 September – afternoon

SESSION 24 – WORKSHOP – ANALYSIS OF MICROPLASTICS IN WATER

Friday 5 September – afternoon

Analysis of Micro-Plastics in Water

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This is a short course (duration: 2 hours), on the analysis of microplastics in water delivered by Prof Damia Barcelo (University of Almeria, Spain).

Course outline:

PART 1. Introduction: Global Pollution Macro-Plastic Litter, from Rivers, Sludge, Soils, Groundwaters, Landfills to the Sea

- RIMMEL. JRC Floating Macro litter in European Rivers, Global pollution
- Co-contaminants (Emerging Contam) and MPs, WWTPs, Plant-soil
- Groundwater pollution, modelling soil-GW and MPs

PART 2. Sampling, Extraction and Analysis

- Sampling, Extraction + clean up: filtration, digestion, density sep
- Visual Identification by Naked Dye, Optical/Electronic Microscopy
- Confirmation: (μ)FTIR, (μ) Raman, Pyrolysis GC-MS, TG-DSC
- Green Analytical Chemistry methods for MPs

PART 3. EcoToxicology and Human Health Risk

- Toxicology, effects on fishes and biota, marine and freshwater
- Human health via food and air, citizen science examples

PART 4. Remediation Technologies and Sustainable Management

- Engineering solutions- advanced water treatment for MPs

SESSION 25 – LIFE CYCLE ANALYSIS (LCA)

Friday 5 September – afternoon

Advancing Organisational Life Cycle Assessment in the Fashion Industry: Strategies for Sustainable Corporate Practices

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ABSTRACT

The fashion industry, particularly fast fashion, is one of the most environmentally destructive sectors, accounting for 10% of global carbon emissions and consuming approximately 93 billion cubic meters of water annually. Textile production alone is responsible for 20% of global clean water pollution due to dyeing and finishing processes. With over 150 billion garments produced each year, the industry generates vast amounts of waste, with 87% of discarded textiles in the EU either incinerated or sent to landfills.

This paper examines the environmental impact of fashion, assessing corporate sustainability practices through methodologies such as Life Cycle Assessment (LCA) and Organisational Life Cycle Assessment (OLCA). A detailed case study of an Italian apparel manufacturer is presented, evaluating its environmental footprint over a one-year period using the SimaPro LCA tool and the Ecoinvent database.

The findings highlight critical areas for improvement, particularly in resource consumption, emissions reduction, and waste management. Recommendations focus on increasing resource efficiency, adopting renewable energy, and ensuring transparent sustainability reporting to combat greenwashing. By identifying data-driven solutions, this paper contributes to the broader discourse on sustainable fashion, offering practical strategies for reducing the industry's environmental footprint and supporting long-term sustainability goals.

KEYWORDS: Organisational Life Cycle Assessment (OLCA), Environmental Sustainability, Fashion Industry, Corporate Environmental Practices, Life Cycle Assessment (LCA), Sustainable Development

PAPER ID: cest2025_00048

LCA of methods increasing energy self-sufficiency of small wastewater treatment plants

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ABSTRACT

Directive 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment requires wastewater treatment plants (WWTPs) to become more energy-independent. WWTPs above 10 000 population equivalent (PE) will have to generate at least 20% of their total energy consumption by the end of 2030, while 15 years later - achieve energy independence. At the same time, the directive should contribute to the progressive reduction of greenhouse gas emissions from urban wastewater treatment to contribute to the 2045 climate neutrality target. The directive also requires monitoring greenhouse gas emissions, including at least CO₂, N₂O, CH₄ emitted by municipal wastewater treatment plants above 10 000 PE. Combining these objectives requires using Life Cycle Assessment (LCA) as early as the upgrading stage of currently operating plants. This paper presents LCAs of exemplary methods for increasing energy self-sufficiency that are economically and technologically justified in the smallest wastewater treatment plants. The work indicate the directions in which long-term projects should follow. Acknowledgments: Research was funded by (POB Energy) of Warsaw University of Technology within the Excellence Initiative: Research University (IDUB) programme. Project “Environmental Life Cycle Assessment (LCA) of methods to increase energy self-sufficiency in wastewater treatment plants.”

KEYWORDS: wastewater treatment plant, energy, LCA, carbon footprint

PAPER ID: cest2025_00137

Development of industrial bio-based systems: BIORADAR Project

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ABSTRACT

The bio-based economy is a key pillar of European policies for sustainable future, leveraging renewable biological resources, such as plants, microorganisms, and organic waste, to produce energy, materials and chemicals. This transition supports the European Green Deal's goals of reducing fossil fuel dependency, ensuring food security, and decarbonizing the economy. However, the limited availability of land and resources in the EU presents challenges to achieving material circularity, mitigating carbon emissions, and addressing social impacts. To support this transition, reliable indicators and tools are essential to measure and improve the sustainability of bio-based systems. The BIORADAR project addresses these challenges by developing a digital monitoring system for assessing the circularity, environmental impacts, and social sustainability of industrial bio-based systems. The project focuses on creating Material Circularity Indicators (MCIs) to measure system performance, developing methods to assess carbon capture and identifying opportunities for climate change mitigation across supply chains. Coordinated by YAGHMA B.V., BIORADAR unites seven European partners, working to provide policymakers and stakeholders with actionable insights and frameworks for a sustainable bio-based transition. Next Technology Tecnotessile (NTT), as the lead of Work Package 1 (WP1), is responsible for assessing the environmental, economic and social sustainability of industrial bio-based systems. This includes Life Cycle Assessment (LCA), indirect Land Use Change (iLUC) Life Cycle Costing (LCC), Eco-Cost evaluation and Social LCA (S-LCA).

KEYWORDS: Bio-Based Products; Textile, Packaging; Fertilizer; LCA, LCC, S-LCA

PAPER ID: cest2025_00138

Enhancing Agricultural Sustainability and Certification through Real-Time LCA: A Case Study on Circular Economy in Wheat Production

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ABSTRACT

Within the framework of the project “Real-time environmental assessment of agricultural and agrifood production for the support of certification schemes”, a real-time, web-based Life Cycle Assessment (LCA) tool has been developed. The tool is designed to simulate all stages of the supply chain, providing a user-friendly interface while utilizing real-world sensor data to assess the carbon footprint and environmental impacts of the agricultural sector with greater accuracy. These assessments are essential for environmental certification processes.

To demonstrate the tool’s functionality, the environmental impacts of four different wheat production routes, with or without vetch and including one or two harvests crops have been assessed. Their environmental performance has been compared in a Cradle to Gate approach, per 700 kg of produced wheat. Furthermore, to validate the tool’s accuracy against existing software on the market, the environmental impacts of these four processes have also been assessed using the OpenLCA software.

KEYWORDS: Life Cycle Assessment; Circular Economy; Agricultural; Real-time LCA; Wheat Production;

PAPER ID: cest2025_00222

Acknowledgments: This research was carried out as part of the project «Real-time environmental assessment of agricultural and agrifood production for the support of certification schemes» (Project code: KMP6-0078501) under the framework of the Action «Investment Plans of Innovation» of the Program «Central Macedonia 2021-2027», that is co-funded by the European Union and Greece.

Economic analysis and environmental impact of anti-corrosive protection systems in a full-scale aeronautical fuselage part from aluminium – copper – lithium alloy

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ABSTRACT

The present work conducts an economic comparison between the traditional chromium-based corrosion protection system and a chromium-free alternative, employing sulphuric acid for anodization. Past studies have proven that the sulfuric acid protection system is more effective on the modern AA2198 lithium enriched aluminium alloy compared to the industry standard AA2024 aluminium copper alloy. Industries have long been searching for an effective substitute to chromium because of its toxicity but there has been less research done on the economic aspect of its replacement.

This investigation utilizes the activity-based costing method to compare the chromic acid protection system on an AA2024 alloy with the sulphuric acid protection system on an AA2198 alloy. Visits were conducted to the Hellenic Aerospace Industry in order to document the work process of the protection systems and form an activity model to study. For the cost calculations, a 3.85 m² workpiece was used as a baseline to derive the cost figures and acquire comparative results.

The findings indicate that the sulphuric acid protection system, applied to the AA2198 alloy, is not only 13.7% more cost-effective but also more environmentally friendly with 82.3% less carbon emissions, presenting a compelling case for its adoption as a replacement to the use of chromium.

KEYWORDS: Anodization, aluminium alloy, sustainable materials, LCA, circular economy.

PAPER ID: cest2025_00331

Acknowledgements

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From Biogas to Propulsion and Power: A Life Cycle Perspective on Fuel Synthesis and CHP Integration

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ABSTRACT

Anaerobic digestion of organic waste offers a promising pathway for energy production and sustainable waste management. Within this framework, five pathways for biogas energy utilization were evaluated, and their environmental performance was compared, focusing on marine transportation and combined heat and power (CHP) production. In Scenarios 1 and 2, biogas is upgraded to biomethane, while the captured CO₂ is used to synthesize additional methane (Scenario 1) or methanol (Scenario 2). The upgraded methane is used to produce CHP, while the synthesized fuels are used for marine transportation. In Scenarios 3 and 4, the upgraded methane is liquefied and used in marine transportation. Finally, in Scenario 5, the direct use of biogas for CHP, without further upgrading or fuel synthesis, was evaluated. A Life Cycle Assessment (LCA) was performed using OpenLCA software, Ecoinvent database, and the Environmental Footprint method. Regarding Global Warming Potential, Scenario 1 causes the lowest impact, while Scenario 5 causes the highest. In the scenarios where CO₂ is utilized to produce methanol instead of methane, the impact is higher by 3.3-3.4%. These results suggest that additional criteria, such as fuel handling and life cycle cost, should also be considered in future decision-making.

KEYWORDS: Maritime transportation; Energy transition; Power-to-x; Electrofuel; Greenhouse Gas emissions

PAPER ID: cest2025_00376

Environmental impacts of cereal straw pellets in biogas systems: A comparative life cycle assessment

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ABSTRACT

Anaerobic digestion (AD) of straw pellets is a promising technology for the production of renewable energy by tapping into previously unused material, as straw pelleting offers advantages in terms of transportation, handling and methane production potential of the material. A life cycle assessment (LCA) was carried out in accordance with ISO 14040/14044 across the entire process chain, from grain cultivation to digestate utilization, with different scenarios for the provision of straw and straw pellets as well as biogas substrate mixtures. The results of the LCA showed that a reduction in emissions can be achieved in some environmental impact categories such as global warming potential (GWP) or particulate matter formation (PM). However, the environmental impact of using straw pellets as a biogas substrate depends on the underlying boundary conditions, such as the choice of allocation method for grain cultivation, transportation distances, pelleting technology or the substrate mixture for AD used. Overall, the LCA reveals that a suitable substrate mixture incorporating straw pellets with other agricultural residues can reduce the environmental impact of biogas production and thus contribute to a sustainable supply of renewable energy.

KEYWORDS: biogas, anaerobic digestion, straw pellets, substrate pre-treatment, environmental impacts

PAPER ID: cest2025_00216

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A sustainable approach to smart manufacturing: The IndustriSphere digital twins initiative

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ABSTRACT

Modern industrial production faces several critical challenges, including inefficiency, lack of adaptability, and unsustainable practices. Traditional manufacturing systems struggle with high operational costs, suboptimal resource utilization, and limited capabilities for predictive maintenance, leading to frequent downtime and increased environmental impact. Moreover, existing production processes often lack integration with advanced technologies like IoT and AI, restricting real-time monitoring and innovation potential. The IndustriSphere initiative pioneers a sustainable shift in manufacturing by applying digital twin technology to optimize industrial processes. Integrating IoT, AI, 3D scanning, and augmented reality, it enhances real-time monitoring, predictive maintenance, and resource efficiency. Validated at B&T Composites, the project combines academic expertise with practical implementation, advancing Industry 4.0. Through lifecycle sustainability analysis and immersive digital models, IndustriSphere demonstrates how smart manufacturing can reduce environmental impacts while boosting competitiveness and innovation across industrial sectors.

KEYWORDS: Digital Twins, Industrial Efficiency, Predictive Maintenance, Sustainability.

PAPER ID: cest2025_00050

SESSION 26 – ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Friday 5 September – afternoon

Forest Resilience, Precipitation, and Ecosystem Service Value: A Correlation and Trend Analysis

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ABSTRACT

Ecosystem service value (ESV) is critical for understanding ecosystems' economic benefits and their responses to environmental change. This study uses Earth Observation (EO) data, statistics, and machine learning methods to evaluate ESV trends across multiple continents from 2000 to 2024. Three key datasets were used: MODIS NDVI for vegetation monitoring, CHIRPS precipitation data, and the ESVD database. Data preprocessing includes data cleaning, feature engineering, and outlier detection. We compared Random Forest, XGBoost, and ensemble stacking models to predict key variables and their relationships, such as kNDVI, as a proxy of forest resilience and ESV trends, precipitation patterns, and biome-specific variables. Our results show that kNDVI changes across continents reveal various patterns in vegetation dynamics that are in-line with precipitation patterns and are weakly correlated with ESV changes for forest biomes. Our study emphasizes the significance of time interdependence and climate variability in ESV predictive modelling. Future efforts focus on refining the time/space granularity of data collection and aggregation techniques and incorporating more environmental indicators to improve model robustness and application in policy-making.

KEYWORDS: Forest, Landscape, Ecosystem, Service, Valuation.

PAPER ID: cest2025_00053

Acknowledgement

This work is supported by the European Horizon Project eco2adapt [grant agreement ID 101059498].

Towards Optimal Building Retrofits: A Multi-Objective Optimisation Framework Using Genetic Algorithms and EnergyPlus

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ABSTRACT

The decarbonisation of the building sector requires the identification of optimal retrofit strategies that balance energy efficiency, cost, and indoor comfort. This paper presents the conceptual design of an integrated simulation pipeline that couples Genetic Algorithms (GAs) with dynamic building performance simulations. The tool will leverage EnergyPlus for energy and comfort simulations, while multi-objective optimisation will be conducted using NSGA-II and NSGA-III algorithms. Key inputs include the building model, a microclimate-adjusted weather file, user-defined objectives, and a set of possible retrofit measures. A novel feature of the pipeline is the dynamic adjustment of objective functions based on stakeholder preferences, ensuring that outputs are aligned with user priorities. Following simulation and optimisation, the Pareto-optimal retrofit scenarios will be ranked through a Multi-Criteria Decision Support System (MDSS), providing tailored recommendations. The proposed pipeline aims to deliver an effective, user-centric decision-making framework to support engineers, consultants, advanced homeowners, and policymakers in achieving sustainable building upgrades.

KEYWORDS: *Multi-objective optimization, Building retrofit, EnergyPlus, Microclimate weather data*

PAPER ID: cest2025_00309

Acknowledgements: This work has been funded from the European Union's Horizon Europe research and innovation program under the 'CBDC powered Smart PerFORmance contracTs for Efficiency, Sustainable, Inclusive, Energy use' (FORTESIE) project, grant agreement No. 101080029

Artificial Intelligence in Public Administration for Environmental Sustainability: An Integrative Review of Research and Practice

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ABSTRACT:

Artificial intelligence (AI) is increasingly utilized in public administration as a strategic enabler for achieving environmental sustainability and advancing progress toward the Sustainable Development Goals (SDGs). This study presents an integrative review of 3,107 peer-reviewed publications indexed in Scopus and 98 documented use cases from European public administrations. It explores how AI contributes to environmental goals by synthesizing academic insights and practical implementations. Key themes include environmental monitoring and forecasting, sustainable urban and resource governance, and ethical AI use. Use cases are organized across six environmental SDGs with notable applications in water management, climate action, and biodiversity protection. Findings inform future research and support evidence-based environmental policymaking, while addressing regulatory, technical, and institutional challenges.

KEYWORDS: artificial intelligence, public administration, environmental sustainability, integrative review

PAPER ID: cest2025_00382

Acknowledgement: The authors acknowledge the financial support of the Slovenian Research and Innovation Agency (research program No. P5-0093, project No. J5-50165 and project No. J5-60097). During manuscript preparation, limited use of ChatGPT (version 4o, OpenAI) was made to support language editing. All intellectual content, analysis, and conclusions are the original work of the authors.

A Spatial Platform for Predicting Health Impacts of Air Pollution

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ABSTRACT

Air pollution is a critical global health concern, contributing to millions of premature deaths each year. Although significant progress has been made in air quality monitoring, there remains a gap in predictive tools that effectively link pollution exposure to health outcomes. To bridge this gap, we developed **ODESSA**, an AI-powered WebGIS platform designed to forecast hospital admissions attributable to air pollution.

ODESSA integrates diverse data sources, including air quality measurements, satellite imagery, meteorological variables, demographic information, and health records, to generate spatially explicit risk assessments. These insights aim to support proactive public health planning and response. Our approach employs advanced machine learning techniques, to uncover patterns and correlations between air pollution and hospitalizations. These models are trained on historical datasets to capture both short-term pollution spikes and long-term exposure effects.

Preliminary results from pilot studies conducted in Lisbon, Portugal, demonstrate promising predictive accuracy, offering a valuable tool for healthcare systems to anticipate and manage patient surges. An interactive WebGIS interface is currently under development to enable policymakers, urban planners, and health authorities to visualize high-risk areas, evaluate intervention strategies, and optimize the allocation of healthcare resources.

This work aligns with the Sustainability and AI track by showcasing how artificial intelligence can enhance environmental health management. By combining AI and spatial analysis, ODESSA offers real-time decision support, contributing to smarter urban planning and more resilient, sustainable cities. Furthermore, its participatory and data-driven design fosters community engagement and informed decision-making.

KEYWORDS: Air Pollution; Health Impacts; Hospital Admissions

PAPER ID: cest2025_00317

Acknowledgements

The authors would like to acknowledge the support of CESAM (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020) and C2TN (UIDB/04349/2020). Special thanks to FCT/MCTES for the research contract awarded to Helder Relvas (10.54499/2021.00185.CEECIND/CP1659/CT0026) and ODESSA - <https://doi.org/10.54499/2024.07293.IACDC>.

Advancing Temperature Swing Solvent Extraction Desalination with Machine Learning

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ABSTRACT

The management of hypersaline wastewaters, including desalination brines, poses significant environmental and technical challenges. Temperature swing solvent extraction (TSSE) offers a promising solution by exploiting the temperature-dependent water affinity of low-polarity solvents, typically amines. In this study, machine learning (ML) is applied to enhance TSSE by predicting the mutual solubilities of water and amines. Experimental data and amine properties were used to train eight ML models. A stacking ensemble strategy yielded high predictive accuracy, with R^2 values of up to 97.8% for water-in-amine solubility and 95.8% for amine-in-water solubility. By integrating ML predictions with multi-objective optimization, the study identified ideal amines and operational temperatures.

KEYWORDS: Artificial intelligence; Data-driven modelling; Process optimization; Solvent-driven desalination.

PAPER ID: cest2025_00359

SESSION 27 - WATER AND WASTEWATER REUSE

Saturday 6 September – morning

CYANOTECH Project: Sustainable management of toxic cyanobacteria in surface waters

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ABSTRACT

Surface water quality and availability have been drastically reducing globally because of environmental pollution from natural and manmade compounds, urban, industrial, and agricultural waste, and climate change. It is estimated that in Europe, water demand will go up by 30%, while water resources will reduce by 30% by the end of 2030. The persistent uncontrolled global blooming of toxic cyanobacteria is another contributing factor to restricted water resources. CYanoTech is a 27-month project that developed a novel, sustainable, and innovative management system for mitigating the effects of toxic cyanobacteria blooming in surface waters. The project addressed issues related to eutrophication, water scarcity, global warming, climate change, nutrient reclamation, sustainable agriculture, and food safety. This presentation will give a brief overview of the CYanoTech approach which comprises of the removal of the excess aquatic biomass (cyanobacteria cells and algae) from water with a low-energy non-mechanical separation technology, the co-digestion of livestock waste and aquatic biomass for the production of energy and marketable products (fertilizers-struvite), and the application of treated and untreated surface water in hydroponic cultures that produces safe for consumptions crops (cyanotoxins-free crops). The energy produced can potentially compensate for the total energy needs of the applied treatment processes, further reducing the system's overall carbon footprint, making it self-sustainable. Life-Cycle-Analysis proved the reduced environmental footprint of the CYanoTech approach.

KEYWORDS: cyanobacteria, cyanotoxins, anaerobic digestion, struvite, crops

PAPER ID: cest2025_00156

Electroactive nanowire membranes for enhanced membrane fouling control and phosphorus removal in membrane bioreactors

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ABSTRACT

Integrating membrane filtration with electrochemical technologies offers an innovative and highly efficient approach to reducing membrane fouling and addressing wastewater contaminants. This study optimizes the fabrication of electroactive membranes to improve durability and delay fouling in membrane bioreactors (MBRs) by applying an electrical current. Electroactive membranes were fabricated using titanium filters with varying porosities, hydrothermal conditions, and catalyst loading. Membrane properties were characterized, including tensile strength, porosity, pore size, and current density. Batch experiments with MBR effluent were conducted at 0 V (control) and 4 V. Results showed that, in contrast to the control where total phosphorus (TP) removal efficiency declined from 52% to 4%, the application of electricity enhanced TP removal from 12% to 70%. This improvement is attributed to phosphate precipitates (e.g., calcium phosphate) formed through electrochemical reactions, which were then filtered by the membrane. The electroactive membranes in MBRs demonstrated significantly longer operation times and improved TP removal efficiency, especially when electrode polarity was reversed. This reversal likely prevents foulant adhesion, facilitating membrane cleaning through oxidants and bubbles generated at the membrane surface. In conclusion, electrified membranes effectively delay fouling while promoting phosphorus recovery as precipitates. This work was supported by the National Research Foundation of Korea (RS-2022-NR066724), funded by the Korean government.

KEYWORDS: Electroactive membrane; Fouling mitigation; Phosphorus removal; Electrode polarity; Membrane bioreactor

PAPER ID: cest2025_00224

Development of a multi-factorial model to assess the sustainability of irrigation wastewater reuse: application to case studies in Sicily

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ABSTRACT

The reuse of wastewater is a non-conventional water resource that is an essential measure for climate change adaptation. This research introduces an index based on a holistic methodology to evaluate the techno-economic, water-related, and environmental sustainability of wastewater reuse for agricultural applications. The development of the model is structured in the following phases: estimate of preliminary reuse factors, assessment of screening factors, selection of appropriate treatment schemes, assessment of cost factors. The first phase is fundamental to calculate annual reusable volume and the water level stress index (LWSI). Screening factors include desertification tendency, BOD, nitrogen, and phosphorus loads in water bodies, ecological sensitivity of the area, nitrate vulnerability, organic carbon and heavy metal content in soils, and the risk of aquifer contamination. The treatment schemes are selected based on the presence of a storage reservoir and on the nitrate vulnerability of the area. Cost factors include costs of upgrading supply network, pumping system and monitoring soil. The model also includes the calculation of the economic benefit. The model is applied to 101 wastewater treatment plants in Sicily. The obtained results reveal high sustainability indexes attributed to the rising of market prices, which in turn increased the direct economic benefit associated.

KEYWORDS: sustainability index, water level stress index, screening factors index, cost curves, annual reclaimed volume.

PAPER ID: cest2025_00183

Acknowledgments: The authors gratefully acknowledge support from the SAMOTHRACE project (PNRR M4C2 – Investment 1.5), WP2 – Task 2, for research on low-impact materials for the real-time monitoring of emerging contaminants in water.

Hollow fiber nanofiltration for water and solute recovery from industrial effluents

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ABSTRACT

Nanofiltration (NF) has undergone rapid development and has found numerous applications in recent years. Among them, the separation of multivalent ions (e.g. hardness) from various wastewaters and industrial process streams is still its main application. This paper reports on the cross-flow nanofiltration process in a fully automated laboratory pilot NF unit for the treatment of two real industrial wastewaters (samples A and B), aiming to produce high quality water for reuse in the production process and also to reduce fouling/scaling of the membrane. Samples A and B had moderate inorganic and organic content (pH 6.9-8.2, eC 1.9-2.5 mS/cm, 11-150 mg/L COD, 17-146 mg/L Ca²⁺, 11-13 mg/L Mg²⁺, 156-249 mg/L SO₄²⁻, 99-472 mg/L Na⁺, 16-227 mg/L K⁺, 119-316 mg/L Cl⁻) and originated from a steel and a pulp and paper industry, respectively. A series of filtration experiments were conducted in batch mode under various key process parameters such as initial pressure, cross-flow velocities and water recovery, testing different commercial hollow fiber membrane modules. Under optimal experimental conditions, encouraging results were obtained as high removal percentages of divalent cations (Ca²⁺, Mg²⁺) and rather moderate rejection rates of monovalent ions (Na⁺, K⁺, Cl⁻) were reported, followed by a rather low fouling tendency of the membranes as shown by the transmembrane pressure (TMP) temporal variation. In addition, optimization of the process was achieved with the aim of maintaining water productivity, increasing solute recovery (high selectivity towards divalent ions) and reducing energy requirements.

KEYWORDS: Cross-flow nanofiltration, membrane scaling, water recycling, process optimization, wastewater treatment

PAPER ID: cest2025_00260

Acknowledgements The study is part of the CORNERSTONE project funded by the European Union. Horizon Europe under Grant Agreement No. 101138504.

Development of asymmetric membranes modified with ionic liquids for the recovery of aromas and fragrances from model agricultural residues to be used in pervaporation processes

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ABSTRACT

This study focuses on the development of asymmetric multilayer membranes modified with ionic liquids for the recovery of aromas and fragrances (AF) from model agricultural waste streams through pervaporation. The membranes were prepared using hydrophobic polymers PEBA and POMS combined with two ionic liquids: [Bmim][Tf₂N] and [P1444][Tf₂N], stabilized through gelation with 12-hydroxystearic acid. The research evaluated membrane preparation, extraction capacity, transmembrane flux, selectivity, and mass transfer resistance.

Results showed that the membrane PEBA/[Bmim][Tf₂N]/PEBA exhibited the highest extraction rates and lowest mass transfer resistance for key aroma compounds such as hexanal and linalool. The choice of ionic liquid significantly influenced the membrane's affinity towards different compounds: [Bmim][Tf₂N] favored polar compounds, while [P₁₄₄₄][Tf₂N] enhanced transport of hydrophobic ones. Membranes containing ionic liquids showed improved selectivity toward aroma compounds over water, outperforming single-layer membranes.

These findings confirm that the integration of ionic liquids into polymeric membranes enhances the efficiency of pervaporation for aroma recovery. This approach offers a sustainable and high-value solution for the valorization of agro-industrial residues, with promising applications in the cosmetics industry. The study supports the development of environmentally friendly separation processes aligned with circular economy principles.

KEYWORDS: Ionic liquid-modified membranes, Pervaporation, Aroma and fragrance recovery, Agricultural waste valorization, Circular economy

PAPER ID: cest2025_00352

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Holistic Assessment of Struvite Production from Real Wastewater: Bridging Laboratory Research and Market Implementation

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ABSTRACT

Conventional wastewater treatment plants are not integrated biorefineries, resulting in the discharge of phosphorus- and nitrogen-rich effluents. This not only contributes to eutrophication but also leads to the loss of valuable, recoverable resources such as non-renewable phosphorus. Struvite crystallization (SC), a robust nutrient recovery technology, offers a sustainable solution by producing market-ready, waste-derived struvite fertilizers. This critical review provides a comprehensive analysis of SC technologies, focusing exclusively on studies using real wastewaters. Among various wastewater types, SC from liquid digestates of municipal wastewater demonstrates the highest technological readiness level (TRL) 9. Chemical precipitation remains the most applied method due to its simplicity and low cost. However, recent methodological advancements in electrochemical precipitation and membrane crystallization show promising potential. Notably, microbial electrolysis cells enable the formation of high-purity struvite crystals with reduced energy consumption and the added benefit of hydrogen production. Cutting-edge systems such as peroxodisulfate-assisted electrooxidation combined with electrocoagulation, have also emerged as viable alternatives. Operational parameters, pretreatment techniques such as catalytic thermal hydrolysis, and enhancement methods such as zeolite seeding are also scrutinized. For the first time, post-harvest processes like granulation are critically assessed. By bridging research gaps across TRLs, this presentation provides insights to advance scalable SC technologies.

KEYWORDS: struvite, technological maturity, waste valorization, nutrient recovery

PAPER ID: cest2025_00418

Rainwater quality and reuse for small subcatchment - case study

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ABSTRACT

The total freshwater resources available in Poland are relatively scarce and characterised by seasonal and area variability. They amount to about 1600 m³ per person per year which is below the water stress level (1700 m³). Only the Czech Republic, Cyprus, and Malta have lower water resources in Europe than Poland. The average annual precipitation in Warsaw in 2023 was 572.0 mm, compared to 656.2 mm in Poland. Rainfall in Poland allows it to be harvested, treated and reused in households. According to Polish law, apart from using rainwater for irrigating the garden, storing it for reuse in households for flushing toilets, laundry, and other similar purposes is also possible. Such use involves the construction of an appropriate installation. Rainwater can be collected e.g. from roofs. The available research shows that quality of rainwater depends, among other things, on the roof's material, its location and size, the concentrations of chemical pollutants in the surroundings and in rainwater, as well as the time of the year. For the study, rainwater was collected from three types of roofs: bituminous, tinware and eternit located in the surroundings of Warsaw. At the same time, clean precipitation was collected as well. The following parameters were analysed in rainwater: pH, alkalinity, conductivity, colour, turbidity, COD, BOD₅, chlorides, sulphates, nitrates, nitrites, ammonia, and phosphates. The study confirmed that the collected rainwater has differences in their composition. Their quality, indeed, depends on the material of the roof and its location, among other things. To be reused, they must be subjected to treatment processes.

KEYWORDS: rainwater, reuse, quality, roof

PAPER ID: cest2025_00084

SESSION 28 - ENERGY TECHNOLOGIES AND RENEWABLE ENERGY SOURCES

Saturday 6 September – morning

Thermochemical Heat Storage: heat and mass transfer modelling in the reactor

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ABSTRACT

The global increase in demand for raw materials and energy is a source of geopolitical concerns and tensions, and this is leading governments and industries to secure their resources and supplies. This observation leads companies and also countries to secure operational supply by improving system performances and reducing needs. In this context, heat storage is solution for energy management improvement since it makes it possible to use waste heat or solar sources for different thermal applications. Thermochemical heat storage (THS) using water adsorption/desorption in porous materials is particularly suitable. Indeed, it allows heat to be stored at room temperature by separating water from the adsorbent material. To restore heat, the material needs to be re-moisten and this can be done with air humidity (energy-carrier). These materials are shaped and thermally characterized. Especially, an improvement in storage capacity and the heat and mass transfers in the reactor are required and while guaranteeing structural stability for better cyclability. They are tested under different operational conditions in a laboratory reactor. The reactor performances were simulated by using numerical modelling of heat and mass transfer in the experimental device. After experimental validation, the numerical model can be used to simulate different operational scenarios.

KEYWORDS: Thermochemical heat storage, numerical modelling, experimental validation, heat and mass transfer

PAPER ID: cest2025_00023

Using the EU Environmental Permitting Framework to Promote the Energy Transition in the Western Balkans – The Case of Kosovo

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ABSTRACT

Kosovo's electricity generation is dominated by lignite-fired power plants, resulting in high greenhouse gas emissions and limited integration of renewable energy sources (RES). Despite national strategies aimed at increasing the share of RES and Battery Energy Storage Systems (BESS), administrative, technical, and regulatory barriers hinder progress. In this context, aligning Kosovo's permitting framework with established EU environmental legislation offers a structured pathway to accelerate its energy transition. This paper presents key findings from a recent technical assistance project implemented for the Ministry of Environment, Spatial Planning and Infrastructure (MESPI), which produced a Permitting Support Manual for RES and BESS projects and a Supplementary Guidance Document. These tools identified context-specific barriers and proposed practical institutional and procedural reforms based on EU best practices. The study concludes that implementing standardized screening criteria, integrating spatial planning for RES and BESS, and streamlining administrative procedures are critical to advancing Kosovo's decarbonization efforts.

KEYWORDS: Environmental Permitting, Renewable Energy, Kosovo, Spatial Planning, RED III

PAPER ID: cest2025_00422

Whether the electricity consumption and related behaviour influence the choice of green electricity considering the context of military conflict in Ukraine and environmental concern

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ABSTRACT

The electricity market liberalization enables citizens to choose green electricity and to enhance this electricity consumption. In this paper the main factors of choice of green electricity were analysed considering to environmental aspects, circumstances of military conflict in Ukraine and behaviour related to energy consumption. In this analysis the survey data carried out in Lithuania, in 2023 was referred. In the survey participated 769 respondents and only 35 % of them stated that they have chosen green electricity. By applying the binary logistic regression, the results showed that regarding the consequences of military conflict in Ukraine, the concern about this war only together with contribution to changes in environmental concern positively and statistically significant influence this behaviour. Meanwhile the concern about military conflict together with attitudes towards energy crisis negatively determined the choice of green electricity. In the model including behaviour related to energy, only purchase of energy efficiency appliances was significantly related to the choice of green electricity, while energy saving behaviour, and the level of electricity consumption insignificantly affected this behaviour. Thus, this study showed that the factors and motives of choice of green electricity differed comparing with energy consumption and the consequences of military conflict could cause different outcomes for green electricity consumption.

KEYWORDS: Renewable electricity; environmental attitudes; energy saving; green purchase; climate change.

PAPER ID: cest2025_00174

sim4dhs - Algorithm for the thermohydraulic simulation of district heating systems: Identification of optimal locations for additional heat sources

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ABSTRACT

In 2023, renewables covered 22 % of Germany's final energy use - 53 % in electricity but only 18 % in heat, even though heat makes up half of total consumption. In particular, district heating promises a high potential of reducing CO₂ emissions.

In order to unlock this potential, district heating systems must adapt to the technical requirements of renewable energies in order to keep or even improve the efficiency of the system. Lowering the grid temperatures is the key, but old building structures limit the reduction of the return temperature. This leads to increased mass flow and pressure losses and thus to local bottlenecks. But could decentral integrated renewable heat sources alone be enough to avoid thermal-hydraulic bottlenecks?

This work presents sim4dhs, a non-convex MINLP model, that optimizes the locations of renewable heat sources so that as many extraction points as possible comply with the contractually required pressure differences.

Results show additional heat sources can reduce bottlenecks effectively, and pressure boosting eliminates them entirely. Optimal locations are often at subtree entrances or midpoints of districts.

KEYWORDS: district heating, renewable energies, optimization, thermo-hydraulic simulation, pressure drop

PAPER ID: cest2025_00197

Metal organic frameworks MOF (Cu, Co, Ni) integrated with a heat exchanger as low-energy adsorption systems

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ABSTRACT

Metal-Organic Frameworks (MOFs) are a class of highly promising porous materials with potential applications in the capture and separation of greenhouse gases (GHGs). One of the key considerations in GHG capture technology is the energy efficiency of the process. The objective of this study was to analyze the heat transfer properties of radiators integrated with three types of metalorganic frameworks (MOFs). Specifically, Cu-HKUST-1, Co-MOF-74, and Ni-MOF-74 structures were synthesized in situ on a copper heat exchanger. Direct calorimetric measurements were conducted to determine the heat of adsorption of CO₂ and CH₄, capturing the dynamic nature of these processes. Simultaneously, CO₂ and CH₄ adsorption isotherms were obtained using the gravimetric method under laboratory conditions at various temperatures, allowing for the calculation of adsorption enthalpies.

In the subsequent research phase, experimental investigations focused on the direct capture of low concentrations of CO₂ (0–3%) and CH₄ (0–5%) from an air stream, leveraging efficient thermal stimulation of the sorption processes.

KEYWORDS: GHG, CCS, MOF, metal organic frameworks, heat transfer, CO₂ and CH₄ capture separation and storage

PAPER ID: cest2025_00286

CO₂/CH₄ exchange studies on shales to assess the potential for CO₂-Enhanced Shale Gas Recovery

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ABSTRACT

In the last decade, one of the most promising sources of energy in Poland has been shale gas, whose deposits are estimated at 346-768 billion m³ (approximately 2-5 times more than in the case of gas from conventional deposits) and are the largest in Europe. In the years 2013-2017, a total of 72 wells were drilled to extract shale gas, but low recovery efficiency and increasing difficulties contributed to abandoning further attempts. The work included detailed studies of CO₂/CH₄ exchange on a shale core from the Lewino-1G2 well (Poland) from a depth of 3408 m. The sample permeability coefficients were determined under conditions of confining pressure from 5 MPa to 35 MPa. These studies showed that at a confining pressure of 35 MPa – corresponding to a depth of about 1000 m, the shale core was impermeable in the direction perpendicular to the bedding, and in the direction parallel to the bedding, the sample had very low permeability ($k_{\infty}=0.001$ mD). CO₂/CH₄ exchange experiments were performed under confining pressure of 5 MPa. These experiments were carried out on a unique apparatus, which makes it possible to apply a confining pressure corresponding to *in situ* conditions. The obtained results made it possible to carry out a comprehensive balance of gas exchange during injection of CO₂ into the shale sample, with simultaneous recovery of CH₄. Based on the CO₂/CH₄ exchange studies conducted on core samples under confining pressure conditions, it was found that under conditions, at depths of 3000-4000 m where shale gas occurs in Poland and the confining pressure can reach around 100 MPa, shales are poorly suited for the application of CO₂ storage technology with simultaneous CH₄ recovery. Without stimulating the CO₂/CH₄ exchange rates through fracturing processes, the effectiveness of CO₂-ESGR technology in shales is very low. The research presented in this work is extremely important from the point of view of precise assessment of the potential of CO₂-ESGR technology.

KEYWORDS: shale gas; CO₂/CH₄ exchange; CO₂-ESGR; permeability; CO₂ sequestration

PAPER ID: cest2025_00289

EnaTex - Energy Efficiency in Textile Production in Indonesia

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ABSTRACT

EnaTex is an international research project funded by German Ministry of Education and Recherche within the CLIENT II Program on international partnership. The paper focus on the conduction of energy efficiency on 3 combustion systems based on fossil fuels for generation of steam and thermal-oil heat for textile machines in 2 Indonesian factories. The direct method of flow- and energy balancing was applied to identify the current performance on fuel efficiency and to determine opportunities for improvements. The applied methodology will be presented and findings explained. The research was conducted by IZES gGmbH Saarbruecken/Germany in cooperation with the Politeknik STTT Bandung/Indonesia.

KEYWORDS: Energy Efficiency, Steam grid, thermo-oil grid, combustion, textile industry

PAPER ID: cest2025_00261

Time Series Analysis for Renewable Energy Forecasting in the Philippines: Enhancing the Reliability and Efficiency of Intermittent Energy Sources

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ABSTRACT

The Philippines is rapidly expanding its renewable energy (RE) capacity to meet ambitious targets of 35% RE in the power generation mix by 2030 and 50% by 2040. However, the increasing penetration of intermittent sources like solar and wind poses significant challenges to grid stability and operational efficiency, particularly in an archipelagic nation prone to extreme weather. This paper reviews the application of time series analysis for RE forecasting in the Philippine context. It examines key methodologies, including ARIMA, SARIMA, Prophet, and LSTM models, alongside hybrid approaches, and discusses their suitability for predicting variable RE generation. The paper synthesizes findings from local studies, highlighting the impacts of forecasting on grid management and the specific challenges related to data availability and quality. Accurate RE forecasting is identified as a critical enabler for enhancing power system reliability, optimizing resource dispatch, and supporting the Philippines' transition towards a sustainable energy future. Collaborative efforts in data infrastructure development, localized model refinement, and adaptive forecasting strategies for events like typhoons are crucial for maximizing the benefits of the nation's abundant renewable resources.

KEYWORDS: Time Series, Philippines, Energy, AI models

PAPER ID: cest2025_00011

SESSION 29 - AGROFORESTRY, FOREST AND AGRICULTURAL SUSTAINABILITY

Saturday 6 September – morning

Equilibrium strategies for forest restoration via an approach based on dynamic games

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ABSTRACT

It is investigated whether forest restoration should be the responsibility of the forest owners or the non-owners from both social welfare and environmental perspectives. Two types of countries are considered: one where the forest owner profits from deforestation - the “deforester” - and another where the forest non-owner generates income through production – the “producer”. Both face costs due to the negative externalities caused by pollution. They participate in a non-cooperative dynamic game where the restoration efforts are alternatively carried out by either the deforester or the producer. By using the cooperative mode of play as a benchmark, the economic and environmental effects of the two non-cooperative modes are analyzed.

KEYWORDS: pollution accumulation, environmental absorption efficiency, emissions, deforestation, restoration, non-cooperative strategies.

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Acknowledgements:

The authors were supported by the 2019 Italy-France Galileo project (IT-G19-48, FR-42089QH). M. Sanguinetti was supported by the Italian Ministry of Research (PRIN project 2022S8XSMT), the Ministry of Enterprises and Made in Italy (project F/310027/02/X56), the FISA-2022-00827 project “UAVFIRE”, and CNR (PDGP DIT.AD021.104 project). G., Gnecco and M. Sanguinetti are members of GNAMPA-INdAM.

COMPAS: Pyric herbivory and precision livestock farming as a tool for landscape management

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ABSTRACT

Pyric herbivory (PH) combines prescribed burning and targeted grazing to reduce wildfire risk and restore ecosystems by mimicking natural disturbances. Targeted grazing uses livestock strategically to manage vegetation, requiring knowledge of plant growth, animal behavior, and ecosystem dynamics. The COMPÁS project in Spain promotes this approach, integrating prescribed burns with environmental grazing to guide livestock to key areas. This reduces fuel loads and supports ecosystem recovery. The project uses advanced tools—satellite imagery, drones, GPS collars, and virtual fences—to monitor and optimize PH practices. It also aims to develop new regulatory frameworks to support implementation. This article presents results from a pilot in Galicia, focusing on animal behavior data and vegetation monitoring after prescribed burns

KEYWORDS: Prescribed burns, extensive farming, animal behaviour, GPS collars, virtual fencing.

PAPER ID: cest2025_00095

Acknowledgments

COMPAS is supported by the Biodiversity Foundation of the Ministry for the Ecological Transition and the Demographic Challenge (MITECO) within the framework of the Recovery, Transformation and Resilience Plan (PRTR), funded by the European Union – NextGenerationEU.

Silvopastoralism as a tool for enhancing forest resilience: LIFE SILFORE demonstrations in Galicia

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ABSTRACT

European forests, especially in Atlantic regions, face growing threats from climate change and wildfires. The LIFE SILFORE project promotes silvopastoral systems—combining livestock grazing with forest areas—to boost forest resilience and biodiversity. Through eleven pilot sites in Galicia, the project demonstrates how silvopastoralism improves land management. It aims to develop scalable, sustainable models for climate adaptation and enhanced forest resilience.

KEYWORDS: biodiversity, precision livestock, ecosystem services, autochtonous breeds, sustainable forest management

PAPER ID: cest2025_00097

Acknowledgments

This project is financed by the LIFE programme of the European Union - "Climate Action" sub-programme within the priority area "Adaptation to climate"

History of Forest fires and resin tapping as a tool in the management of the Varibobi forest

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ABSTRACT

This study examines the historical interrelation between forest fires and resin tapping in the Varibobi forest, which was significantly affected by the devastating fire of 2021. By analyzing tree-ring widths and chronology from both unburned and burned Aleppo pine stands, we identified and dated instances of fire and resin tapping. Our findings highlight the beneficial role of traditional resin tapping practices in mitigating forest fires and underline the importance of integrating such practices into forest management strategies.

KEYWORDS: dendrochronology, Aleppo pine, climate change

PAPER ID: cest2025_00293

Acknowledgement: This study was funded by Vianex S.A., GlaxoSmithKline S.A., Groupama S.A., Rossi S.A. through the research initiative *Varibobi-Reset*

SUS-SOIL: Revitalizing Subsoil Health for Sustainable Agriculture and Ecosystem Resilience in the EU

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ABSTRACT

About 60–70% of European Union soils are categorised as unhealthy mostly due to the erosion of the topsoil layer and subsurface depletion, meaning soil degradation being a significant danger to global sustainability. Even though it is acknowledged its ecological importance, subsoil is still understudied, which difficulties addressing its problematics. With a multidisciplinary approach, the SUS-SOIL aims at closing this gap by improving subsoil health, ecosystem services, and agroecological transitions across various land-use settings. A set of 15 Subsoil Living Labs (LLs) are being developed over eight European biogeographic areas in order to co-create and benchmark agroecological subsoil management practices (ASM). The LLs will be based in several stakeholders' categories using a participatory method to examine ASM effects on subsurface dynamics. Modern techniques include digital tools and sophisticated soil monitoring systems to support achieving project objectives. For promoting sustainable land management, key developments include interoperable soil databases, a Subsoil Decision Support Tool (S-DST), and region-specific ASM farm idiosyncrasy based on key developments.

SUS-SOIL seeks to raise awareness among stakeholders of subsoil issues, assist in policy creation for ASM techniques, and offer practical advice to improve water security and minimise climate effects. These results will improve soil management, therefore benefiting urban and rural ecosystems.

KEYWORDS: Subsoil, agroecology, LUCAS, Sustainability, ecosystem services.

PAPER ID: cest2025_00099

Acknowledgements

This study was conducted with support from the SUS-SOIL project funded by the European Union under the Mission SOIL GA 101157560.

AF4EU Buzz: Unveiling Beekeeping Value Chain and Sustainable Agroforestry Practices in the EU

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ABSTRACT

This study examines the honey farm value chain developed within the European Agroforestry Business Model Innovation Network (AF4EU) project, which aims to promote agroforestry practices across Europe. Despite being the world's second-largest honey producer, the EU still requires imports to meet domestic demand (European Commission, 2024). The AF4EU project created value chains through co-creation workshops. Honey farms were recognized as significant across all climatic regions involved in the project, with participants identifying direct sales of honey and other products as the main revenue stream. Inputs such as beehive production and post-harvest machinery were considered external to the farm, while ecosystem services and training emerged as key outcomes. This study highlights the importance of short supply chains and traditional beekeeping knowledge in supporting sustainable honey production.

KEYWORDS: Value chains, business model innovation, apiculture, honey, ecosystem services.

PAPER ID: cest2025_00078

Fostering Rural Innovation and Sustainability with GREENCOOP

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ABSTRACT

Rural areas cover 83% of EU territory and face critical socio-economic challenges, with nearly 20 million hectares at high risk of abandonment by 2030. This is driven by aging populations, youth outmigration, low social inclusion, and a lack of viable rural business models, resulting in land degradation, biodiversity loss, and declining food and water security. Funded by Horizon Europe, the Green Transition Cooperation for the Integration of Rural Innovation-Based Business and Production Models (GREENCOOP) project aims to develop and implement innovative Rural Community Business Models (RCBMs) that integrate Agroecology and Digital Innovations (ADIs). GREENCOOP will establish an International Rural Innovation Business Community Network (RIBC-Net) with 15 EU and 3 Chinese Living Labs (LLs) to co-create and test six ADI-driven strategies: energy supply, nutrient management, weed control, landscape connectivity, water security, and value chain optimization. The project will promote bio- and circular economies, improve labor conditions, and create quality jobs. By enhancing environmental sustainability and rural vitality, GREENCOOP seeks to combat land abandonment and reinforce food security. This communication presents the initial ADIs to be implemented in selected EU and Chinese regions.

KEYWORDS: Land abandonment, agroecology, business models, digital innovation, ecosystem services.

PAPER ID: cest2025_00081

Acknowledgements

This work is supported by the GREENCOOP project, funded by the European Union under the Horizon Europe Programme (Grant Agreement No. 101182021).

GOOD for Weeds: Building an Agroecological Weed Management Network

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ABSTRACT

Weeds present a major challenge to the sustainability of farming systems in the EU with herbicides currently playing a dominant role in their management. Reducing herbicide use and mitigating associated risks have become central objectives of the EU's Farm to Fork strategy, which advocates for agroecology and the shift toward more sustainable and resilient farming systems. The GOOD project, a four-year project funded by Horizon Europe, supports this transition by promoting agroecological weed management across Europe and beyond. The project has set up 16 Living Labs (LLs) in six pedoclimatic regions across nine countries (Portugal, Spain, France, Italy, Greece, Cyprus, Netherlands, Serbia, and Latvia). These LLs form the Agroecological Weed Management Network (AWMN). The LLs cover a variety of crops, including annual (cereals, vegetables, legumes) and permanent crops (olives, grapes, fruits), across conventional, organic, and mixed farming systems. The aim is to create conditions for effective agroecological weed management, and to support this transition, GOOD has assessed stakeholder perceptions of various weed management strategies. This communication will describe stakeholder perception of herbicides and agroecological weed management in arable crops.

KEYWORDS: herbicide, living labs, annual crops, permanent crops, organic, conventional, stakeholders, questionnaires

PAPER ID: cest2025_00093

Unlocking the Potential of Operational Groups in Sustainable Weed Management: The Oper8 Project

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ABSTRACT

The Oper8 project address the urgent necessity of reducing the use of chemical herbicides in Europe by practitioners on both agricultural and forestry sectors. Thus, Oper8 relies on eight existing Operational Groups (OGs) covering seven countries of Europe and moving forward on sustainable non-chemical weed management solutions, building up seven multi-actor National Networks (NNs) developed for co-creating and scaling weed management innovative practices.

Oper8 NNs are built to identify best solutions and facilitate the exchange of knowledge among stakeholders, therefore establishing a platform for guiding the co-creation of solutions specifically adapted to local conditions and challenges. A down-top and top-down approach was applied at national and European levels in order to identify 80 best practices for the creation of easily accessible training materials (e-learning module) and knowledge objects. In addition, practical knowledge is spread to end-users through dissemination materials, cross visits, workshops and demonstration events. Best practices were thoroughly evaluated for a range of agricultural systems and countries, demonstrating their advantages for the economy and environment while minimizing implementation obstacles.

The outputs generated within the project will strengthen the EU AKIS, leading the way for reducing the reliance on chemical herbicides, contributing to more resilient and environmentally friendly agricultural practices.

KEYWORDS: Non-chemical weed management, agricultural sustainability, e-learning, multi-actor networks, knowledge dissemination, AKIS, Horizon Europe

PAPER ID: cest2025_00094

Forest Land Use Dynamics in Greece: Insights from the LUCAS Database

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ABSTRACT

SUS-SOIL is a four-year multidisciplinary project aimed at developing 15 living laboratories to document, analyze, and benchmark various agroecological management practices and subsoil uses. These labs will evaluate the spatial dynamics and changes in subsoil conditions to identify optimal combinations of practices for both rural and urban areas worldwide. Site selection and soil characteristic data collection will be carried out through the LUCAS program. This study focused on identifying forest land use changes in Greece over the past decade using LUCAS points. The findings reveal significant shifts in land use, with the greatest changes observed in broadleaved areas and the least in coniferous zones. These results provide a valuable foundation for informing future forest policy guidelines

KEYWORDS: forests, soil characteristics, living labs, management

PAPER ID: cest2025_00488

SESSION 30 - RECYCLING OF MATERIALS TO NEW PRODUCTS

Saturday 6 September – morning

Use of waste dealuminated metakaolin in alkali-activated cement mixes

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ABSTRACT

This paper explores the feasibility of using dealuminated metakaolin (DMK), a hazardous by-product of the alum industry, in alkali-activated cement (AAC) mixes, as an outlet for this voluminous hazardous waste, alternative to landfilling. After reviewing global DMK waste management practices and emerging uses as a pozzolanic material, the study experimentally investigates geopolymer mortars made with 75% Ground Granulated Blastfurnace Slag (GGBS) and 25% DMK. Activated with various alkaline solutions across different silicate modulus values (M_s 0.2–1.2), the mortars were tested for compressive strength (CS). Some mixes achieved compressive strengths over 40 MPa after just 7 days of curing, demonstrating the potential of DMK in structural concrete applications. Ongoing research aims to elucidate the interaction between DMK and GGBS, towards further optimization of the AAC systems to enhance mechanical performance, durability, workability, and setting behaviour.

KEYWORDS: hazardous waste management; aluminium sulphate industry; dealuminated metakaolin (DMK), Ground Granulated Blastfurnace Slag (GGBS); alkali-activated cements (AAC)

PAPER ID: cest2025_00149

Towards a Sustainable Future: Circular Strategies for Critical Raw Materials Recovery from End-of-Life Magnets

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ABSTRACT

The transition to a circular economy is crucial for addressing the environmental and resource challenges posed by traditional linear production models such as resource depletion, environmental degradation, and waste accumulation. In this context, growing interest is devoted to critical raw materials (CRMs), including rare earth elements (REEs), cobalt, and others, which play a vital role in clean energy technologies, advanced electronics and high-performance magnet applications. This study presents an eco-friendly method for the recovery of REEs from end-of-life (EoL) NdFeB permanent magnets. The proposed method involves a hydrometallurgical metal recovery using an aqueous solution of bio-based leaching agents (citric acid), enabling the one-pot material dissolution and selective precipitation of REE-based compounds. This approach demonstrates high recovery efficiency, with ≥ 90 wt.% of neodymium retained in the solid phase, and yields valuable metal-rich fractions that can be potentially repurposed into new advanced applications. By opening the possibility to valorize both REE-rich solids and base metal-containing leachates, the process offers a viable path toward reduced CRMs dependency and aligns with circular economy principles through waste minimization and resource reuse.

KEYWORDS: rare earth elements, circular economy, green chemistry, waste valorization, permanent magnets

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Acknowledgements

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From waste to treasure: boosting upcycling of critical raw materials from hard disk drives

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ABSTRACT

EU's green and digital transition heavily depends on critical raw materials (CRM). Batteries, solar panels, wind turbines, electric vehicles and other green and digital technologies are inseparable from the use of critical raw materials, which in most cases are imported in the EU. In total, there are 34 critical materials listed in the European Critical Raw Materials Act (2024). Some of the critical raw materials, like neodymium (Nd) and boron (B) are also listed as strategic raw materials, i.e., exponential growth in demand of such elements is expected at the same time posing risks of supply disruption. Currently, 85% of Nd used in EU is imported from China and 99% of B from Turkey. Some of these CRM could be recycled from end-of-life products like wind turbines, electric vehicles and hard disk drives, however, existing technologies are rather limited. Hence, Horizon project NEO-CYCLE provides an interdisciplinary solution for upcycling of neodymium–iron–boron (NdFeB) permanent magnets from hard disk drives by provisioning technologies for Nd, Fe, B separation and ensuring high purities needed for applications in pharmaceutical, ammonia, fertilizers and polymers industries. To fulfil project ambition and ensure green transition, environmental, social and economic aspects of proposed processes and technologies including associated risks, circularity, and green logistics will be assessed. In addition, developed digital twins and mathematical modelling will support optimization of the processes, contributing to the green twin transition. To boost the uptake of the developed technologies, inclusive and sustainable business models will be created and fostered by the project partners in line with stakeholder engagement and various training for technical and soft skills development including gender issues in recycling industries.

KEYWORDS: NdFeB magnets, upcycling, critical raw materials, sustainability, circularity

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Acknowledgements: Funding by the European Union under GA no. 101138058 is gratefully acknowledged.

Determination of Potential Product Circularity Scores of Upcycled Plastic Products in the Philippines

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ABSTRACT

The mismanagement of post-consumer plastics poses a significant threat to human health and the environment. Plastics in the open environment blocks rivers and waterways increasing the risk of flooding and the proliferation of microplastics. These environmental issues prevail especially in developing countries. In the Philippines, there are different approaches in minimizing plastic wastes through waste diversion and recovery. However, the assessment of the potential useful life extension of plastics through recycling has still yet to be extensively conducted in the Philippines. This results in uncertainty among plastic product manufacturers on which recycled products can use plastics for a longer period or for multiple product life cycles, i.e., having a high potential product circularity. The absence of a comprehensive assessment tool focusing on the design phase of the product life cycle makes it difficult to achieve plastic circularity at the product level. A design-based product circularity assessment called Concept Circularity Evaluation Tool (CCET) was developed in 2020 by Albaek et al. This tool can be used for determining options for circularity by identifying improvement opportunities on the different stages of the product life cycle. Highly circular products from plastic wastes in the Philippines were determined through assessing the potential product circularity through a numerical score based on the CCET. A higher circularity score means that the product has a relatively longer useful life and can be used for more than one useful life among the products considered. Household furniture and construction products are considered in the assessment because these are the most common applications of recycling post-consumer plastic wastes in the Philippines. The increasing number of recycled plastic product manufacturers in the Philippines results in a more established plastic waste collection scheme and production of household furniture and construction products from plastic wastes. Among the household furniture products, compression-molded school chairs got the highest potential circularity score of 43.57. For the products used in the construction industry, eco-pavers obtained the highest circularity score of 32.95. The household furniture plastic products have a higher average circularity score. Although these products have shorter useful life than construction products, household furniture plastic products can still have higher level of circularity. Most of these products are made with higher plastic content compared to construction products which can have different material components such as aggregates and binders affecting the amount of plastic materials being recycled throughout their product useful life. The product circularity assessment can be made available through multi-stakeholder discussions among the manufacturers, members of the academy, government agencies, and local communities in identifying possible circularity improvement opportunities throughout the product lifecycle. The manufacturers can use the assessment to strategize their approach in developing their product by identifying which stage of the product lifecycle can be improved further and what products can have high circularity. However, the determination of potential circularity scores of upcycled plastic products is only a part of the entire decision-making of manufacturers during the product design and development phase. This assessment can be used in conjunction with quantitative product circularity assessment providing a more holistic approach in developing technical and data-driven product circularity assessment for products from post-consumer plastic waste.

KEYWORDS

Circular Economy, Plastic Recycling, Post-Consumer Plastics, Waste Management

PAPER ID: cest2025_00144

Volcanic ash recovery and valorization

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ABSTRACT

Volcanic ash (VA) from Mt. Etna, frequently deposited in surrounding urban areas due to intense eruptive activity, poses significant environmental, infrastructural, and economic challenges, especially related to cleanup operations and air traffic disruption. Traditionally treated as waste and destined for landfilling, VA management has been reconsidered in light of Italian Law 108/2021, which promotes its reuse within a circular economy framework. The REUCET Project developed technical Guidelines for the recovery and reuse of VA from Mt. Etna in various civil and environmental engineering applications. The proposed applications include its use as a raw material in cement and mortar production, lightweight ceramics, road foundation layers, and in the development of innovative materials for air and water treatment. These include photocatalytic composites and zeolites, derived from the fine ash fraction (<1 mm). Recovery processes require preliminary screening to remove contaminants and classify VA by grain size, a key factor for its integration into suitable production cycles. The Guidelines aim to enable sustainable and economically viable VA reuse while ensuring environmental and public health protection.

KEYWORDS: end-of-waste, circular economy, solid waste management.

PAPER ID: cest2025_00245

Acknowledgements

This study was partially funded by the “Ministero dell’Ambiente e della Tutela del Territorio e del Mare” within the Project “REUCET - Recupero e utilizzo delle ceneri vulcaniche etnee”.

Environmental and economic assessment of the reuse of expanded polystyrene (EPS) waste as an aggregate substitute in cement mortar

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ABSTRACT

This study investigates the feasibility of using expanded polystyrene (EPS) waste collected in coastal areas as a partial substitute for sand in cement mortars, without the need for pre-treatment. Two scenarios were evaluated: (i) direct collection from polluted coastlines and (ii) recovery from existing recycling stations. The environmental assessment was carried out through a life cycle assessment (LCA), while the economic performance was assessed through a life cycle costing (LCC). The results showed that second scenario had approximately 30 % lower environmental impact and significantly lower costs, mainly due to the elimination of the collection phase. Compared to sand, EPS had lower emissions per cubic meter due to its low density. The results confirm that the direct reuse of EPS waste from the coastal areas without pre-treatment is a technically feasible and economically viable solution for non-structural applications. This approach contributes to the reduction of plastic waste and supports the transition to a circular economy in the construction sector.

KEYWORDS: Marine plastic pollution, EPS waste reuse, sustainable materials, LCA, circular economy.

PAPER ID: cest2025_00354

Feasibility of peat soil stabilisation with solid waste material inclusions and biocementation treatments

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ABSTRACT

This paper studies the stabilisation of a peat railway embankment foundation soil from East Anglia, UK, using solid waste material inclusions and biocementation treatments. Peats are weak, high water content soils which lead to construction problems, due to the high water content and poor engineering properties. Chemical peat improvement to improve its engineering properties is commonly relying on Portland cement, which absorbs water while forming cementing gels. However, due to the negative environmental impact of Portland cement, the civil engineering industry is seeking innovative, more environmentally friendly alternatives. This study introduces soil biocementation based on biomimetic precipitation of natural minerals. Specifically, heterotrophic carbonic anhydrase producing bacteria that sequester CO₂ in the process are used. Solid waste/by-product materials such as wood saw ash, sawdust and ground granulated blast furnace slag filler/water absorbing materials are also used, as a means of contributing to solid waste management by waste recycling. The results indicate undrained shear strengths of 2-16 times higher than that of the untreated peat depending on treatment, although further study is needed to improve treatment homogeneity with possible modifications in the treatment protocol.

KEYWORDS: peat stabilisation, solid waste inclusions, biocementation, carbonic anhydrase

PAPER ID: cest2025_00150

Acknowledgements: Network Rail Ltd, funded this study (contract ecm-34465)

Designing for Disassembly and Reuse: A Modular Repair Model Proposed in the Manual of Good Practices for the Production and Recycling of Waste from Electrical and Electronic Equipment

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ABSTRACT

This paper proposes a modular design approach based on Design for Circular Disassembly (DfCD) to reduce waste and repair costs in Electrical and Electronic Equipment (EEE). Drawing from practical examples and aligned with European circular economic directives, the study demonstrates how product architecture and repair protocols can be restructured to enable component-level maintenance and reuse. The methodology includes design criteria, a conceptual case study, and an implementation roadmap. The results suggest that DfCD improves sustainability, extends product lifespan, and supports circular business models.

KEYWORDS: Design for Circular Disassembly, Sustainable Product Design, Waste from Electrical and Electronic Equipment, End-of-Life Strategies, Circular economy.

PAPER ID: cest2025_00456

Acknowledgements: Work funded by PRR (Plano de Recuperação e Resiliência) and NextGenerationEU, at Universidade de Aveiro through “Agenda Microeletrónica” (nº. 14, C644916358-00000028)

SESSION 31 – PLENARY SESSION

Saturday 6 September – morning

Biotechnological upgrading of biogas using green hydrogen as a reducing agent

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ABSTRACT

The replacement of fossil fuels by renewable energy sources is one of the most important steps for the reversal of climate crisis through circular economy. The contribution of solar and wind energy has been continually increasing in the recent years to this end. To fully exploit their potential, their storage as chemical energy in the form of green hydrogen or methane is of paramount importance. Green hydrogen generated via electrolysis of water using the surplus electricity generated by photovoltaic cells is employed in this work for the reduction of the carbon dioxide contained in biogas to methane. This leads to almost complete upgrading of the biogas generated via anaerobic digestion of the wastewater generated by a potato processing industry. The upgraded biogas may then be injected into the natural gas network, used in a combined heat and power (CHP) process or used as transportation fuel in the form of bioCNG. Two alternative approaches are examined. The first is an ex situ process: biogas is generated in a UASB reactor and co-fed with green hydrogen to a mesophilic trickling bed reactor (TBR) in order to be upgraded to biomethane via hydrogenotrophic methanogenesis. In the second alternative, green hydrogen is fed as microbubbles to a wastewater processing UASB reactor for an in-situ enrichment of biogas to biomethane. A third alternative also examined is the direct use of the generated electricity with or without hydrogen addition in a microbial electrolysis cell anaerobic digestion (MEC-AD) system.

KEYWORDS: biogas upgrade; green hydrogen; biotechnology; combined heat and power (CHP) process

PAPER ID: cest2025_00476

Acknowledgements: The research project “GREENUPGRADE: Valorization of green energy for enhancing the robustness and upgrading the performance of anaerobic digestion systems (61401400)” is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union – NextGenerationEU (H.F.R.I. Project Number: 15522).

SESSION 32 – WATER TREATMENT

Saturday 6 September – morning

Development of fluorescence sensors for DBPs control in drinking water

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ABSTRACT

Chlorination of drinking water has been recognized as one of the most effective public health measures ever. However, chlorine reacts with Natural Organic Matter (NOM) present in all surface waters to produce disinfection by-products (DBPs). Trihalomethanes (THMs) and haloacetic acids (HAAs) are the most prominent classes of DBPs, but a vast array of yet unidentified compounds contribute to about 60% of the total organic halogen have been found in disinfected water. Due to the complexity and heterogeneity of NOM, several surrogate parameters have been used to quantify NOM reactivity in halogenation reaction and DBPs formation. Differential absorbance and fluorescence were also strongly correlated with DBPs formation. The goal of this study is to explore the performance and applicability of fluorescence based surrogates to control DBPs and DBPs precursors during the water chlorination at varying operating conditions. Obtained results highlight that selected fluorescence signals are powerful parameters for in situ monitoring of the organic precursors of DBPs.

KEYWORDS: Disinfection; chlorination; disinfection by-products; monitoring.

PAPER ID: cest2025_00246

Acknowledgements

This work was partially supported by the European Union (Project intoDBP, Horizon Europe).

The Smart Hydrogels for the Controllable Adsorption and Desorption of PFAS

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ABSTRACT

In order to address the regeneration issue of adsorbents for the elimination of per- and polyfluoroalkyl substances (PFAS), this work synthesized a novel smart hydrogel based on a temperature-responsive polymer, poly(N-isopropylacrylamide) (PNIPAm). These hydrogels exhibit hydrophobicity and hydrophilicity above and below the lower critical solution temperature (LCST) of PNIPAm, respectively. Concurrently, the monomer 2-(methacryloyloxy)ethyltrimethylammonium chloride (MTAC), distinguished by its quaternary ammonium groups, was co-polymerized with NIPAM to augment its electrostatic effect. Utilizing perfluorooctanoic acid (PFOA) as a case study, the smart hydrogel attained an 80% desorption efficiency through the mere adjustment of temperature, obviating the necessity for salt solution or organic solvent. This work is expected to overcome the challenges associated with the regeneration of adsorbents and contribute to the sustainable management of PFAS.

KEYWORDS: PFAS, smart hydrogels, adsorption, regeneration

PAPER ID: cest2025_00355

Acknowledgment: This work was funded by the Alexander von Humboldt Foundation.

Optimizing Plasma Bubbles at Pilot Scale for Organic Pollutant Degradation in Water

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ABSTRACT

This study investigates the scalability of nanopulsed plasma bubble technology for water remediation, transitioning from lab to pilot scale. The pilot-scale plasma bubble reactor was optimized to degrade toxic organic pollutants, including dyes (methylene blue, MB), antibiotics (sulfamethoxazole, SMX), and pharmaceuticals (valsartan, VAL). High degradation efficiencies were achieved: >99% for MB after 10 min, >99% for SMX after 20 min, and >98% for VAL after 40 min. The reactor produced high concentrations of short-lived hydroxyl radicals ($\cdot\text{OH}$, ~25 mg/L under O_2), with minimal long-lived species (O_3 , H_2O_2 , $\text{NO}_3^-/\text{NO}_2^-$), maintaining stable pH (~7). Energy efficiency was superior at the pilot scale, with electrical energy per order (EEO) values of 0.18 kWh/m³ for MB, 0.42 kWh/m³ for SMX, and 0.88 kWh/m³ for VAL, 2-3 orders of magnitude lower than other advanced oxidation processes (AOPs). The system's performance was consistent across tap and ultrapure water, demonstrating its applicability in real-world conditions. These findings highlight the potential of nanopulsed plasma bubbles for rapid, effective, and energy-efficient water remediation at larger scales.

KEYWORDS: non-thermal plasma, water remediation, plasma bubbles, pilot scale, organic pollutants

PAPER ID: cest2025_00360

Acknowledgements

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EUROPEAN PARTNERSHIP

Performance Of Preoxidation and Coagulation in Arsenic Removal from Groundwater for Human Consumption in A Small Rural Community in Western Romania

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ABSTRACT

Health problems caused by high arsenic concentrations (over 200 µg/L) in groundwater sources in the Pannonian Basin (Hungary, Romania, Croatia, Serbia) have become a major concern for researchers and environmental experts. This paper evaluates the effect of the preoxidation (with hypochlorite)/coagulation process (with commercially available coagulant FeCl₃) on the removal efficiency of arsenic (with an initial concentration of 235 ± 0,6 µg/L) from a groundwater source for a small rural community in western Romania, at laboratory scale. The results of this experimental study showed that, through the preoxidation/coagulation process, the arsenic concentration is removed up to 94% from the groundwater used. Since coagulation and flocculation are simple and commonly applied in drinking water treatment plants in most countries of the Pannonian Basin, this work aims to contribute to long-term improvement of drinking water in this geographical area, with groundwater sources naturally contaminated with arsenic.

KEYWORDS: arsenic removal, preoxidation, coagulation, groundwater treatment.

PAPER ID: cest2025_00389

Acknowledgements

This work was carried out through the “Nucleu” Program within the National Research Development and Innovation Plan 2022-2027 with the support of Romanian Ministry of Research, Innovation and Digitalization, contract no. 3N/2022, Project code PN 23 22 03 03.

Exploring the applicability of differential absorbance to simultaneously quantify and control microbial inactivation and DBPs formation

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ABSTRACT

Chlorination is effective in inactivating microorganisms. However, its interaction with natural organic matter (NOM) and inorganic ions leads to the formation of disinfection byproducts (DBPs). Surrogate parameters, such as the differential absorbance at 272 nm (DA272), have shown potential for monitoring NOM degradation and DBP formation. This study aims to evaluate the applicability of DA272 as a control tool for both microbial inactivation and DBP control. The results demonstrate a strong correlation between DA272 and the microbial inactivation ratio and suggest that specific DA272 thresholds can be established to ensure both effective disinfection and DBP control within the treatment plant.

KEYWORDS: Chlorination; disinfection by-products; inactivation ratio; differential absorbance.

PAPER ID: cest2025_00404

Acknowledgements: This work was partially supported by the European Union (Project intoDBP - 101081728, Horizon Europe).

The role of methylparaben as an environmental contaminant in enhancing the pathogenicity of drinking water bacteria

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ABSTRACT

Parabens, commonly used as preservatives in personal care products, can affect drinking water (DW) environmental microbial communities, posing an emerging global concern for public health. This study examines the impact of MP at 15 µg/L on the virulence of *Acinetobacter calcoaceticus* and *Stenotrophomonas maltophilia* both isolated from a drinking water distribution system (DWDS). MP was able to change the production and properties of bacterial released outer membrane vesicles (OMVs) by affecting the OMVs hydrodynamic size, lipid content and OMVs concentration. Furthermore, MP exposure increased the ability of *A. calcoaceticus* cells to invade human gingival fibroblasts (HGF). These findings highlight how MP can amplify interconnected virulence mechanisms - including OMV production, and host cell invasion - posing potential health risks in DWDS.

KEYWORDS: bacterial virulence, biofilms, internalization, invasion, methylparaben, outer membrane vesicles

PAPER ID: cest2025_00019

Investigating the potential of phytoremediation-assisted treatment of rainwater for domestic use using selected agro-wastes as filter media

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ABSTRACT

The Bicol Region is one of the most exposed areas to natural disasters in the Philippines. It is economically reliant on agriculture, with coconut and rice among the important crops being produced. This study looks into the potential of utilizing locally available agro-waste materials as sustainable and cost-effective solutions to the artificial scarcity of good quality water from abundant rainwater and stormwater run-off for many disadvantaged communities in the region. Cocopeat (CP) and carbonized rice hull (CRH) were studied as alternative adsorptive materials to sand (S) in the preliminary treatment of rainwater via filtration. Vetiver grass (*Chrysopogon zizanioides*) and reeds (*Phragmites karka*) were planted onto cocopeat (CP + Phy) to enhance its filtering performance. The treatment efficacy of the filter materials was determined by comparing the pH, total dissolved solids (TDS), temperature, oxidation reduction potential (ORP), resistivity and salinity of rainwater before and after filtration. Analysis of variance (ANOVA) was used to compare the performance of the filter media tested. The treatment performance of cocopeat is comparable to sand in improving the quality of the tested rainwater samples. Further improvement in the treatment efficiency of cocopeat was observed on some water quality parameters when phytoremediating plants were added.

KEYWORDS: rainwater, stormwater, harvesting, filtration, treatment

PAPER ID: cest2025_00215

SESSION 33 – CIRCULAR ECONOMY IN AGRICULTURE AND FOOD SYSTEMS (1)

Saturday 6 September – morning

Sustainable production of Omega-3-rich fish oil from Tuna by-products using green extraction process

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ABSTRACT

Omega-3 fatty acids are essential for human health, yet the increasing global demand necessitates the exploration of sustainable alternative sources, such as fishery by-products. An innovative and environmentally friendly extraction method, previously applied to small fish by-products, was employed on large fish by-products, particularly tuna soft tissues, utilising green solvents including d-limonene, 2-methyloxolane (2-MeOx), and ethanol. The results indicated that d-limonene and 2-MeOx efficiently extracted omega-3-rich oils, achieving notable concentrations of EPA (4–7%) and DHA (17–28%). However, substantial impurities were detected, attributed to the greater difficulty of purifying large fish by-products, which tend to retain blood and other fluids despite cleaning. This contrasts with previous findings from small fish such as sardines and anchovies, where extraction yielded purer oils with greater ease. These findings underscore the necessity of further optimisation of extraction protocols for larger fish waste. Nonetheless, the preliminary outcomes suggest that, with appropriate refinement, tuna by-products represent a promising and sustainable source of omega-3 fatty acids, contributing to more sustainable fishery resource management practices.

KEYWORDS: Biorefinery, Fish oil, Omega3, Tuna, Solvent

PAPER ID: cest2025_00033

Fish waste valorization route: production of biohydrogen and volatile fatty acids under different process conditions

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ABSTRACT

Acidogenic fermentation with anaerobic microbial consortia is an attractive route for fish waste (FW) valorization towards high-value products, including volatile fatty acids (VFAs) and biohydrogen (H₂). Nonetheless, literature on the influence of operational parameters on VFAs and H₂ production from FW is scarce. This study aimed to explore the influence of initial pH, food-to-microorganisms' (F/M) ratio, and co-fermentation with fruits and vegetables waste (FVW) on VFAs and H₂ production from FW. The results revealed that adjusting the initial pH to 4.5, 5.0, 6.0, 6.5, and 7.0 significantly affected VFAs and H₂ yield in comparison to the condition without initial pH adjustment ($p < 0.05$). The highest H₂ yield was observed at initial pH 4.5, reaching 59.51 ± 3.02 NmL H₂/g VS while the highest VFAs production was observed at initial pH 7, reaching a concentration of 1876 mg HAc/L. Increasing the F/M ratio from 1 to 5 resulted in a 64% increase in VFAs yield at initial pH 7. Moreover, co-fermentation with 75% FVW resulted in a 68% increase in H₂ yield, while the optimum VFAs yield (758.6 mg HAc/g VS) was obtained by co-fermentation with 50% FVW. The results are useful for the emerging trash-to-cash concept.

KEYWORDS: co-fermentation, resource recovery, circular economy, food/microorganisms' ratio, Ph

PAPER ID: cest2025_00203

Electrospun microbial protein and cellulose acetate nanocomposite fibers for heavy metals-contaminated water remediation

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ABSTRACT

Heavy metal pollution is a major environmental issue, with industrial and agricultural activities increasing metal concentrations in water. Effective treatment methods are crucial, and adsorption is one of the most efficient techniques. This study combines microbial proteins (MPs) from waste cheese whey permeate with biodegradable cellulose acetate to create nanocomposite mats via electrospinning. The resulting mats exhibit high adsorption capacity for lead (66.23 mg/g) and stability, demonstrating their potential as sustainable bio-adsorbents for wastewater treatment. The material's reproducibility, high efficiency, and eco-friendly nature make it a promising solution for heavy metal removal.

KEYWORDS: electrospinning, cellulose acetate-based membrane, microbial protein, sustainable process, heavy metals water treatment

PAPER ID: cest2025_00211

A Circular Approach to Wheat Residue Management: Lab-Scale Production of Biofuels

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ABSTRACT

Within the framework of the project “Real-time environmental assessment of agricultural and agrifood production for the support of certification schemes”, a real-time, web-based Life Cycle Assessment (LCA) tool has been developed. To demonstrate the tool’s functionality, the environmental impacts of four different wheat production routes were assessed. Emphasizing a circular economy approach in the agricultural sector can reduce waste, produce bioenergy, and reduce the overall environmental footprint. Despite this potential, there is an increased uncertainty regarding bioenergy output and electricity consumption of various small-scale technologies. Therefore, within the scope of the project, laboratory-scale experiments were conducted to evaluate the production of biofuels using wheat residues and wastes. The waste-to-energy technologies that were included are an oil press, a pellet mill, and an ethanol still. This study presents the results of the lab-scale production of biodiesel, bioethanol, and pellets. Finally, the potential reduction in Global Warming Potential (GWP) that can be achieved by the integration of waste-to-energy in wheat production was quantified.

KEYWORDS: Waste-to-energy; Circular Economy; Agriculture; Biofuel production; Wheat Production

PAPER ID: cest2025_00365

Acknowledgments: This research was carried out as part of the project «Real-time environmental assessment of agricultural and agrifood production for the support of certification schemes» (Project code: KMP6-0078501) under the framework of the Action «Investment Plans of Innovation» of the Program «Central Macedonia 2021-2027», that is co-funded by the European Union and Greece.

Assessing Methodologies for Measuring Food Loss in Tomato Cultivation: A Field Study in Cyprus

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ABSTRACT

Tomato cultivation is one of the major crop production systems practiced across the globe with an estimated production volume of around 187 million tons in 2022. The versatility of the product and the development of techniques and technological advancements for producing it year-round led to improvements and the use of various crop production systems (greenhouse, hydroponics, open field cultivation, etc.), and the development of varieties destined for different uses (industrial, table, paste, etc.). Nonetheless, losses at the production and post-harvest stages are a significant global challenge that impacts food security, the environment, and economic development. This study examines the effectiveness of different methodologies for quantifying post-harvest food loss in tomato cultivation with an emphasis on the field methods that are relevant to Cyprus's agricultural situation. Field testing and validation are conducted, combined with a multi-criteria analysis that evaluates the accuracy, replicability, scalability, adaptability to local conditions, required expertise, time, and cost-efficiency of each method. While the study centers on Cyprus as a case study, the findings are applicable to similar agricultural settings in other regions facing comparable challenges. The research evaluates both direct and indirect quantification methods, combining interviews with farmers, and middlemen to estimate price and volume changes, as well as mass flow approaches to determine the most appropriate ways of estimating FL at various levels of the production chain. Furthermore, the main causes of FL such as environmental conditions, pest and disease attacks, and handling practices, across different tomato farms are identified. The findings are meant to give strategic options for minimizing the FL in tomato farming, and provide recommendations on how to improve the quantification approaches and the practices That can be useful in enhancing the efficiency of the resources used in agriculture, supporting the efforts towards improvement of sustainable agricultural practices.

Keywords: Food Loss, Food Security, Primary sector, Food Loss Quantification.

Paper ID: cest2025_00417

Optimizing Biochar from Palm Tree Waste for VOC Mitigation in Cattle Farms

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ABSTRACT

Optimizing biochar production from Washingtonian palm tree municipal waste presents a sustainable approach to mitigate volatile organic compounds (VOCs) from cattle farms, advancing the principles of the 4Rs: Reduce, Reuse, Recycle, and Recover. Key pyrolysis parameters, including temperature, nitrogen flow rate, and scalability, were systematically investigated to enhance the biochar's adsorption efficiency.

Pyrolysis temperatures were evaluated in a wide range (350-750 °C) at the laboratory scale, with 550 °C identified as the optimal temperature, producing biochar with high adsorptive capacity and structural stability. At this temperature, the biochar exhibited enhanced surface area, optimal pore volume, and suitable pore size, all of which are crucial for effective VOC adsorption and odor mitigation.

Nitrogen flow rates were varied between 100 and 1600 mL/min, with 100 mL/min proving optimal. This flow rate enhanced thermal decomposition efficiency, enabling a reduction in pyrolysis temperature. Under these conditions, VOCs, including odorous compounds like indole, p-Cresol, skatole, dimethyl disulfide (DMDS), and dimethyl trisulfide (DMTS), commonly associated with cattle manure emissions, were reduced by over 95%.

The process was successfully scaled up to a semi-pilot kiln, demonstrating the feasibility of translating laboratory results to larger-scale production while maintaining product consistency. Comprehensive characterization confirmed the biochar's structural integrity, thermal stability, and enhanced adsorption potential.

These findings position biochar derived from municipal woody waste as a sustainable, scalable solution for mitigating manure-associated VOC emissions, with potential for further enhancement through Mediterranean feedstocks and advanced activation techniques.

KEYWORDS

Biochar production, Palm tree waste, Pyrolysis operational parameters, Odor control, Sustainable biomass utilization, Semi-pilot scale.

PAPER ID: cest2025_00071

Acknowledgments: The project (RE-GreenVOCs, CODEVELOP-REPowerEU/1223/101) is funded by the European Union Recovery and Resilience Facility of the NextGenerationEU instrument, through the Research and Innovation Foundation.

Impact of Carbon-Based Materials on the Anaerobic Digestion of Citrus Processing By-product

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ABSTRACT

Orange peel waste holds promise for biomethane production via anaerobic digestion, though challenges such as the presence of d-Limonene, an inhibitory compound, and seasonal availability persist. In this study, ensiled OPW was used in Biochemical Methane Potential (BMP) tests to evaluate its degradability and assess the effect of carbon-based additives (i.e. granular activated carbon and biochar). Methane production was monitored over time and modelled using first-order and modified Gompertz kinetics. The highest methane yield (578 ± 59 NmL CH₄/gVS) was observed in the control, consistent with literature values for ensiled OPW. Yields from tests where additives were used ranged from 520 to 560 NmL CH₄/g_{VS}, with no significant enhancement. However, kinetic modelling indicated a slight increase in the maximum methane production rate (R_m) using an additive, suggesting an acceleration in methane production kinetics.

KEYWORDS: Orange Peel Waste, Anaerobic Digestion, Biochemical Methane Potential, Biochar, Granular Activated Carbon

PAPER ID: cest2025_00465

Sustainability and Accountability in Agricultural Cooperatives: The Case of ZAGORIN through the GRI Lens

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ABSTRACT

This research explores the Agricultural Cooperative of Zagora (ZAGORIN), considered as one of the most sustainable and resilient agricultural cooperatives in Greece. It seeks to evaluate the perception and implementation of sustainability inside the cooperative, as perceived by its active members, under the framework of the Global Reporting Initiative (GRI) standards. The research employed a qualitative approach, through in-depth interviews with 15 cooperative members to investigate sustainable practices across the three equally weighted pillars of the GRI framework: Environmental, Social, and Governance (ESG). The aim is to assess the members' perceptions of the cooperative's actual sustainability initiatives and to identify strengths, weaknesses, opportunities, and threats using a systematic GRI-based SWOT analysis. The results demonstrate a strong relationship between the cooperative's activities and sustainability principles, especially in governance and social responsibility; yet, there remain opportunities for enhancement in environmental practices and formal sustainability reporting. The results provide significant insights into member-driven evaluations of sustainability and emphasize the necessity of implementing standardized reporting systems. This study enhances the dialogue on cooperative sustainability within the agrifood industry and offers a framework for other cooperatives seeking to better align with global sustainability standards.

KEYWORDS: GRI Standards; ESG; Sustainability; SWOT Analysis; Agricultural Cooperatives

PAPER ID: cest2025_00379

SESSION 34 – ENVIRONMENTAL IMPACT OF MARITIME TRANSPORT – NAVGREEN

Saturday 6 September – morning

Study of the Ecotoxicological Effects of Metals from Scrubber Washwaters on Aquatic Biota

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ABSTRACT

The maritime transport sector predominantly relies on fuel oil as the energy source for ships, leading to the emission of exhaust gases that comprise harmful substances, which could cause chronic toxicity (polycyclic aromatic hydrocarbons) and inherently persistent (heavy metals), posing substantial short and long-term risks to marine ecosystems. Exhaust Gas Cleaning Systems (EGCS), commonly referred to as scrubbers, play a crucial role in compliance with international maritime emissions regulations. While this technology effectively lowers SO₂ emissions, the environmental challenges related to the subsequent discharge of scrubber water containing the aforementioned harmful substances remain. This study investigates the toxicity of the most prevalent heavy metals in scrubber effluents: iron, vanadium, nickel, and zinc, using two key marine model organisms widely used in toxicity bioassays: *Artemia franciscana* and *Brachionus plicatilis*. The results indicate a marked sensitivity of these organisms to the evaluated metals, particularly in early developmental stages of *A. franciscana* (nauplii). The study reveals that vanadium and iron were the most toxic metals. Furthermore, the metal mixture showed higher toxicity than any individual metal, indicating significant effects and representing a potentially underestimated environmental risk.

KEYWORDS: ecotoxicology, metals, environmental risk, scrubber washwater, EGCS.

PAPER ID: cest2025_00445

Monitoring ship-generated waste in Greek ports using ECOMARPOL platform

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ABSTRACT

European Green Deal sets targets and priorities to ensure the sustainability of the blue economy and fisheries sectors. It therefore presents a clear incorporation of the ecosystem approach between the status of natural resource systems and ecosystem services.

Specifically for the Mediterranean region, the climate change impacts, tourism and maritime transport should be considered as critical factors. The significant reduction of precipitation will stress natural and anthropogenic systems soon, while the area is the largest global tourism destination, attracting almost a third of the world's international tourists (306 million out of 980 million worldwide). It is forecasted that the Mediterranean region will reach 500 million international tourist arrivals by 2030 (UNWTO 2012). Maritime transport is also a factor to consider, since the Mediterranean is among the world's busiest waterways, accounting for 15 % of global shipping activity, therefore creating pressures in the region.

The purpose of this study is to use ECOMARPOL platform to provide information on:

- ✓ Ports with waste reception and management facilities (Port Reception Facilities – PRFs)
 - Vessel types
 - Waste categories
- ✓ Estimation of waste quantity
- ✓ Environmental Management Systems in the ports
- ✓ Management / competent authorities
- ✓ Legislative framework
- ✓ Management, transport and disposal protocols

For the estimation of waste generated, a data set provided by marinetraffic.com has been analysed and the quantities for each of the 6 annexes of MARPOL 73/78 convention were derived. This estimation enables the port authorities and the related stakeholders to understand and predict the amount of waste delivered at each port based on the type, number and size of ships and the related travel time.

KEYWORDS: maritime transport; MARPOL 73/78; waste; shipping; climate change

PAPER ID: cest2025_00453

Maritime transport impact on pollution in Saronikos Gulf: modelling, insight and perspectives from two research projects.

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ABSTRACT

This work concisely presents findings and insight on the impact of shipping on pollution of an eastern Mediterranean coastal marine ecosystem - Saronikos Gulf, Greece: Advanced modelling tools (STEAM, SILAM, Delft3D) were employed to assess shipping-related pollution from direct discharges and atmospheric emissions of heavy metals, PAHs and Elemental (black) Carbon (EC). Simulations for 2018 revealed that shipping contributed < 1% to total pollutant loads. Projections for 2050 under various traffic and fuel scenarios indicated that open-loop scrubber discharges could increase concentrations locally. The fate of fine EC particles was also investigated, showing that EC from shipping represents a small fraction of total atmospheric deposition, though some accumulation in marine sediments occurs. High-resolution Delft3D simulations, forced by seasonal EC deposition data accounting for all sources from the WRF-CAMx modelling system, were used to evaluate EC transport and distribution in the Gulf. Results showed increased EC levels in Elefsis Bay for January and July 2019 and decreasing gradients offshore, in agreement with field observations, reflecting source importance and seasonal variation. Findings highlight the limited yet important role of shipping in localized marine pollution.

KEYWORDS: Shipping emissions, scrubber effluent, black carbon dispersion, modelling, marine pollution

PAPER ID: cest2025_00458

Acknowledgments

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Ship electrification as a pathway to decarbonize shipping: The case of Perama-Salamina line

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ABSTRACT

Ship electrification offers a promising pathway to decarbonise maritime transportation, especially for short-sea shipping, and activities within port areas. This paper examines the viability of using hybrid or fully electric vessels on a coastal route in the Aegean Sea, with the goal of assessing the positive impact on the environmental footprint. The reduction of greenhouse gas (GHG) emissions and air pollutants impacting human health and climate is estimated through emission inventories and atmospheric modeling. The line Perama – Salamina was selected for study since it is a busy line in terms of ship itineraries. Considering the current technologies in batteries the distance of the line (1.62 nm) makes it ideal for full ship electrification. Preliminary photochemical modelling results from the environmental assessment for a winter period of the year 2019 showed that by zeroing-out the shipping emissions, the maximum difference in the mean daily concentrations of pollutants such as NO₂ could be up to -15.5%. Public consultation revealed support for electrification but noted key barriers like funding, regulation, and incentives; national strategy recommended. In general, the study highlights the potential of ship electrification as a solution to the decarbonisation of coastal shipping.

KEYWORDS: Electric ships, short-sea shipping, net-zero emissions, photochemical modelling, citizen laboratory

PAPER ID: cest2025_00250

Funding: NAVGREEN project, “Flagship actions in interdisciplinary scientific fields with a special focus on the productive fabric” (ID: TAEDR-0534767) of the Recovery and Resilience Facility (RRF)

Assessing Knowledge Gaps about Shipping Emissions: Designing Educational Programs for Sustainable Maritime Logistics for Future Professionals in Albania & Montenegro

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ABSTRACT

This study assesses knowledge gaps among Albanian and Montenegrin maritime professionals regarding EU shipping emissions and their implication on current and future curricula. Survey data revealed educational needs across economic, legislative, and engineering domains. Utilizing IMO model course frameworks and competence-based assessment methodologies, we propose structured educational interventions to facilitate knowledge transfer from established EU member states to the West Balkan countries. The findings contribute to environmental management policy by addressing regional capacity development needs for maritime emissions compliance, technological innovation and best practices.

KEYWORDS: Engineering Education, Questionnaire, West Balkan, Shipping Emissions, Sustainability

PAPER ID: cest2025_00361

Acknowledgement

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From Weather to Waypoints: Predicting Fuel Consumption and Optimizing Maritime Routes with ML and Graph Search

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ABSTRACT

This paper introduces a framework for predicting ship fuel consumption and optimising routes by integrating physics-based models, machine learning (ML), and graph search algorithms. A synthetic dataset was generated using a physics-based resistance and propulsion model of a Kamsarmax bulk carrier under varying environmental conditions. A Multi-Layer Perceptron (MLP) was trained to forecast fuel consumption from this dataset. The model was then combined with a dynamic A* routing algorithm over a spatio-temporal graph of the Aegean Sea. Results reveal that this approach captures nonlinear ship-environment interactions and identifies fuel-optimal routes, reducing overall consumption compared to static methods. The study demonstrates the potential of physics-informed ML with adaptive routing for sustainable maritime transport

KEYWORDS: Fuel consumption prediction, Machine Learning (ML), Weather routing

PAPER ID: cest2025_00472

Acknowledgement

The work presented in this paper is in the context of the NAVGREEN. The funding for the project is provided through the Recovery and Resilience Fund under Greece's National Recovery and Resilience Plan (Greece 2.0)

Towards market-oriented measures for reducing the emissions of maritime passenger transport: Assessing potential business models.

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ABSTRACT

As the emission reduction of maritime transport becomes an increasingly important objective, passenger maritime services face mounting pressure to adopt cleaner practices. However, market-oriented strategies for reducing emissions often rely on consumers' willingness to pay more for environmentally friendly transport—an assumption that does not consistently hold true in practice according to current academic research. This study investigates willingness to adopt and willingness to pay toward two distinct business models in passenger maritime transport, both offering potential for emission reductions without relying on conventional regulatory or taxation-based mechanisms.

The first model centers on cruise ferries, which reduce sailing speeds and thus significantly lower fuel consumption and emissions. Cruise ferries are widely developed in the Nordic region as well as other parts of the World such as the North Sea, Japan and Chile. These vessels compensate for longer travel times by enhancing the onboard experience through upgraded amenities, thereby repositioning travel time as leisure time. The second model explores on-demand transport solutions for small island regions, made feasible by recent advances in battery-electric vessel technology. These smaller vessels provide higher service frequency, lower waiting times, and improved inter-island connectivity, while offering an inherently cleaner mode of travel.

Using a stated preference survey and discrete choice modeling, this study quantitatively assesses individuals' willingness to shift toward these modes.

The findings suggest that well-designed, service-oriented business models—rather than externally imposed policies—can effectively drive the decarbonization of passenger maritime transport. Cruise ferries and on-demand transport offer compelling, user-centered pathways that align environmental goals with improvements in both quality of service and level of service. The behavioral insights presented in this work are essential for the design of economically viable and publicly acceptable low-emission transport services, and have important implications for multiple stakeholder groups such as policy-makers, operators, terminal administrators etc.

KEYWORDS: Passenger Maritime Transport, Willingness to Pay, Low-Emission Shipping, Discrete Choice Modeling

PAPER ID: cest2025_00474

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PAHs-contaminated water and sediment marine habitats shape microbial diversity and community structure in a eutrophic multi-stressed coastal system

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ABSTRACT

This study investigates the influence of Polycyclic Aromatic Hydrocarbons (PAHs) driven contamination on microbial diversity and community structure in seawater and sediment samples from five sites in the Inner Saronikos Gulf and Elefsis Bay, Greece, two marine coastal areas under intense anthropogenic pressure. PAHs were quantified in both seawater (dissolved and particulate phase) and sediments. The molecular profiles of the determined PAH compounds indicate mixed petrogenic and pyrolytic sources, with low molecular weight (LMW) PAHs dominating seawater and high molecular weight (HMW) ones prevailing in sediments. High-throughput sequencing revealed distinct microbial communities, highlighting the use of microbial taxa as contamination bioindicators. Canonical Correspondence Analysis (CCA) grouped the bacterial communities according to PAH sources. The results describe pollutant-driven microbial responses and highlight the ecological risks of chronic PAH contamination in the study area.

KEYWORDS: Polycyclic aromatic hydrocarbons, pollution, metabarcoding, bacterioplankton, biodegradation

PAPER ID: cest2025_00243

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SESSION 35 – REUSE AND RESOURCES RECOVERY

Saturday 6 September – morning

Ultrasound Treatment of Digested Sludge: a dual approach for Energy Recovery and Emerging Contaminant Reduction

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ABSTRACT

Digested sludge (DS) is a valuable matrix that still holds potential for energy and nutrient recovery. This study explored the application of low-frequency ultrasound (US) treatment of DS to enhance organic matter solubilization and Polycyclic Aromatic Hydrocarbons (PAHs) transfer while reducing energy losses on already biodegradable substances. US treatment significantly increased solubilization, enhancing the specific methane production (SMP) by 51%. It also mobilized PAHs into the liquid phase. Preliminary BMP tests showed an improvement in the removal of target compounds, highlighting US as a promising method for improving DS biodegradability and quality.

KEYWORDS: Anaerobic digestate; Ultrasonic treatment; Emerging contaminants; Recovery; Circular economy

PAPER ID: cest2025_00180

Optimization of copper recovery from Printed Circuit Boards

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ABSTRACT

Recent data indicates that 62Mt of e-waste (approximately 8 kg per capita) were generated worldwide in 2022 and this amount is foreseen to rise of 32%, reaching around 82Mt, in 2030. Despite this significant quantities, less than 20% is recycled. Recent researches demonstrated that disassembling prior to physical and mechanical treatment could optimize the recycling rate of the valuable metals and non-metals inside the electronic part of the e-waste. Despite this, pyrometallurgical and hydrometallurgical processes are still commonly applied directly to extract valuable metals from such waste. Printed circuit boards (PCBs) represent an important fraction in electronic waste, as they contain a considerable amount of valuable metals and critical raw materials (CRM). PCB compositions varies depending on its specific type, product, and brand. For this reason, PCBs are an important target for metals recycling in the context of waste management. Moreover, not considering the components installed on the PCBs, the layer remaining consists of copper sheets, glass fiber, and epoxy resin, with copper content reaching up to 30%. The aim of this work is to find a technologic approach to improve the recovery efficiency of copper from PCB by means of a sustainable, economic and green technique. In particular, an optimized integrated treatment composed of dismantling, grinding, sieving, electrostatic separation and hydrometallurgical extraction with green reagents, was designed. To evaluate the content in copper in the inlet and processed material, aiming at calculating a separation efficiency, x-ray fluorescence (XRF) and microscope analysis were carried out. As a result of the processes implemented a copper concentration major than 60% has been reached.

KEYWORDS: physical mechanical treatment; WEEE; selective dismantling; XRF

PAPER ID: cest2025_00107

A Magnetic Approach to Sustainable *Chlorella vulgaris* Harvesting: Methods and Applications

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ABSTRACT

Microalgae are unicellular microorganisms with many applications; however, their high harvesting costs compromise their large-scale use. Magnetic separation has been explored as a potential solution for overcoming harvesting challenges. In addition to promoting microalgal harvesting, the magnetic capacity of particles allows their recovery, regeneration, and reuse, lowering process costs and promoting a circular economy. This study explored the impact that production conditions have on the properties of magnetic particles and, consequently, on the harvesting of *Chlorella vulgaris*. By using the base NH₄OH to produce magnetite, it was possible to reduce the particle size and increase their magnetic capacity, essential parameters for a successful harvesting. In addition, by increasing the stirring time and the temperature (80 °C), the particle size was further reduced. As a result, microalgal harvesting was increased by optimising magnetite production.

KEYWORDS: *Chlorella vulgaris*, Circular economy, Magnetic particles, Microalgal harvesting, Resource recovery.

PAPER ID: cest2025_00110

Acknowledgements

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Properties of Thermo-Mechanically and Steam-Treated Recycled Wood Fibers from Post-Consumer Waste and Processing Residues

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ABSTRACT

Engineered wood products like medium-density fiberboard (MDF) are widely used in furniture and construction due to their low cost and ease of processing, with production steadily increasing along with the waste. This research investigates the characteristics of recycled fibers and compares them to virgin fiber; evaluation includes the fiber size distribution, water behavior, pH, buffer capacity, nitrogen content, as well as residual resin. Virgin fibers were produced via thermo-mechanical pulping (TMP). The process was modified (mTMP) to generate secondary fibers from fiberboard processing residues and post-consumer waste, including fiberboard and solid wood. The results thus confirmed the fiber shortening, increased fine content, and the possible presence of residual resin.

KEYWORDS: Characterization; Fiber length; pH buffering; Post-consumer fiberboard; MDF

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Acknowledgments: This research was funded by the Horizon project EcoReFibre (project No. 101057473, 2022-2026).

Enhancing industrial symbiosis in the value chain of anaerobic digestion

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ABSTRACT

The goal of ALIVE project is to establish a robust, scalable, and efficient system that maximises the potential of anaerobic digestion for bioenergy production and in-situ nutrient recovery. By ensuring the effective employment of thermal hydrolysis and application of specialised anaerobic microbial consortia through bioaugmentation (a process where specific microorganisms are added to a biological system to improve or recover specific functions), followed by a membrane system, the project holds promise for maintaining and enhancing methane production efficiency and nutrient recovery in biogas plants worldwide, that utilise ammonia-rich substrates. This approach supports the generation of renewable energy and contributes to more sustainable waste management practices, aligning with broader environmental and economic goals. The production of biofertilisers and biostimulants from the recovered nutrients can potentially enable the standardisation and commercialisation of the process by scaling up the technology for widespread application.

KEYWORDS: Bioenergy production, Anaerobic digestion, Ammonia-rich biomasses, Ammonia toxicity, Nutrient recovery

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Acknowledgements-Funding

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Integrating Citizens' Engagement Model into The Circular Economy: A Multidimensional Approach to The Recycled Construction Materials Usage

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ABSTRACT

This paper proposes a multidimensional model to evaluate citizen engagement in the use of recycled construction materials, integrating individual, institutional, social, and technological dimensions. Drawing from existing literature and enhanced measurement indicators, the study synthesizes behavioural, attitudinal, and systemic factors contributing to sustainable material adoption. Findings suggest that participatory processes, policy coherence, and technological advancements significantly affect recycling efficacy. The proposed *Enhanced Citizen Engagement Model* aligns with EU circular economy goals and offers actionable metrics for academic and policy evaluation.

KEYWORDS: citizens' engagement, recycling, circular economy, sustainability indicators, construction materials.

PAPER ID: cest2025_00380

Acknowledgement: This research work has received funding from the project „Civil Engineering Research Centre“ (agreement No S-A-UEI-23-5, ŠMSM) and Horizon Europe Research and Innovation project CLIMAS, No.101094021.

Valorization of organic biosolids at New York City Water Resource Recovery Facilities

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ABSTRACT

New York City's 14 Water Resource Recovery Facilities (WRRFs) treat 1.3 billion gallons of wastewater daily, producing 1,400 tons of biosolids. Historically landfilled, these biosolids present an opportunity for resource recovery within a biorefinery framework. This study explores three pathways: (1) fermenting biosolids to produce volatile fatty acids (VFAs) as an internal carbon source for nitrogen removal; (2) implementing thermal hydrolysis to enhance dewaterability and biogas yield; and (3) applying pyrolysis to reduce biosolids volume and destroy PFAS contaminants. Together, these innovations aim to support NYC's goal of 90% landfill diversion by 2030 and improve sustainability across the wastewater treatment system.

KEYWORDS: VFAs, Thermal Hydrolysis, Resource Recovery, PFAS

PAPER ID: cest2025_00223

SESSION 36 – PLENARY SESSION

Saturday 6 September – afternoon

Nanotechnology processes for environmental protection and solar energy conversion

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ABSTRACT

Intensive research focuses on photoactive materials (molecular, nanostructured), their involvement in nanotechnology driven photo-induced processes and their application to environmental protection and solar energy conversion. Advanced oxidation and reduction processes (AOPs-ARPs) driven by photoinduced heterogeneous reactions that take place on the semiconductor surface are under intensive investigation. Special emphasis is given to innovative nanostructured photocatalysts and their application to the development of an advanced antipollution technology (AAT) targeting the photocatalytic decomposition of harmful pollutants of emerging concern in water. It also includes the optimization, modeling and scale up of photocatalytic membrane reactors for water treatment. In parallel, the harvesting of solar irradiation by panchromatic absorbers and the sensitization of nanostructured semiconductors in efficient solution processed photovoltaic devices is explored. Particular effort is made on developing hybrid organic-inorganic (1D, 2D and 3D) perovskite (lead-based and lead-free) halides and new sensitizers (organic dyes, transition metal complexes, quantum dots). with powerful absorption in the visible spectrum. In addition, nanocomposite materials (powders, colloidal solutions) and thin films/robust electrodes with optimum morphological characteristics are prepared using solution chemistry and industrially compatible deposition techniques. Applied research is undertaken on the development and optimization of the corresponding solar cells (Perovskite, Dye-sensitized, Quantum-dot) in terms of efficiency and stability, insisting on process engineering, interface tuning and accelerated aging.

KEYWORDS: Nanotechnology

PAPER ID: cest2025_00479

SESSION 37 – MICROPOLLUTANT REMOVAL AND CIRCULAR WATER REUSE: CHALLENGES AND OPPORTUNITIES UNDER THE REVISED URBAN WASTEWATER TREATMENT DIRECTIVE

Saturday 6 September – afternoon

Quaternary treatments in the upgrading of wastewater treatment plants: micropollutant removal and operation reliability

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ABSTRACT

The recent revised Urban Wastewater Treatment Directive (UWWTD) requires the implementation of quaternary treatments (QT) for large wastewater treatment plants (WWTPs) and for small ones placed in risk areas in order to reduce micropollutants (MPs) content. The current study compares the operation reliability and the removal efficiencies of the twelve MPs listed in the UWWTD of several consolidated technologies acting as a QT. The reliability evaluation is based on a risk assessment resulting from: (i) identification of the failure modes for each component of the different treatment trains and their related consequences; (ii) score assignment of the expected likelihood of occurrence (L) of each failure mode and the magnitude (M) of the corresponding effects to the final effluent quality, equipment, worker health and environment; (iii) estimation of the risk (R) of each failure mode ($R = L \times M$); and (iv) ranking and identification of the most critical risks (highest R). Data on removal efficiencies are collected from literature. Ozonation followed by granular activated carbon is the QT with the highest number of very high risks, and the most difficult MPs to be removed are candesartan and irbesartan (slightly lower than 80%).

KEYWORDS: micropollutants, operation reliability, quaternary treatment, removal efficiency, risk assessment

PAPER ID: cest2025_00017

Microwave regeneration of granular activated carbon can destroy PFAS

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ABSTRACT:

This study investigated the regeneration of PFAS-laden granular activated carbons (GACs) by microwave (MW) irradiation. Two commercially available GACs (bituminous coal based GAC [BCGAC] and lignite coal based GAC [LCGAC]) were saturated with perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) and then irradiated at different MW conditions. The performance of MW regeneration for PFAS-saturated GACs was assessed by evaluating the variation of GAC adsorption capacity (regeneration efficiency, RE) and weight loss percentage (WL). Moreover, the effect of MW irradiation on GAC textural properties (e.g., surface area and pore volume) was examined through N₂ adsorption isotherms. Additionally, five successive adsorption/regeneration cycles were carried out at the MW operational condition that allowed to reach the target temperature ($T > 600\text{ }^{\circ}\text{C}$) while minimizing the WL. Both GACs exhibited a strong ability to convert MW irradiation into a rapid temperature increase ($\sim 150\text{ }^{\circ}\text{C min}^{-1}$ at 500 W). The highest values of RE ($> 90\%$) for both PFOA- and PFOS-saturated GACs were obtained at MW irradiation conditions that employed short regeneration time (3 min) and optimal temperature. Indeed, the highest RE did not occur at the highest temperatures ($> 750\text{ }^{\circ}\text{C}$) due to the damage of GAC porous structure, particularly for LCGAC. After five cycles, the observed values of RE ($\sim 65\%$) and a moderate weight loss ($< 7\%$) demonstrated the good performance of MW irradiation for regenerating PFOA- and PFOS-saturated BCGAC. Defluorination of PFAS during microwave regeneration of PFAS-laden GACs was also investigated. Under the optimal conditions ($653\text{ }^{\circ}\text{C/min}$, 65–70 % moisture), fluoride recovery ranged from 91–99 % for PFOA, PFOS, PFBA, and PFBS-laden GACs. The obtained findings pointed out that MW irradiation is a promising alternative regeneration technique for PFAS-laden GAC that reach over 90 % PFAS defluorination.

KEYWORDS: Thermal treatment, Adsorption, PFAS, GAC, Regeneration, Defluorination.

PAPER ID: cest2025_00393

Acknowledgements: This work was supported by the by the Water Research Foundation (Project Number 5103).

Metagenomic analysis of urban wastewater resistome and mobilome: Implications for Reclaimed Water Safety in Agriculture

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ABSTRACT

The reuse of reclaimed wastewater for agricultural irrigation is a promising solution in regions experiencing water scarcity, yet it raises concerns about the persistence of antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs). This study employed metagenomic analyses to characterize the resistome and mobilome in influent, effluent, and sludge samples from three urban wastewater treatment plants (WWTPs) in Barcelona, Spain. Weekly samples were collected over three weeks and analyzed using high-throughput DNA sequencing and UHPLC-qTOF to quantify ARGs, MGEs, and antibiotic concentrations. The results revealed high levels of ARGs across all WWTPs, with ARG removal efficiencies ranging from 2.34 to 2.43 log reductions and antibiotic removals between 50–99%. Despite treatment, effluents retained moderate levels of ARGs, some of which were associated with human activity, high mobility, and pathogenicity. These findings suggest potential risks related to the use of reclaimed water in agriculture and underscore the need for robust risk assessment and management strategies. Structural equation modelling and source tracking further elucidated factors influencing ARG persistence. This study contributes critical insights for improving water reuse safety and informing policy on wastewater treatment standards.

KEYWORDS: Reclaimed wastewater, antibiotic resistance, metagenomics.

PAPER ID: cest2025_00112

Removal of organic micropollutants by quaternary treatments controlled by optical sensors

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ABSTRACT

Advanced oxidation processes (AOPs) are widely applied to degrade persistent organic pollutants. In view of new stringent regulations on organic micropollutants, the real-time monitoring of AOPs became crucial to fulfil the high quality standards over time. A fluorescence sensor was employed to investigate the real-time monitoring of ozone and UV doses during AOPs designed to remove organic micropollutants from wastewater. Based on fluorescence data obtained in real-time with the sensor, accurate predictive models of UV and ozone doses were developed for two different tertiary wastewater effluents. This approach shows how fluorescence sensors can be used to optimize AOPs in real-time in terms of efficiency, chemicals and energy consumption.

KEYWORDS: Contaminants of emerging concern (CEC), endocrine disrupting chemicals, pharmaceuticals, PFAS, wastewater.

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Acknowledgements

This study was partially supported by the European Union (NextGeneration EU), through the MUR-PNRR project SAMOTHRACE (ECS00000022).

Sustainable removal of contaminants of emerging concern from wastewater by the living membrane bioreactor: effect of the co-occurrence of microplastics and antibiotics

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ABSTRACT

Wastewater treatment plants (WWTPs) have been considered as sinks of contaminants of emerging concern (CECs) including antibiotics and microplastics. If not well-retained in the WWTPs, these CECs are discharged to the environment. The co-presence of these CECs in wastewater lead to further environmental impacts since MPs can act as adsorbents and carriers of antibiotics. The study aims to investigate the efficiency of a living membrane bioreactor (LMBR) in the treatment of urban wastewater containing ofloxacin and oxidized polyethylene microplastics (PE MPs). The living membrane (LM), in which a series of biological layers (an external sludge cake and an encapsulated biofilm between two coarse-size mesh sheets) function as a membrane filter, is utilized. This study aimed to investigate the effects of the presence of both ofloxacin and PE MPs to the contaminant removal and to the alleviation of membrane fouling. The influence of the presence of the PE MPs on the prevalence of antibiotic-resistant genes in the reactor will also be examined. The experiment was conducted using two parallel LMBRs, which were fed with synthetic urban wastewater with the antibiotic Ofloxacin at a concentration of 0.2 mg L⁻¹ influent⁻¹. One reactor was dosed with 15 µm PE MPs (10 mg L⁻¹ influent⁻¹) daily. The other reactor without added PE MPs acted as the control. Results showed that the permeate turbidity of the reactor with PE MPs was slightly higher at 1.14 NTU. This implied that the presence of PE MPs potentially affected the formation of the LM layer. Despite this, the average permeate turbidities in both reactors were lower than 5 NTU. Consistently high removals of COD and NH₄-N were obtained in both reactors. However, the removal of Ofloxacin decreased over time in both cases. The removal of Ofloxacin was slightly higher in the reactor without PE MPs (77%). This ongoing work will contribute to the development of membrane technologies for the sustainable treatment of wastewater containing micropollutants including antibiotics and microplastics.

KEYWORDS: microplastics, antibiotic resistance, dynamic membrane, membrane fouling, wastewater treatment

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Acknowledgement:

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Revalorized Reverse Osmosis Membranes: A Sustainable Solution for Gray Water Treatment

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ABSTRACT

Water scarcity has intensified global interest in wastewater reuse. Greywater, due to its lower contamination load, is a promising source for non-potable applications. This study evaluates the reuse of end-of-life reverse osmosis (RO) membranes, recovered through chemical cleaning and NaClO oxidation, to produce membranes suitable for greywater treatment. The membranes oxidized with 4% and 5% NaClO for 120 minutes were selected based on their permeability (15.3–55.8 L·h⁻¹·m⁻²·bar⁻¹) and structural integrity. Treated membranes demonstrated effective turbidity (>97%), TOC (55–70%), and COD removal, complying with Chilean irrigation standards. Although salt rejection was lower than that of commercial nanofiltration membranes, the effluent quality was adequate for reuse in applications not requiring strict TDS control. Wheat germination tests confirmed the suitability of the treated effluent for irrigation, showing plant growth comparable to that obtained with drinking water. This work highlights the technical and environmental feasibility of reusing oxidized RO membranes as a sustainable solution for decentralized greywater treatment, supporting circular economy practices and resource efficiency

KEYWORDS: greywater, End-of-life membrane

PAPER ID: cest2025_00164

Performance of Electrified MXene Membranes in Real Wastewater Applications

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ABSTRACT

Nanoplastic (NP) contamination in wastewater is a growing environmental concern, requiring innovative and scalable treatment. Electrified membranes have emerged as a promising approach for NP removal by leveraging electrostatic repulsion and electrocoagulation mechanisms. In this study, we investigate the performance of a MXene-based membrane for NP filtration, focusing on the effects of real wastewater conditions. Results show that the applied electric field significantly improved NP rejection, achieving high removal efficiency, while increasing water flux compared to non-electrified conditions. Intermittent ON/OFF operation effectively mitigated fouling and maintained a stable flux over 30 h. This study provides critical insights into the scalability and practical deployment of MXene-based electrified membranes for advanced water treatment. The findings highlight the membrane's potential for efficient Multi-contaminant removal, antifouling performance, and energy-efficient operation.

KEYWORDS: Nanoplastics; MXene; electrified membranes; electrocoagulation; wastewater treatment

PAPER ID: cest2025_00264

Ongoing Developments in the Implementation of the New Directive: How the European policy is reshaping water and sewage companies

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ABSTRACT

The recast Urban Wastewater Treatment Directive (EU) 2024/3019 introduces a transformative regulatory framework for water and sewage companies across Europe. This paper explores the directive's core provisions, including the mandatory implementation of quaternary treatment, the introduction of Extended Producer Responsibility (EPR), and the push toward energy neutrality. It also examines the scale of infrastructure investments required and their estimated costs. Drawing on EU policy documents and case studies, the paper argues that the directive is not only a regulatory upgrade but a strategic realignment of the sector toward sustainability, innovation, and circularity.

KEYWORDS: UWTD, regulatory framework, quaternary treatment, (EPR), energy neutrality

PAPER ID: cest2025_00481

SESSION 38 – CIRCULAR ECONOMY IN AGRICULTURE AND FOOD SYSTEMS (2)

Saturday 6 September – afternoon

Evaluation of *Aneurinibacillus aneurinilyticus* isolated from corn steep liquor as source of Biosurfactants, Gramicidin S and Polyhydroxyalkanoates

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ABSTRACT

This study investigates the potential of *Aneurinibacillus aneurinilyticus* (*A. aneurinilyticus*), isolated from corn steep liquor, as a sustainable source of valuable bioproducts such as biosurfactants, Gramicidin S homologs, and polyhydroxyalkanoates (PHAs). Using phosphate-buffered saline (PBS), a biosurfactant extract was successfully extracted from *A. aneurinilyticus* cells, demonstrating its surface-active properties. In addition, ethanol was employed to extract Gramicidin S homologs from *A. aneurinilyticus* cells, showcasing their potential to obtain new antibiotics against Gram-positive bacteria to address drug-resistant pathogens. Finally, vacuoles in *A. aneurinilyticus* were identified as potential reservoirs for PHAs, biopolyesters that can serve as sustainable alternatives to petroleum-based plastics.

KEYWORDS: Circular economy, antibiotic, biosurfactant, bioplastic, Bacillus, sustainability

PAPER ID: cest2025_00060

Sustainable crop management through the use of biochar and manure based biofertilizers

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ABSTRACT

The application of biochar to soil can contribute to reducing climate change through the development of the bioeconomy. However, biochar does not provide adequate amounts of nitrogen to the soil. Therefore, it is necessary to develop biofertilizers based on a mixture of biochar with a residual source rich in nitrogen such as manure from dairy farms. In this context, it is important to be aware that in Galicia (NW Spain) manure is very abundant because this region produces 40% of the raw milk from Spain. Moreover, these new biofertilizers could also be enriched with inoculums to improve soil health. BIOFER-CC is a Spanish project with the main aim to develop a crop-targeted biofertilizer based on the mix of commercial biochar with manure to sustainably improve soil health and enhance soil carbon sequestration while increasing crop production in annual (maize and pasture) and permanent crops (vineyard and chestnut trees) of high interest in the Galician region. BIOFER-CC includes a characterization of different commercial biochar and manure that will be used to prepare biofertilizers based on biochar and manure. The biofertilizers with the best properties will be tested on annual and perennial crops under greenhouse conditions to then be evaluated in the field. The biofertilizers will also be analyzed from a sustainable perspective that includes economic analysis (cost/benefit analysis), environmental (life cycle analysis (LCA) and carbon footprint) and social analysis (social LCA).

KEYWORDS: climate change, bioeconomy, soil fertility, dairy farms, maize, pasture, vineyard, chestnut trees

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Acknowledgements

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Utilization of *Komagataeibacter xylinus* for Bacterial Cellulose Production from Food Waste: A Sustainable Approach for Reducing Agricultural Pesticide Use

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ABSTRACT

The widespread and intensive use of chemical fertilizers and pesticides has led to significant environmental and agricultural challenges, severely impacting soil health, reducing biodiversity, and contributing to long-term ecological imbalances. These adverse effects not only threaten agricultural productivity but also pose risks to human health and environmental sustainability. Therefore, developing eco-friendly and sustainable alternatives to conventional agricultural practices has become a global priority. One promising approach to mitigating these negative consequences is the valorization of food waste for the production of high-value biomaterials, particularly bacterial cellulose (BC). However, despite its potential, the high production costs and relatively low yield of BC remain major barriers to its large-scale adoption. This study focuses on addressing these challenges by exploring the production of BC from food waste using the bacterial strain *Komagataeibacter xylinus* under non-sterile conditions. By employing a resource-efficient and cost-effective approach, the research aims to enhance the economic feasibility of BC production while simultaneously contributing to waste valorization and circular economy principles. Furthermore, this work presents an environmentally friendly alternative to reduce the dependence on chemical fertilizers and pesticides, potentially improving soil health and promoting more sustainable agricultural practices.

KEYWORDS: Bacterial cellulose, food waste, *Komagataeibacter xylinus*, agroecology, sustainability

PAPER ID: cest2025_00173

Combined sludge treatment can improve their field application

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ABSTRACT

Society high pressure on the quality improvement of river and lake water pushing authorities to provide more and more sophisticated treatments to clean wastewater in municipal wastewater treatment plants. These activities helping the environment to minimize contaminant transport on one site, producing more sewage sludge (SS) on the other site. 27 EU states generate annually around 13.5 mil. tons of dry solids. Huge amount of SS is a great source of all nutrients, mainly strategic P and organic matter. Land applications can substantially decrease consumption of mineral fertilizers and protect natural resources. Direct land sewage sludge application is limited by the presence of inorganic and organic contaminants, which can directly affect growing plants and subsequently food chain. Origin and properties of inorganic and organic contaminants are completely different therefore one step treatment cannot be applied. We have tested two steps cleaning procedure to remove all contaminants from the sludge. The chelate extraction was applied on the release of toxic elements and pyrolysis on the removal of organic contaminants and decay of any microplastics. Results of applied treatments showed that chelate extraction substantially decrease bioaccessibility of metal content, and their uptake by spinach biomass. Pyrolysis at 550o C did not substantially affect metal ability and their accumulation in plants. Pyrolysis removed persistent organic contaminants from sludge, therefore the risk of their plant uptake is diminished. Combined treatment showed promising results related to safe sludge field application.

KEYWORDS: Sewage sludge, heavy metals, persistent organic contaminants, combined remediation

PAPER ID: cest2025_00232

Bio-oil production from biomass pyrolysis via a hybrid mathematical and machine learning approach

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ABSTRACT:

A hybrid mathematical and machine learning (HMML) approach is applied for maximizing bio-oil yield during the continuous biomass pyrolysis, using local common reed as feedstock. The HMML approach, which combines Response Surface Methodology (RSM) and Machine Learning algorithms (Gaussian Process (GPR) and Support Vector Regression (SVR)), provides a powerful tool for experimental optimization. Temperature, carrier gas flow rate, and feeding rate were the major parameters studied and optimized. The HMML approach demonstrated a strong predictive capability, as indicated by the statistical results. The optimal conditions (490 °C, 220 SCCM, 10.8 RPM) were identified and implemented, achieving a validated bio-oil yield of 39.90 ± 0.19 wt.%. The results confirm HMML as an effective tool for optimizing complex pyrolysis processes and improving bio-oil yield.

KEYWORDS: Pyrolysis, Response surface methodology, Machine learning, Bio-oil, Process optimization.

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SESSION 39 – TRANSPORTATION AND THE ENVIRONMENT

Saturday 6 September – afternoon

Navigating Urban Spaces: The Enablers and Barriers of Micromobility

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ABSTRACT

This policy paper examines micromobility's transformative role within urban transportation, highlighting its potential to enhance sustainability, accessibility, and livability. Micromobility, defined by lightweight vehicles such as e-bikes and scooters, presents viable solutions for reducing urban congestion, emissions, and improving public health. Despite these advantages, significant barriers hinder widespread adoption, including regulatory ambiguities, insufficient infrastructure, safety concerns, and public skepticism. Additionally, the paper explores "Micromobility as a Service" (MaaS) as an emerging model promoting shared, accessible, and integrated urban mobility options. Synthesizing insights from the European Green Deal, SAE J3194™ standards, and the LIFE2M (2022) project, this analysis identifies key enablers for micromobility's expansion: technological innovations like hybrid supercapacitor technology, shifting consumer preferences towards shared mobility, and proactive urban planning strategies. The paper further outlines persistent challenges facing micromobility and MaaS implementation, recommending policy interventions to address these barriers. These recommendations include harmonizing regulations, targeted infrastructure investment, and strategies aimed at improving safety and public perception. Ultimately, the paper advocates for collaborative policy frameworks among stakeholders to leverage micromobility and MaaS as cornerstones of sustainable urban development.

KEYWORDS: Policy framework, Mobility as a Service (MaaS), Micromobility, Urban Mobility, Sustainable Transportation, Urban Planning, Environmental Impact, Transportation Barriers, Safety Regulations

PAPER ID: cest2025_00049

Advancing Electric Vehicle Technology: Evaluating Supercapacitors Versus Batteries

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ABSTRACT:

Electric vehicles (EVs) are crucial in the global shift from fossil fuels towards sustainable transportation. However, conventional EVs alone do not fully address issues such as urban congestion, parking difficulties, battery recycling challenges, and the environmental concerns associated with battery disposal. To overcome these limitations, micromobility solutions particularly light electric vehicles offer promising advantages for short urban journeys. This paper provides an in-depth examination of two key energy storage alternatives: supercapacitors and batteries, assessing their roles and future implications for electric transport. Supercapacitors are evaluated for their superior power density and rapid energy discharge capability, making them ideal for applications involving frequent stops and regenerative braking in urban mobility. Concurrently, battery technologies, including lithium-ion and lead-acid, are critically analyzed regarding energy capacity, longevity, economic feasibility, and environmental impacts.

Additionally, this study incorporates insights from the LIFE2M project, which utilizes hybrid supercapacitor accumulators designed to significantly extend battery life, reduce environmental impact, and lower ownership costs. Ultimately, this paper underscores how the strategic integration of advanced energy storage systems and supportive infrastructure can achieve substantial reductions in energy consumption, urban pollutants, and CO₂ emissions, driving urban transport towards a greener, more inclusive future.

KEYWORDS: Electric Vehicles (EVs), Energy Storage Technologies, Supercapacitors vs. Batteries, Urban Mobility, Sustainable Transportation, Micromobility, Energy Storage Applications

PAPER ID: cest2025_00051

Development of a Standardized Greenhouse Gas Quantification Template for the Philippine aviation industry

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ABSTRACT

International aviation contributes 2.1% of global carbon emissions, with Philippine air transport emitting 0.712 million metric tonnes of CO₂e. In response, a greenhouse gas quantification template (GHGQT) was developed to enhance industry-wide emissions monitoring, using established methodologies from IPCC, WRI, and WBCSD, and other organizations. A readiness assessment identified regulatory gaps, inadequate data collection, and limited sustainability training. The GHGQT was applied to selected aviation companies to analyze Scope 1, 2, and 3 emissions. Results showed that PAL had the highest emissions due to large-scale operations, while Cebu Pacific led in Scope 3 emissions from wastewater discharge. The COVID-19 pandemic caused temporary reductions, reinforcing the importance of assessing GHG intensity rather than absolute emissions during disruptions. By providing a standardized approach, the GHGQT aims to improve emissions tracking, regulatory compliance, and sustainability efforts within the Philippine aviation industry.

KEYWORDS: GHG emissions, emissions quantification, standard template, Philippine aviation industry

PAPER ID: cest2025_00146

Development and Validation of a Representative Driving Cycle for Metro Manila: A Data-Driven Approach to Assess Vehicle Emissions and Inform Emission Reduction Strategies

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ABSTRACT

Metro Manila's severe traffic congestion and air pollution demand accurate emission assessment tools. Standard driving cycles often fail to capture unique local conditions, leading to flawed inventories. This paper details the data-driven development and validation of the Metro Manila Driving Cycle (MMDC). Real-world vehicle data (GPS, OBD-II) were processed to construct the MMDC via micro-trip clustering and synthesis. The MMDC features significantly lower average speed (~20.3 km/h) and higher idle time (~29%) than standard cycles (FTP-75, WLTC Class 3b). Validation against field data confirmed its representativeness, with kinematic parameters and speed-acceleration probability distributions showing strong correlation. The MMDC enables more accurate vehicle emission estimations and informs targeted emission reduction strategies for Metro Manila.

KEYWORDS: Driving Cycle, Emissions, Philippines, Urban Mobility, Markov Chain

PAPER ID: cest2025_00007

Optimization of Drive Cycle Generation for Green Route Planning in the Philippines: A Data-Driven Approach to Mitigating Urban Vehicle Emissions

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ABSTRACT

Philippine urban centers, particularly Metro Manila, face severe air pollution from vehicular emissions. This paper proposes a data-driven framework to optimize drive cycle generation for green route planning, mitigating these emissions. Real-world GPS data from local urban vehicles, K-means clustering, and Markov chain models will synthesize localized drive cycles linked to vehicle-specific emission factors. These cycles are integrated into a Green Vehicle Routing Problem (GVRP) solved via a Genetic Algorithm to generate routes minimizing emissions, improving on generic cycle strategies. This research underscores localized, data-informed strategies for sustainable urban transport and air quality management in the Philippines, supporting national environmental goals.

KEYWORDS: Drive Cycle Green, Route Planning, Vehicle Emissions, Urban Mobility, Philippines

PAPER ID: cest2025_00013

SESSION 40 – HEAVY METALS IN THE ENVIRONMENT

Saturday 6 September – afternoon

Effect of different metals on the chromate reductase activity of *Magnetospirillum gryphiswaldense* MSR-1

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ABSTRACT

Bioreduction of hexavalent chromium Cr(VI) from industrial wastewater has been extensively studied because of the process's low cost and high effectiveness. While several bacteria were found to be capable of reducing Cr(VI) to the less toxic Cr(III), reduction in the presence of other pollutants is usually not studied. This study explores the effect of other metals on the chromium reduction capabilities of the magnetotactic bacteria *Magnetospirillum gryphiswaldense* (MSR-1). The bioreduction ability was measured using the activity of the bacteria's chromate reductase, an enzyme group that enables them to perform reduction from Cr(VI) directly to Cr(III). The results showed that the presence of other heavy metals significantly limited the activity of chromate reductase. Mercury was identified to be the strongest inhibitor, reducing the chromium reduction efficiency from 28.27% to 13.67%, followed by copper, zinc, and then nickel. These findings can be used to identify which heavy metals should be treated first to achieve the best chromium removal from wastewater.

KEYWORDS: magnetotactic bacteria, heavy metal, chromate reductase, enzyme crude extract

PAPER ID: cest2025_00080

Salinity on growth and chromium reduction abilities of *Magnetospirillum gryphiswaldense* MSR-1

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ABSTRACT

Use of bacteria in removal of heavy metals, including hexavalent chromium Cr(VI), has been proven to be as effective yet more eco-friendly compared to other existing technologies. However, polluted wastewater usually contains high amounts of salts in addition to the heavy metals and may interfere with the bioremediation process. Thus, the ideal bacterial strain for these scenarios must be resistant to the heavy metal and high salt concentration but still capable of removing the target pollutant. The current paper studies the effect of salinity on the growth and chromium reduction capabilities of the magnetotactic bacteria *Magnetospirillum gryphiswaldense* (MSR-1). MSR-1 was exposed to 20 mM, 50 mM, and 100 mM NaCl concentrations and monitored for 27 hours by measuring its optical density and chromium concentrations at different time periods. The results showed that the presence of NaCl does not greatly affect the growth of MSR-1 even at increased concentrations. On the other hand, the introduction of salt in the culture hampered the chromium reduction capacity of the strain with the addition 100 mM NaCl resulting in a decrease of 43% on the amount of chromium reduced.

KEYWORDS: magnetotactic bacteria, chromium reduction, salinity, bioremediation, heavy metal

PAPER ID: cest2025_00091

Concentration ratio of copper to antimony in dust - an indicator for brake dust?

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ABSTRACT

Sources for antimony in road dust is abrasion of brake pads and brake linings and organic antimony compounds used as additives in grease and oil. Copper is also contained in brake linings and pads, but it is also contained in tire tread. Additionally, copper is released by wear and abrasion of parts made of copper, bronze and brass. In literature, the ratio of the concentration of copper to antimony is used as an indicator for the presence of brake dust in road dust. A ratio of around 5:1 is an indicator of brake-related particles, while the typical crustal ratio of the two metals is around 125:1. Reported values of the ratio for road dust samples are in the range of 20:1. Literature data of the size-dependent concentrations copper and antimony in road dust result in a ratio of copper to antimony of about 10:1 for the fine size fractions while for the coarse size fraction the ratio is higher. This result supports how reliable the ratio is as an indicator for brake dust in road dust.

KEYWORDS: road dust, metals, brake dust, ratio copper to antimony

PAPER ID: cest2025_00120

A 50-Year Meta-analysis review of metal pollution in sediments of the N. Saronikos Gulf, Salamina Straits

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ABSTRACT

Saronikos Gulf encounters the highest environmental challenges due to heavy metal contamination, among Greece's coastal areas. In the present study fourteen scientific papers published from 1974 to 2024 were chosen, from online databases, for meta-analysis review. The mean values of heavy metals were calculated per decade, while the ecological status of the area was estimated via the application of the Pollution Loading Index (PLI). Integrated comparisons that would enhance Saronikos Gulf's management and sustainable development were made possible by the reassessment of the data cited in the literature.

KEYWORDS: Heavy metals; Saronikos Gulf; Ecological assessment

PAPER ID: cest2025_00320

PART B – POSTER PRESENTATIONS

ADVANCED OXIDATION PROCESSES

Enhancing electro-Fenton-based tertiary treatment for tannery effluent via Response Surface Methodology

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ABSTRACT

This study focuses on improving advanced oxidation methods as a final treatment for tannery wastewater. The goal was to find the best conditions for an electrochemical peroxidation (ECP) process that removes COD and color from tannery effluents at neutral pH, while reducing costs by avoiding chemicals that increase salinity effluent. Using an experimental design (CCD-RSM), the effects of current, treatment time, and hydrogen peroxide levels were tested. The best results were achieved with 36 mA/cm² current, 19.7 minutes of treatment, and 9.9 g/L of H₂O₂, removing 74% of COD and 96% of color. Adding UV-C light in photo-electrochemical and photolysis processes did not significantly improve removal and increased energy use. This study offers a new approach to remove hard-to-treat COD from tannery wastewater, overcoming limitations of traditional electro-Fenton methods. Future work should focus on making the process more sustainable for large-scale use.

KEYWORDS: CCD-RSM, tertiary treatment, wastewater treatment, electrochemical advanced oxidation, recalcitrant COD

PAPER ID: cest2025_00430

Application of Ozonation-Based Processes to Reduce Environmental Impact of Waste Antibiotics

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ABSTRACT

The aim of the work was to determine the efficiency of direct ozonation, ozonation at elevated pH, ozonation at elevated pH with the addition of hydrogen peroxide, catalytic ozonation, photo-catalytic ozonation, ozonation with Fenton oxidation and ozonation with photo-Fenton oxidation for removal of waste Vancomycin from industrial wastewater. Vancomycin belongs to the glycopeptide antibiotics, preventing cell wall synthesis in susceptible bacteria. Batch oxidation experiments were carried out at room and elevated temperatures in a 300 mL laboratory bubble column. Additional toxicity test with *Vibrio fischeri* was accomplished to determine the environmental toxicity of treated and untreated wastewater. It was confirmed that a two-stage ozonation reaction takes place, more efficient at elevated temperatures. Complete mineralization was not achieved with any type of enhanced ozonation, as the decomposition efficiencies were up to 94%. Based on TOC (Total Organic Carbon) and COD (Chemical Oxygen Demand) determination, ozonation at elevated temperature with photo-Fenton oxidation was the most successful. Toxicity tests revealed significant detoxification of model wastewater in most of the applied oxidation processes. In most of the cases obtained inhibitions that were higher than 10%, while in photo-catalytic ozonation it was reduced below 10%.

KEYWORDS: antibiotics, catalytic processes, ozonation, wastewaters

PAPER ID: cest2025_00009

Acknowledgement

This work was financed by the Slovenian Research and Innovation Agency, the research program P2-0191. Technical assistance of Teja Urbanc is greatly appreciated.

Catalytic activation of peracetic acid to decompose micropollutants in water

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ABSTRACT

Acetaminophen (APAP), a widely used pharmaceutical, is frequently detected in aquatic environments due to its persistence and limited removal by conventional wastewater treatment processes. In this study, a peracetic acid (PAA) based advanced oxidation system was developed using magnetically recoverable tungsten modified iron oxides (TI) as heterogeneous catalysts to degrade APAP without external energy. TI catalysts were synthesized via a combustion method in the presence of polyvinyl alcohol for providing their magnetic properties for easy recovery after their use. The catalytic performance of the TI/PAA system was evaluated under various conditions, showing efficient APAP degradation. Radical scavenging experiments revealed the generation of hydroxyl, acetyloxy, and acetylperoxyl radicals as dominant reactive species in the system. Degradation intermediates were identified to propose a possible APAP degradation pathway. The findings demonstrate the effectiveness of tungsten modification in enhancing the catalytic performance of iron oxides for PAA activation. This study highlights a green, energy-free, and reusable catalytic system with strong potential for the treatment of pharmaceutical micropollutants in water.

KEYWORDS: Acetaminophen, AOPs, Peracetic acid, Catalyst, radicals

PAPER ID: cest2025_00089

Acknowledgement

This work was supported by Korea Environmental Industry & Technology Institute (KEITI) grant funded by the Korea Government (Ministry of Environment) (The Knowledge-based Environmental Service Specialized Graduate School Program).

Photochemical fate and advanced oxidation of Pyrimethanil in waters and wastewater

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ABSTRACT

Commonly used fungicide pyrimethanil (PYR) has been detected in various aquatic environments, presenting persistence, adverse effects on ecology and resistance to conventional degrading methods^{1,2}. In this study, the abiotic phototransformation of PYR was investigated under simulated solar irradiation (SSI). The results indicated that photolysis was the principal degradation process, following pseudo – first order kinetics in the following order: ultra-pure < sea < lake < river water. The impact of prevalent water components such as humic acid, Fe³⁺, NO₃⁻, and Cl⁻ was examined. Furthermore, sulfate radical-based advanced oxidation processes (SR-AOPs) activated by SSI were explored for its removal from both ultra-pure water and wastewater. SSI/persulfate (PS) exhibited the best degradation efficiency, achieving 100% PYR removal in 240 min, compared to PMS and H₂O₂. Wastewater experiments significantly affected the degradation efficiency, leading to a 55% decrease in first-order reaction rate constant. Scavenging studies assessed the role of reactive species revealing •OH as the dominant contributor concerning SSI/PS process. Major phototransformation routes include C–N bond cleavage, hydroxylation, and oxidative ring opening as indicated by liquid chromatography-high-resolution mass spectrometry (LC-HRMS). Potential environmental implications of photoproducts were evaluated using *in vitro* (Microtox assay) and *in silico* (ECOSAR) ecotoxicity tools.

KEYWORDS: pyrimethanil; liquid chromatography-high resolution mass spectrometry; pesticides; phototransformation products; toxicity assessment

PAPER ID: cest2025_00240

New Insight on Homolytic Peroxodisulfate Activation by Iron Sulfides and $\text{Fe}^{\text{IV}}=\text{O}^{2+}$ Formation

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ABSTRACT

The aim of this study is to further investigate the mechanism of peroxodisulfate (PS) activation by iron sulfide crystals (FeS_x) in the surface-mediated process in the aqueous environment. Various iron sulfide crystals were synthesized through co-precipitation and etch coating methods and screened for the intended use. XRD was employed to elucidate differences in crystal structure. PS activation by the synthesized iron sulfides produced about 70 times more oxidation equivalents than is possible by homolytic PS activation, suggesting that homolytic cleavage and a catalytic pathway contribute significantly. Reactive species generated during PS activation were identified as $\text{SO}_4^{\cdot-}$, $\cdot\text{OH}$, and $\text{Fe}^{\text{IV}}=\text{O}^{2+}$. The predominant reactive species varied depending on the crystal structure of FeS_x . The investigation of the PS activation process reveals that FeS_x containing pyrite performed longer-term homolytic PS activation and higher stability compared to troilite and mackinawite.

KEYWORDS: FeS_x , peroxodisulfate, homolytic activation, catalytic properties, crystal structure

PAPER ID: cest2025_00370

Treating PAHs in Scrubber Washwater: an Investigation into Fenton-like Advanced Oxidation

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ABSTRACT

The maritime transport sector primarily uses fuel oil, leading to exhaust gas emissions that contain harmful substances like heavy metals and polycyclic aromatic hydrocarbons (PAHs), which pose risks to marine ecosystems. Exhaust Gas Cleaning Systems (scrubbers) are essential for complying with international emissions regulations, but the discharge of contaminated washwater presents a significant environmental challenge. This washwater, characterized by an acidic pH and the presence of metals and PAHs, contains naphthalene in high concentrations.

To address this issue, the evaluation and optimization of phenton-like advance oxidation processes that use two different approachs (with persulfate and hydrogen peroxide) to treat scrubber washwater are proposed. These technologies generate radicals with high oxidation potential, capable of eliminating hard-to-degrade compounds such as naphthalene. Activation will be carried out using UV light and transition metals, specifically iron and vanadium, which are already present in scrubber waters. Treatment effectiveness will be measured by analyzing naphthalene degradation at different metal concentrations, simulating conditions found in these systems.

KEYWORDS: scrubber washwater, fenton-like, AOP, naphthalene, metals

PAPER ID: cest2025_00446

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AGROFORESTRY, FOREST AND AGRICULTURAL SUSTAINABILITY

The historical background and current state of chestnut cultivation in the southern part of Central Slovakia

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ABSTRACT

The contribution is devoted to one of the oldest non-native tree species in Slovakia – European chestnut (*Castanea sativa* Mill.) At present, it is widespread at more than 220 localities. It occurs in the southern part of country, on steep slopes with altitudes ranging from about 200 to 400 m a.s.l. Chestnut grows here outside the recorded natural distribution range and therefore doesn't have optimal climatic conditions. In Slovakia, chestnut occurs mostly in extensive old orchards or forest stands. Currently, the health condition as well as chestnut production has rapidly declined as a result of enormous dying out of chestnut individuals infected by fungus *Cryphonectria parasitica* (Murr.) Barr. Populations of this useful crop are small today, but they are important habitats that would deserve more scientific interest. The main objectives of the contribution are focus on the mapping of chestnut population in the south part of central Slovakia and chestnut biocultural value assessment in the given traditional landscape types.

KEYWORDS: agroforestry, chestnut, cultivation, biocultural value

PAPER ID: cest2025_00413

Acknowledgement

The contribution was supported by the Slovak Research and Development Agency SRDA (APVV), under the contract No. APVV-20-0326 and the project Conversion of abandoned tree-covered permanent grassland into productive agroforestry pastures (TRANSAGROLES)

Beyond the Grove: Climate-Driven Dispersal of *Bactrocera oleae* into Adjacent Forest Habitats in Mediterranean Landscapes

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ABSTRACT

The olive fly (*Bactrocera oleae*) is a significant pest in olive cultivation areas, jeopardizing both productivity and quality. Conventional pest management has concentrated on grove perimeters, frequently neglecting the influence of surrounding non-agricultural ecosystems. As climate change escalates, resulting in heightened temperature extremes and modified ecosystem dynamics, comprehending the impact of these environmental conditions on pest behavior is essential. Agroecological methods, which emphasize ecological linkages across landscape types, offer promising insights for sustainable pest management. Mediterranean areas such as Lesvos Island, Greece, include mosaic landscapes of olive trees and neighbouring forests, creating a complex ecological matrix. This work investigates the dispersal of *B. oleae* outside its conventional agricultural environment into pine woods and examines how microclimatic variations in these regions may influence its mobility and survival, especially under the stress of elevated summer temperatures linked to climate change.

KEYWORDS: *Bactrocera oleae*, climate change, agroecology, Mediterranean, pest ecology

PAPER ID: cest2025_00444

AIR POLLUTION

Indoor air pollution: innovative solution for active purification treatments

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ABSTRACT

Indoor air is heavily polluted, much more so than outdoor air, but unfortunately it's indoors that we spend most of our time. This pollution can have a real impact on health, which is why it's necessary to treat it. To do this, various methods exist, including photocatalysis. Technopure is a French company that manufactures air purification equipment using this technology. Its devices were then tested under real-life conditions to prove their effectiveness and non-hazardousness. These two points have been validated by various criteria.

KEYWORDS: air pollution, active purification, photocatalysis

PAPER ID: cest2025_00070

Optical and microphysical properties of Saharan and Saudi Arabian desert based on AERONET data products

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ABSTRACT

The study investigates possible differences between the Saharan and Saudi Arabian deserts' dust particles based on AERONET network. Our results shows that while particle depolarization ratio values at 440 nm were similar for both regions, the Saudi Arabian lidar ratio (at 440 nm) was determined to be 53 ± 7 sr, much lower than the Saharan lidar ratio at the same wavelength that was found equal to 66 ± 10 sr. Our findings are in consistent with earlier studies based on AERONET products but they do not agree with lidar observations. We found significantly larger lidar ratios at 440 nm both for Arabian dust (difference of 15 sr) and Saharan dust (difference of 13 sr) compared to lidar observations. These differences are smaller for 532 nm. Reliable conversion factors between aerosol optical thickness and column-integrated particle size distribution based on AERONET photometer observations are also for Saharan and Saudi Arabian dust particles.

KEYWORDS: AERONET, dust, Saharan, Saudi Arabian

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Acknowledgements: The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "Basic Research Financing (Horizontal support for all Sciences), National Recovery and Resilience Plan (Greece 2.0)" (Project Acronym: SCOPE, Project Number: 015144)

Aerosol Characterization Based on Graphical Method of Gobbi Diagrams

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ABSTRACT

A practical graphical approach for translating α and its spectral curvature ($\Delta\alpha$) into estimates of fine-mode aerosol radius and its contribution to total AOT was proposed by Gobbi et al. (2007). In the present study, we utilize AERONET Version 3 Level 3 data—specifically lidar ratio and depolarization ratio products—to evaluate the potential of this graphical method for aerosol type classification.

KEYWORDS: AERONET, aerosol type, Gobbi diagram

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Acknowledgements: The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the “Basic Research Financing (Horizontal support for all Sciences), National Recovery and Resilience Plan (Greece 2.0)” (Project Acronym: SCOPE, Project Number: 015144)

Long-term Measurements of SO₂ Concentrations Within the Atmospheric Column on Gozo (Maltese Islands)

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ABSTRACT

Sulphur dioxide (SO₂) concentrations were measured over a twelve-year period (2011 - 2023) at the Giordan Lighthouse Atmospheric Observatory, located on the Island of Gozo (forming part of the Maltese Archipelago), in the Central Mediterranean. Trend analysis reveals that SO₂ concentrations are decreasing at an annual average rate of 0.03 ppbv per year. This is in keeping with what has been recorded throughout Europe following the introduction of several sulphur directives by the European Union and stringent regulations on marine fuels by the International Maritime Organisation. SO₂ concentrations exhibit a strong seasonal variability of 55.9% with a maximum in July and a minimum in March, which contrasts with what is observed in Northern Europe. The diurnal amplitude of SO₂ is 29.7% with a maximum at 10:00 and a minimum at 19:00. With respect to wind direction, SO₂ concentrations exhibit a maximum when the prevailing wind is from the 0° - 60° sector due to emissions originating mainly from two sources, the active Etna volcano and ships traversing the Straits of Sicily. A broad minimum of circa 0.32 ppbv is observed when the wind is blowing from the 160° - 300° sector.

KEYWORDS: sulphur dioxide, Giordan Lighthouse, Central Mediterranean, shipping emissions, Etna volcano

PAPER ID: cest2025_00271

ANTIBIOTIC RESISTANCE

Biofilm Formation and Antibiotic Resistance in *Arcobacter butzleri* Strains Isolated from Environmental Sources

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ABSTRACT

In recent years, a marked increase in antimicrobial resistance among microorganisms has been reported. One of the key factors contributing to this phenomenon is the formation of biofilms—structured microbial communities that significantly enhance bacterial survival and resistance to external stressors.

The present study aimed to assess the biofilm-forming potential of selected *Arcobacter butzleri* strains isolated from environmental sources. This evaluation included the molecular detection of six biofilm-associated genes (*flaA*, *flaB*, *spoT*, *flhS*, *luxS*, and *pta*), which are involved in bacterial motility, invasiveness, and pathogenicity. All six target genes were detected in 21 strains (42%), while 6 strains (12%) tested negative for all investigated genes.

Biofilm formation was quantitatively assessed under static and dynamic conditions using Christensen's colorimetric assay. Under static conditions, biofilm formation was observed in 96% of the strains, with 74% classified as strong or moderate biofilm producers. Conversely, biofilm development was markedly reduced under dynamic conditions, with up to 80% of strains exhibiting limited adhesion capacity.

KEYWORDS: *Arcobacter*, biofilm, microbial resistance, pathogenic potential

PAPER ID: cest2025_00270

BIOMONITORING

A sampling strategy and protocol for pan-European monitoring of chemicals across trophic levels (from soil to apex species) in terrestrial wildlife food chains

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ABSTRACT

In order to safeguard terrestrial biodiversity in Europe from harmful effects of anthropogenic chemicals, there is a need for better monitoring of exposure of wildlife to these chemicals, across various biomes, and at all trophic levels from soil micro-organisms to apex species, at pan-European scale. This can then inform, inter alia, environmental risk assessment of chemicals, the design of appropriate risk management measures, and assessment of effectiveness of chemicals regulations. Despite decades of research on exposure to anthropogenic chemicals in terrestrial wildlife, there are few examples of one-off studies or monitoring programmes that focus on the transfer of chemicals across multiple trophic levels, from soil to apex species, in the terrestrial environment, and no such monitoring takes place at pan-European scale. Such periodic monitoring requires an effective sampling strategy that provides for the selection of representative wildlife food chains, the selection of representative organisms at each trophic level, the selection of sampling locations, replication to allow for statistically robust results, and co-location of samples in both space and time. Sampling also needs to be guided by a protocol that ensures best practice and ethically acceptable sampling methods are used for sampling at each trophic level, and ensures that the same sampling methods are used for all food chains studied. This poster outlines such a sampling strategy and protocol developed under the Horizon Europe project TerraChem.

KEYWORDS: Sampling strategy, sampling protocol, terrestrial wildlife food chain, exposure to chemicals, pan-European

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BIOWASTE

Grape Pomace as a Sustainable Fining Agent in Winemaking: A Review on Valorization for Circular Economy

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ABSTRACT

Winemaking generates substantial byproducts, primarily grape pomace, which is often underutilized despite its rich composition. Traditional fining agents, essential for wine clarity and stability, frequently raise environmental, ethical, and allergenic concerns. This review synthesizes recent research on grape pomace as a sustainable, natural, and vegan-friendly alternative. It explores grape pomace's composition, its valorization potential within a circular economy framework, and its efficacy in clarifying wine, modulating sensory attributes, and removing contaminants like ochratoxin A and pesticides. Methodological advancements, particularly continuous filtration systems, are highlighted for their efficiency. While promising, challenges in industrial-scale application and the need for further research on specific stability parameters and comprehensive life cycle assessments are discussed. The review concludes that grape pomace valorization is a critical step towards more sustainable and eco-conscious winemaking practices.

KEYWORDS: Grape Pomace, Fining Agent, Winemaking, Circular Economy, Sustainability

PAPER ID: cest2025_00412

CIRCULAR ECONOMY AND INDUSTRIAL SYMBIOSIS

Comparison between different agri-food residual streams as direct source of biosurfactants

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ABSTRACT

In this work various residues were evaluated as direct source of biosurfactants, observing that those coming from the wine, cider, and potato chip industries exhibited limited potential as direct sources of biosurfactants. Consequently, it should be recommended to evaluate their use as nutritional supplement with other residues in controlled fermentation process rather than use them as direct source of biosurfactants. Notably, winery streams exhibited a lower profile for the spontaneous generation of biosurfactants.

In contrast, dairy products, particularly sour buttermilk, olive oil residues, and Brewer's spent grain residues, gave promising results for considering them as natural sources of biosurfactants. These biosurfactants were able to reduce water surface tension (ST) by approximately 20 units exhibiting in some cases critical micellar concentration (CMC) values lower than 0.1 g/L.

Furthermore, this study aligns with previous research where it was demonstrated the effectiveness of corn steep liquor, a subproduct of wet corn milling industry as direct source of biosurfactants.

KEYWORDS: circular economy, biosurfactant, surface tension, secondary streams, valorization

PAPER ID: cest2025_00066

CIRCULAR ECONOMY AND BIOECONOMY

The Cyprus Case study in ECO4ALL COST ACTION (CA22124) regarding Fashion Waste

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ABSTRACT

The main components of humanity include energy, food and clothing. Each of us, individually and collectively, contributes to climate change and CO₂ emissions, natural resource consumption, and social attitudes and behaviour. The fashion industry has a strict relationship to waste, as waste production is central to the operation of it.

According to the Ellen MacArthur Foundation (2017) and Voukkali et al., (2024) stated that the fashion industry releases 5000 million tons of carbon dioxide (CO₂) each year and is responsible for 9% of Greenhouse gasses (GHGs) emissions worldwide, and more than third of the accumulation of microplastics in marine environments. 20% of industrial wastewater contamination if again due to the industry while 98 million tons of non-renewable sources, 93 billion cubic meters of water and more than 70 million barrels of oil are being consumed. In 2017 alone, 1.3 tons of raw materials and 104 cubic meters of water were consumed in the EU alone, resulting in 654 kg of CO₂ eq. in emissions.

Fashion trends are expected to increase in value from 1.5 trillion dollars in 2020 to around 2.25 trillion dollars by 2025, indicating that the fashion demand is on the rise (Papamicahel et al., 2023). Circular Economy constitutes one of the main objectives in the reduction of the environmental burden of the fashion industry. Consumer behavior also plays a crucial role in the success of circular fashion initiatives.

After a deep fashion waste compositional analysis in Cyprus was estimate that consumers disposed of many quantities of ready to use clothes. Those cloths are been collected and export in other countries or donate in other families. Additionally, was found that consumers do not consider circular practices as well as do not buy second hand clothes.

KEYWORDS: Fast fashion; Fashion waste; circular economy

PAPER ID: cest2025_00420

Industrial Urban Symbiosis: A Solution to Transform Waste into Resources

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ABSTRACT

The Greek EcoSite, located in Western Achaia, exemplifies the benefits of industrial-urban symbiosis (I-US) through its innovative waste treatment processes and integrated approach. By promoting collaboration between industries and urban areas, the EcoSite optimizes resource use and minimizes waste, addressing critical waste management challenges in the region. The Greek EcoSite demonstrates a viable, circular approach to waste management, aligning with broader environmental and economic sustainability goals. It showcases potential for replication across different industrial and urban landscapes aiming to close material loops and produce high-value resources from waste.

KEYWORDS: I-US, industrial- urban symbiosis, methane, AnMBR

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Acknowledgements: The research project has received funding from the European Unions' Horizon Europe program under GA Project 101058426 SYMSITES- HORIZON-CL4-2021-TWIN-TRANSITION-01-14.

Valorization of Food Waste and Anaerobic Sludge as Cultivation Media for *Arthrospira platensis* under the Framework of Circular Economy

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ABSTRACT

This study explores the cultivation of the cyanobacterium *Arthrospira platensis* (spirulina) in food waste (FW) and anaerobic digestion sludge (ADS) as alternative nutrient media, aligned with principles of the circular economy. Four experimental trials were conducted to assess acclimatization, growth potential, and nutrient removal efficiency. Experiments tested acclimated and non-acclimated cultures under varying concentrations of FW and combinations with ADS. Key environmental parameters such as pH, chemical oxygen demand (COD), and phosphate (PO_4^{3-}) levels were monitored. Lipid content was quantified in harvested biomass using the Folch method and compared across substrates and drying methods. Results demonstrated that *A. platensis* can adapt and grow effectively in 10% diluted FW, achieving higher growth rates and nutrient uptake when acclimatized. Lipid yields ranged between 13–20%, indicating promising bioresource potential. The findings support the integration of waste valorization with microalgal biotechnology for sustainable biomass production.

KEYWORDS: *Arthrospira platensis*, Spirulina, food waste, anaerobic sludge, lipid content, circular economy, nutrient removal, acclimatization

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Kinetic Modeling of *Spirulina platensis* Growth Under Varying Light Intensities in Zarrouk Medium and Anaerobic Digestate

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ABSTRACT

Cyanobacteria have the ability to photoautotrophic growth, optimizing it for viable biomass and lipid production. This study investigated the kinetic behavior of *Arthrospira platensis* by culturing it in two different substrates: synthetic zarrouk medium and anaerobic sludge. The four kinetic models studied were those of Webb-Edwards, Andrews, Camacho and Steele. The evaluation was carried out using experimental data to estimate basic kinetic parameters ($\mu_{\max}$, K_s , K_i) through nonlinear regression. The results showed significantly higher growth rates and lipid yields in the zarrouk medium, which appear to be attributed to sufficient phosphate availability and low organic inhibition, while the anaerobic substrate yield was reduced probably due to toxicity and limited nutrients. The integration of kinetic modeling with physicochemical analysis provided a comprehensive understanding of the system behavior, highlighting the importance of substrate selection in the optimization of photobioreactor-based systems.

KEYWORDS: kinetic behavior, photoautotrophic, cyanobacteria

PAPER ID: cest2025_00487

CIRCULAR ECONOMY IN AGRICULTURE AND FOOD SYSTEMS

Towards a Circular Aquaculture: Assessing Sustainability and Consumer Acceptance of Insect-Based Feed for Trout Farming

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ABSTRACT

Addressing the urgent need for sustainable aquaculture amidst escalating protein demand and environmental burdens from conventional practices, the newRIF project investigates a novel circular economy solution: the valorization of agricultural organic waste into alternative protein sources for trout feed. This research critically evaluates the technical, economic, environmental (via LCA), and social (via S-LCA) sustainability of replacing traditional fishmeal and oil with insect meal derived from *Hermetia illucens* and *Tenebrio Molitor* reared on locally available by-products. Beyond the comprehensive multi-disciplinary assessment of production performance and product safety, a distinctive focus of newRIF lies in analyzing consumer perception and acceptance. Through willingness-to-pay (WTP) studies, we explore the influence of innovative packaging, clear labelling, nutritional claims, and environmental impact information on consumer purchasing decisions. This holistic approach generates crucial insights into the market potential and policy implications for insect-based feeds, offering a scalable pathway to enhance resource efficiency, mitigate environmental degradation, and foster a more resilient and circular global food system, directly aligning with themes on innovative environmental solutions.

KEYWORDS: Sustainable Aquaculture; Insect-Based Feed; Consumer Acceptance; Life Cycle Assessment.

PAPER ID: cest2025_00441

Circular Economy through Berry Pomace Valorization

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ABSTRACT

This investigation delineates the economic aspects associated with the valorization of pomace derived from ten distinct berry varieties within the context of the circular bioeconomy paradigm. Through the implementation of a comprehensive marketing costs and returns (MCR) analysis, this research evaluates the economic viability and market potential associated with the conversion of berry pomace, an ancillary product of the juice and wine sectors, into high-value commodities. The economic assessment reveals considerable prospects for the development of functional food additives and cosmetic constituents, underscoring the cost efficiency associated with the utilization of berry pomace as a valuable resource. The outcomes indicate that sophisticated analytical techniques, encompassing fermentation and biorefinery processes, may be employed to augment the value of the pomace, thereby fostering increased profitability and market competitiveness for the products generated through this approach. The results imply that the amalgamation of agronomic expertise with economic frameworks can significantly bolster the feasibility of berry pomace valorization, thus aiding rural economies, encouraging sustainable industrial practices, and contributing to the realization of Sustainable Development Goals.

KEYWORDS: Circular Bioeconomy, Berry Pomace, Economic Analysis, Market Viability, Functional Food.

PAPER ID: cest2025_00044

Sustainable Manure Management: VOC Monitoring and Biochar Integration for Emission Mitigation

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ABSTRACT

Effective monitoring of volatile organic compounds (VOCs) is crucial for managing farm waste, particularly in addressing odors and mitigating health risks from manure emissions. VOCs, which are generated by microbial activity and chemical reactions during manure storage, contribute to air pollution and pose significant environmental challenges. The factors influencing VOC emissions, such as manure type, storage practices, and environmental conditions, are critical for developing effective emission management strategies.

Biochar, with its high surface area and porous structure, proves to be an effective tool for VOC mitigation. Applications such as co-composting and surface application have shown promise, with optimizing biochar-to-manure ratios key to maximizing its effectiveness in emission control. Scalability and cost-effectiveness are also vital for broader adoption of biochar in agricultural systems.

Advanced analytical methods, including headspace gas chromatography-mass spectrometry (HS-GC-MS), offer reliable VOC detection. However, challenges like environmental variability and sampling accuracy need to be addressed to enhance the consistency and reliability of biochar-related studies. This work underscores biochar's potential in manure management, offering a sustainable solution for improving air quality and tackling pressing environmental issues in agriculture.

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KEYWORDS

Manure management, Biochar integration, Volatile organic compounds, Odor control, Sustainable agriculture.

Acknowledgments

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Value of Orange processing residues

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ABSTRACT

Adopting Circular Economy practices reduces waste and aligns with EU priorities on prevention, reuse, and recycling. Italy, the EU's second-largest agricultural producer, faces challenges like food waste and climate change impacts. In 2022, Italy's fruit crop volumes grew by 7%, with 15% increase in citrus prices. The Italian industry of orange juice creates every year over 55 million tons of orange peel waste (OPW), i.e., a mixture of pulp, seeds, and peel accounting for up to 60% of the fresh citrus weight. This large amount of OPW is usually managed by applying different technologies, as the extraction of active components for cosmetic applications, thermochemical (mostly incineration) or biological processes (e.g., anaerobic digestion and/or composting), or recycled into animal feed. Innovative perspectives for recycling OPW, already mature at industrial scale, involve the production of materials for various applications, as biodegradable biocomposite materials used for manufacturing design objects, eco-leather. In these applications OPW is usually combined with other materials. The aim of this study is an assessment of the mentioned OPW valorization perspectives based on technical and environmental performance indicators. In details, resource inflow/outflow circularity indicators, energy circularity indicators and material productivity indicators; respectively specify the fractions of material that are reused in the inflow/outflow, net consumed energy qualifies as renewable, and the ratio of revenue generated by total mass of all linear resource inflows. In conclusion, agricultural waste is increasingly replacing raw materials in production processes, and continued investment in research is essential to improve manufacturing methods and create useful products with increasing amounts of agricultural waste.

KEYWORDS: Orange, circular economy, environmental, waste

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CIRCULAR ECONOMY IN MANUFACTURING AND INDUSTRIAL PROCESSES

Circular Saar - Circular design thinking in the German steel industry

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ABSTRACT

The steel industry is currently facing many challenges, such as increasingly expensive energy and the availability of raw materials. At the same time, the transformation of many industrial processes takes time. The circular Saar project addresses these challenges by bringing together research institutions from various disciplines such as data science, engineering, political science, law and product research to investigate how circular economy processes and design thinking processes can have a positive impact on the challenges facing the steel industry.

KEYWORDS: Transition, steel industry, circular thinking

PAPER ID: cest2025_00459

CIRCULAR PRODUCT DESIGN: DESIGN OUT WASTE

Optimizing the use of plastic materials from Walloon buildings for material and environmental innovation

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ABSTRACT

The construction industry is one of the largest consumers of plastic materials, contributing significantly to global plastic waste and CO₂ emissions. This study focuses on optimizing the recycling and reuse of plastic materials in Walloon buildings, contributing to circular economic practices by proposing concrete solutions. Wallonia, through its circular strategies, aims to utilize recycled plastics as an alternative to virgin raw materials in construction, addressing both material scarcity and environmental impacts. The research is conducted in different phases: starting with a comprehensive literature review and the identification of the barriers to recycling plastics in construction, including policy gaps and technical challenges; the second concerns the assessment of plastic deposits in buildings within the Borinage region, providing a detailed and reproducible methodology using GIS-based mapping, material flow analysis, and lifecycle assessment to evaluate recycling potential. Preliminary results show a lack of data on plastic waste in buildings and significant challenges in policy, quality control, and economic feasibility. Future work will explore the techno-economic feasibility of energy recovery from plastic waste and its integration into sustainable building practices in Wallonia.

KEYWORDS: Plastic Materials, Building construction, Circular Economy, Recycling, Sustainable Development, Energy Recovery

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CITIZEN SCIENCE

Validation of an innovative stream assessment protocol for application in the global south

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ABSTRACT

In many developing countries, most rivers and streams remain unclassified and unassessed for water quality. Monitoring key parameters is crucial for identifying areas for conservation or restoration. However, limited resources and technical expertise pose challenges, particularly in the global south. The Stream Visual Assessment Protocol (SVAP), developed by the US Department of Agriculture, is a qualitative, field-based method to evaluate stream health. It allows non-technical individuals to conduct rapid assessments based on observable features. In this study, seven groups of five people, including both technical and non-technical participants, applied SVAP to two local streams. They assigned visual scores to stream features such as Riparian Buffer, Bank Stability, Canopy Cover, Water Clarity, Stream Substrate, Channel Condition, and Hydrology across 10 monitoring stations. The total scores were compared to established water quality benchmarks. Results showed that the first stream was rated "Fair," indicating moderate impairment with noticeable impacts on habitat and water quality. The second stream was classified as "Poor," reflecting severe degradation and significant impairment. To validate these findings, water samples were collected from all 10 stations and analyzed for BOD, COD, coliform levels, dissolved oxygen, ammonia, and phosphates. The chemical analysis supported the SVAP results, demonstrating its reliability as a preliminary assessment tool. SVAP provides an accessible method for evaluating stream health and engaging communities in water resource stewardship.

KEYWORDS: SVAP, water quality, visual assessment

PAPER ID: cest2025_00162

CLIMATE CHANGE

Assessing the reliability of four air temperature interpolation functions in estimating chill accumulation for deciduous fruit trees

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ABSTRACT

Chill models, which are essential for estimating the chill accumulation necessary for the dormancy of various fruit trees, require continuous hourly temperature. To date, there has been no comprehensive study establishing the best method for filling gaps in hourly temperature records for Greek weather stations. Firstly, this study compares the performance of four temperature interpolation functions (the akima, cosine, hourly, and linear) against hourly air temperature observations from the Aristotle University of Thessaloniki weather station, for the dormancy period (October to March), during 1951-2023. Next, it tests these methods as input to two chill accumulation models (the Dynamic and the North Carolina Model. The hourly model was the most robust interpolation method during the day, even though at midday it was outperformed by the others. The hourly and linear interpolation methods exhibited the lower daily MAE values during the dormancy period. The hourly model was also the most accurate method for estimating chill accumulation with both chill models. the Dynamic and North Carolina model.

KEYWORDS: Air temperature interpolation functions; Chill accumulation; The Dynamic chill model; The North Carolina chill model; Greece

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Temporal Evolution of Seasonal Crop-Specific Climatic Indices in Greece, Based on ERA- and CMIP6- derived Data

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ABSTRACT

This study presents an updated temporal evolution of seasonal crop-specific climatic indices in Greece, based on ERA5- and CMIP6- derived temperature and precipitation data. The indices include days with (a) daily maximum air temperature $T_{max} > 30^{\circ}\text{C}$ in spring (HD30spr) and $T_{max} > 35^{\circ}\text{C}$ in summer (HD35sum), respectively, (b) daily minimum air temperature $T_{min} < 0^{\circ}\text{C}$ (frost days) in spring and (c) spring and summer precipitation of the reference period (1950-2023) and in the near future (2024-2050) (NF). The climatic indices related to T_{max} (T_{min}) presented increasing (decreasing) trends, with both ERA5 and CMIP6 data, towards the present and strong (weak) increases in the NF. Precipitation showed statistically weak decreasing trends in spring, increasing trends in summer, and weak decreasing trends for both seasons in the NF.

KEYWORDS: crop-specific climatic indices; ERA5; CMIP6 simulations; Greece

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Acknowledgement: This research was funded by the project "Support for enhancing the operation of the National Network for Climate Change (CLIMPACT)", National Development Program, General Secretariat of Research and Innovation (2023NA11900001 - N. 5201588).

CLIMATE CHANGE ADAPTATION AND RESILIENCE

Patenting Trends in Agricultural Climate Innovation: A Global Analysis with a Focus on China

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ABSTRACT

Agriculture faces mounting pressure to both adapt to climate change and mitigate its environmental impact. Green technology innovation is central to this challenge, yet little is known about how global patenting trends reflect the balance between adaptation and mitigation efforts. This study analyzes 13,727 agricultural climate-related patent families to assess temporal, geographical, and institutional patterns in innovation. The results reveal that adaptation technologies dominate the patent landscape, with innovations focusing on water management, soil stabilization, and climate-resilient crops, whereas explicit mitigation technologies, such as carbon sequestration and low-emission fertilizers, remain limited. China emerges as the overwhelming leader in agricultural climate patents, driven by state-led research funding and policy incentives, particularly during the 2016–2017 surge. However, the high abandonment rate of Chinese patents suggests a short-term, institution-centric patenting strategy rather than sustained commercialization. In contrast, U.S., German, and Japanese firms maintain patents as strategic assets with stronger long-term retention. The study highlights key policy and market implications, emphasizing the need for greater industry engagement and cross-sector collaboration to ensure that green agricultural technologies transition from research outputs to commercially viable solutions.

KEYWORDS: Green Patents; Climate Change; Agriculture

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EMERGING POLLUTANTS

Investigating the chemical impact of human-related activities on the Red Sea marine environment utilizing High Resolution Mass Spectrometry

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ABSTRACT

A baseline study was conducted in the Red Sea marine environment, where sediments were collected, aiming to investigate the long-term impact of anthropogenic activities, and provide useful insights to legislative parties in the framework of the Marine and Coastal Environment Protection Initiative (MCEP). Generic sample preparation protocols were implemented for the extraction of as many semi-polar to polar, LC-amenable emerging contaminants (ECs) and a hybrid trapped ion mobility tandem high-resolution mass spectrometric technique was utilized. Subsequently, wide-scope target and suspect screening of more than 3,100 ECs was conducted. A total of 51 ECs from 7 distinct chemical classes were determined. The highest chemical burden was determined in Jeddah Mena and Jeddah Lagoon regions, with cumulative concentrations of ECs reaching up to 2.24mg/kg d.w. and 5.80mg/kg d.w., respectively. Risk assessment showed that 8 compounds were at high environmental risk, highlighting the significance of their comprehensive monitoring. This study aims to set the baseline of chemical pollution in the study area and act as a reference for future research.

KEYWORDS: HRMS, sediments, target/suspect screening, risk assessment, WWTPs

PAPER ID: cest2025_00448

Study of the occurrence, sources and distribution trends of emerging contaminants in the Saronikos Gulf and Elefsis Gulf, Greece, utilizing ion mobility tandem high-resolution mass spectrometry

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ABSTRACT

This study investigates the occurrence, distribution and ecological risk of emerging contaminants (ECs) and priority pollutants (PPs) in seawater and sediments of the Saronikos Gulf, and Elefsis Bay, Greece. The occurrence of more than 4,000 LC-amenable organic micropollutants was investigated through wide-scope target and suspect screening. A total of 171 analytes were detected, with pharmaceuticals identified as the most prevalent class. Semi-polar ECs with higher molar mass were determined exclusively in sediments near WWTPs, possibly due to their high logP values, reflecting their affinity for particulate matter. Additionally, seawater circulation was found to play a significant role in controlling the spatial distribution of ECs. Comparison with earlier studies suggests a shift in pharmaceutical usage by local population. Risk assessment revealed that PFAS exceeded annual average environmental quality standard values in 92% of seawater samples, whereas 20 ECs in seawater and 12 in sediments exceeded predicted no-effect concentrations, indicating potential adverse effects on marine biota.

KEYWORDS: ion mobility spectrometry, wastewater, seawater, sediments, target/suspect screening

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Mercury in reference materials (mineral ores and soils): A comparative study of Microwave-Acid Digestion and Analytical Techniques

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ABSTRACT

Mercury (Hg) is a toxic heavy metal that poses a significant threat to human health and the environment. Accurate and reliable methods for Hg determination are crucial for environmental monitoring and risk assessment as well as mineral exploration applications. This study aimed to establish the optimal conditions for microwave-acid digestion of mineral ore samples and to compare the performance of inductively coupled plasma mass spectrometry (ICP-MS) and cold vapour atomic absorption spectrometry (CVAAS) in Hg quantification. The optimization of the microwave-acid digestion procedure was carried out by varying digestion temperature (from 120°C to 200°C) and digestion time (e.g., from 15 min to 60 min). Mineral ore CRMs with different Hg levels were employed to evaluate the effectiveness of the methods applied. The results obtained from the two analytical techniques were compared in terms of accuracy, precision, and sensitivity. The influence of digestion temperature and time on Hg recovery was also assessed. The findings of this study provide valuable information for the development of robust analytical protocols for Hg determination in various geological matrices. The optimized microwave-acid digestion procedure offers a rapid and efficient approach for sample preparation, while the comparison of ICP-MS and CVAAS highlights the advantages and limitations of each technique. The use of CRMs ensures the accuracy and reliability of the analytical results.

KEYWORDS: Mercury, ICP-MS, CVAAS, method comparison

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Comprehensive Target, Suspect, and Non-Target Screening Using LC-HRMS of Pharmaceuticals and Their Transformation Products in Biological Treatment Systems

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ABSTRACT

This study employed LC-HRMS-based target, suspect, and non-target screening to investigate the occurrence, behavior, and environmental risk of pharmaceuticals (PCs) and their transformation products (TPs) in a biological treatment system (BTS). A total of 82 compounds (43 confirmed, 39 tentatively identified) were detected. PCA and HCA revealed temporal variations in concentrations and removal efficiencies, with some compounds exhibiting persistent or increasing trends. Fold change analysis enabled classification of TPs as human, microbial, or dual-type metabolites, highlighting active transformation processes in the BTS. PMT/PBT assessments showed that many TPs (e.g., CBZ-EP, CFN-PT, VST-A) exhibited high persistence, mobility, or potential toxicity. Structural modifications, such as ether, ketone, or hydroxylation groups, often contributed to these properties. Compounds like VST-A and PFN-M300 showed increased mobility and resistance to degradation, even after treatment. These findings underscore the importance of including diverse PCs and TPs in environmental assessments. The study demonstrates the applicability of comprehensive screening and statistical methods for identifying substances of environmental relevance and transformation behavior in the BTS. These findings indicate the necessity of comprehensive monitoring and may contribute to future regulatory development.

KEYWORDS: Emerging pollutants, Wastewater treatment, LC-HRMS, Biotransformation, Non-target screening

PAPER ID: cest2025_00428

Green and simple analysis of brominated and organophosphate flame retardants in Fish Samples Using QuEChERS Extraction and GC-MS

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ABSTRACT

The persistence of PBDEs (Polybrominated Diphenyl Ethers) and the increasing risk of OPFRs (Organophosphate Flame Retardants) to aquatic ecosystems and human health require detailed studies on their prevalence in fish, an essential component of the food web. The present work describes the development of a QuEChERS extraction method followed by gas chromatography-mass spectrometry (GC-MS) for the extraction and analysis of PBDEs and OPFRs in fish samples. Several parameters of the extraction process were evaluated with the aim of enhancing recovery and minimizing interferences, and, thereby, a simple and efficient protocol is given. The validation results showed efficient recoveries and reproducibility. This work focuses on the development and application of QuEChERS-GC-MS as an easy method with environmentally friendly aspect for the analysis of PBDEs and OPFRs in fish.

KEYWORDS: PBDEs, OPFRs, QuEChERS, GC-MS, Fish Samples

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Determination of Polybrominated diphenyl ethers (PBDEs) in Fish Feed by QuEChERS and GC×GC-TOF MS

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ABSTRACT

Polybrominated diphenyl ethers (PBDEs) are organic pollutants widely used as flame retardants in various products. Due to their stability and lipophilic nature, PBDEs tend to bioaccumulate in aquatic organisms, raising concerns about their presence in aquaculture products. In this study, a sensitive and reliable analytical method was developed for the determination of PBDEs in fish feed using a modified QuEChERS extraction followed by comprehensive two-dimensional gas chromatography coupled with time-of-flight mass spectrometry (GC×GC-TOF MS). Method optimization and validation were carried out using spiked samples. The procedure yielded satisfactory recoveries. Limits of detection ranged between 0.03 and 0.40 ng/g, while linearity was excellent. The results confirm the method's robustness and suitability for future application in routine analysis of PBDEs in fish feed and related matrices. This work contributes to improving food safety monitoring in aquaculture by enabling the trace-level determination of flame retardants in complex sample matrices.

KEYWORDS: PBDEs; Flame retardants; Fish feed; QuEChERS; GC×GC-TOF MS

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Application of QuEChERS-GC×GC-TOF MS method for the determination of flame retardants in aquaculture fish samples.

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ABSTRACT

Polybrominated diphenyl ethers (PBDEs) and organophosphate flame retardants (OPFRs) are two groups of chemical compounds commonly found in the aquatic environment, mainly because of their widespread use in consumer and industrial products. These substances can accumulate in fish, especially in fatty tissues, raising concerns about their possible transfer to humans through diet. In this study, an analytical methodology was developed and validated to detect and quantify PBDEs and OPFRs in fish samples using a modified QuEChERS extraction followed by two-dimensional gas chromatography with time-of-flight mass spectrometry (GC×GC-TOF MS) analysis. The method showed good performance in terms of recovery, precision, and detection limits. The two-dimensional chromatography allowed for better separation of isomer compounds, which are often difficult to be analyzed using conventional methods. This approach provides a reliable and sensitive tool for monitoring flame retardants in fish and can contribute to assessing both environmental contamination and potential risks for consumers.

KEYWORDS: PBDEs; OPFRs; Fish; GC×GC-TOF MS; Flame retardants

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ENVIRONMENTAL EXPOSURES AND HUMAN HEALTH

Tebuconazole bioconcentration in European Eels (*Anguilla Anguilla*): the role of pollutant cocktails

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ABSTRACT

European eel (*Anguilla anguilla*) populations are in decline across Europe, with organic pollutants (OPs) identified as one of the contributing factors. In the Albufera of Valencia, a critical feeding and maturation habitat for this species, a significant number of OPs have been identified, with tebuconazole exhibiting the highest concentrations among the compounds detected. This study aimed to assess the bioconcentration of tebuconazole in European eels following waterborne exposure, both alone and in combination with other commonly detected OPs. Eels were exposed under controlled laboratory conditions to environmentally relevant concentrations of tebuconazole and other OPs, and tissue samples were analysed to determine their bioconcentration. Statistically significant differences in tebuconazole accumulation were observed during the exposure phase, with notably higher concentrations in eel tissues when the compound was administered alone, compared to co-exposure with other OPs. These results suggest that the presence of pollutant cocktails may alter the bioconcentration of individual substances, potentially through interactions affecting absorption, distribution, or metabolism. This study highlights the importance of considering the complex nature of contaminants mixtures in natural habitats. Understanding how these interactions affect species like the European eel is crucial for protecting vulnerable populations, and ensuring ecosystem and food safety.

KEYWORDS: European eel, tebuconazole, Albufera de Valencia, liver, muscle.

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ENVIRONMENTAL DATA ANALYSIS AND MODELLING

Estimation of Solar Irradiance for the Maltese Islands

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ABSTRACT

Solar energy is a promising renewable resource. Solar radiation modelling is essential for optimising its potential. This study replicates an existing model, namely, SOLAR, originally implemented in Fortran, and adapts it using MATLAB. The model estimates the hourly average solar irradiance under all-sky conditions, incorporating two cloud cover estimation methods, i.e., sub-models, labelled as Model 1, based on the daily total solar flux, and Model 2, which uses daily total sunshine hours. The new implementation of the model was evaluated using an extensive data set collected at two monitoring sites in Malta. Results indicate that both sub-models perform well under moderate to high solar irradiance conditions, in keeping with findings of previous studies. Higher correlation between the modelled and corresponding measurements were observed for clearer conditions, suggesting better model performance when the cloud cover is minimal. However, the discrepancy increased for low solar irradiance, indicating challenges when it comes to cloud cover estimation. In this study, modelled and observed data correlated better as compared to previous studies, implying that the model suits better the Mediterranean conditions. This study demonstrates that a straightforward, yet effective solar modelling approach can be successfully adapted to different geographical contexts with minimal modifications. The findings highlight the model's reliability for solar energy applications in regions with varying atmospheric conditions, making it a valuable tool for solar radiation forecasting and energy assessments where high computational complexity cannot be afforded.

KEYWORDS: solar radiation; model evaluation; Maltese Islands

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AI tools in the framework of Environmental Impact Assessment Evaluation Procedure

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ABSTRACT

Traditionally, Environmental Impact Assessments (EIAs) depended on data compilation and review done by people, even though detailed, this often-meant drawn-out timelines and issues scaling up. At the same time the rising incorporation of Artificial Intelligence (AI) across different fields has prompted a notable alteration in approaches to gauging environmental consequences, though notable hurdles are still present. EIA in general have seen some pretty big changes lately, mainly thanks to AI. AI tools can bring new ways to make environmental evaluations more accurate, faster and transparent through numbers of KPIs such as legislative targets, circular economy principles, national priorities and many others. This is very important because environmental problems often made worse by human activity and are getting more complicated. Using AI in EIAs gives us a way to handle the huge amounts of data that come with modern environmental decision-making. AI can help with things like predicting what might happen, figuring out risks as well as running simulations. Moreover, regular assessment methods often can't keep up with the complex ways ecosystems work and how they react to different pressures. This research setup a new AI tool to compare and make assessment of the EIA studies that are been submitted to the Department of Environment of Cyprus Government. In addition, the results indicate that the AI tool speeds up the process, making quick decisions in project planning and environmental management as well as makes the whole process easier to get everyone involved in the EIA

The idea that questioning the complete net environmental impacts of AI solutions for the environment (AI for Green) has never been addressed directly, points to a key gap in current research. Additionally, when deciding if AI should be used to get those involved in the EIA process, more engaged and make it easier to monitor the environment in real-time with smart technologies, the risks of making existing inequalities worse must be taken into account. As people increasingly rely on AI for decision-making, there is an important need for clear and inclusive assessment processes. This is further shown in visual representations of the data-driven approach to EIA, where many metrics are utilized to convey impacts visually and intuitively as can be seen in tools like the Environmental Impact Assessment dashboard. This cutting-edge platform have the potential to change how those involved participate, as they must also address problems like data security and biases in algorithms that could weaken public confidence

KEYWORDS: Artificial Intelligent, Environmental Impact Assessment, data monitoring, Environmental performance

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The use of the BigML platform for the analysis of geological-mining parameters influencing the rockbursts hazard

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ABSTRACT

An analysis of geological-mining parameters, characterizing rockbursts that occurred in the mines of the Upper Silesian Coal Basin, was carried out using the BigML machine learning platform. The analyses included data relating to selected groups of parameters: structural, mechanical and geometric, characterizing the conditions of occurrence of rockburst hazard. The collected were used to build machine learning models for predicting the values of selected parameters of the effects of rockbursts, i.e. distance between the focus and the effect of a seismic tremor (1) and the length of damage and/or destruction of the excavations (2). Models based on a decision tree and a random decision forest were developed for each of the predicted parameters. The performance of the models was then determined on test data. For both forecast parameters, better results were obtained using the random decision forest. The R² coefficients of determination of the developed models were 0.782 and 0.883 for the (1) and (2) parameter respectively.

KEYWORDS: BigML platform; rockbursts; machine learning; decision tree; random decision forest

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ENVIRONMENTAL POLLUTION

Evaluation of the effects of water from war-impacted regions of Ukraine on autotrophic test organisms

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ABSTRACT

The continuing armed conflict in Ukraine has had both direct and indirect consequences for the environment, including pollution and habitat destruction, a reduction in biodiversity, and a diminution of ecosystem services. It is therefore necessary to develop a strategy for the restoration of Ukraine's environment, that includes a rapid assessment of the ecological status of damaged ecosystems using cost-effective methods, identification of risks and restoration of bioresources. The primary objective of this study was to establish a complex of test organisms to facilitate the investigation of damaged aquatic ecosystems. Algae and plants play a pivotal role in the food chain, functioning not only as primary producers but also as bioaccumulators. The present study therefore sought to evaluate the effects of twelve water samples taken from water bodies affected to varying degrees by military operations in the Kyiv, Chernigov, Kharkiv and Odessa regions of Ukraine on physiological and biochemical parameters of the green alga *Desmodesmus communis* and the plant *Lepidium sativum*. A hydrochemical analysis was carried out and the concentrations of heavy metals (HM) and polycyclic aromatic hydrocarbons (PAHs) in the studied waters were estimated. The concentrations of HMs and PAHs in the water samples were relatively low or below the detection limit. In most cases, no significant changes were observed in the parameters analysed for *L. sativum* compared to the control ($p > 0.05$). Nevertheless, *D. communis* demonstrated sensitivity to the water tested. The results of the acute toxicity test suggest that water bodies in the study area may be sensitive to the effects of military activities, and that further long-term investigations are required.

KEYWORDS: military activities, aquatic ecosystems, pollution, primary consumers, biological parameters.

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Vulnerability of the pollution-tolerant diatom *Nitzschia palea* to metal pollution

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ABSTRACT

Aquatic ecosystems are highly sensitive to environmental changes, especially in conflict areas, where military actions release various hazardous substances into water bodies. These pollutants pose long-term risks to both human health and aquatic life due to their persistence and bioaccumulation potential. Among aquatic organisms, primary producers respond rapidly to environmental disturbances, making them effective indicators of short- and long-term pollution. Diatoms in particular are valuable indicators for assessing exposure to pollutants such as metals due to their short generation time and sensitivity to environmental stressors. The aim of this study was to evaluate the vulnerability and tolerance of the pollution-tolerant diatom *Nitzschia palea* to a metal mixture and to assess its potential for monitoring water quality in war-affected aquatic ecosystems in Ukraine. Six different concentrations of a metal mixture comprising Ni (II), Zn (II), Cr (III), Cu (II) were tested under laboratory conditions.

The result revealed that exposure to high metal concentrations (≥ 20 times higher than the maximum permissible concentrations for EU inland waters) significantly suppressed the growth of *N. palea* and induced morphological changes, such as deformation of valves. In addition, changes in the levels of photosynthetic pigments, malondialdehyde (MDA) and antioxidants were observed. These morphological and biochemical changes indicate that even pollution-tolerant diatom species can be adversely affected by high levels of pollution.

The ability of *N. palea* to show measurable responses to metal exposure, despite its known tolerance, highlights its importance as a bioindicator in polluted waters to assess long-term ecological changes and/or chronic exposure effects. These findings contribute to a better understanding of ecosystem ecological risks in war-affected water bodies, and support the development of effective pollution mitigation strategies in conflict areas such as Ukraine.

Acknowledgement

KEYWORDS: freshwaters, benthic algae, water quality, military activities.

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Assessing the impact of war-affected water samples on early developmental stages of *Danio rerio*

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ABSTRACT

The armed conflict in Ukraine has had a severe impact on aquatic ecosystems, with military actions leading to contamination and habitat destruction. In response to this, six water samples were collected from bodies of water across four regions - Kyiv, Chernihiv, Kharkiv, and Odessa - all of which have been impacted by military operations. This study evaluates the effects of these water samples on the early development of *Danio rerio* embryos and larvae. Tail bursting activity of embryos at 24 hours post-fertilization (hpf) remained consistent across all samples, indicating no immediate neurodevelopmental impact. Heart rate (HR) measurements at 48 hpf showed a significant effect of water exposure; however, HR values did not significantly differ from the control group ($p > 0.05$). No significant differences in HR were observed at 96 hpf. However, a significant difference in hatching rates was observed among the water samples at 72 hpf ($p < 0.05$). Hatching rates (at 96 hpf) were similar across all groups, showing no significant differences between the treatment and control groups ($p > 0.05$). These findings suggest that exposure to specific water samples from conflict zones may transiently disrupt cardiac function and delay hatching in *D. rerio*, emphasizing the necessity for further research into the long-term implications on fish behavior and survival.

KEYWORDS: military activities, toxicity, contamination, aquatic ecosystems, risk assessment

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ESG (ENVIRONMENTAL, SOCIAL AND GOVERNANCE) AND CIRCULAR ECONOMY

Advancing Biochar Production from Woody Waste for Odor Mitigation and Sustainability

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ABSTRACT

Biochar production from municipal woody waste in Mediterranean regions, particularly Cyprus, presents significant potential for environmental sustainability. Feedstocks such as palm, fig, olive, carob, and eucalyptus trees offer varying lignocellulosic content, wood density, and nutrient profiles, all of which influence the quality of the resulting biochar, including its stability, porosity, and adsorption capacity.

Different pyrolysis techniques, slow, fast, and flash, produce biochar with distinct characteristics. Slow pyrolysis is ideal for generating stable, high-carbon biochar, while fast and flash pyrolysis, with their higher temperatures and shorter residence times, yield biochar with improved adsorption properties. Moisture content plays a crucial role in pyrolysis efficiency, and moisture management strategies like pre-drying methods are particularly useful in Mediterranean climates.

The choice of feedstock directly impacts the physical and chemical properties of the biochar. Advanced characterization techniques, including BET surface area measurement, pore structure analysis, and elemental composition, help link these properties to biochar's effectiveness in mitigating greenhouse gases (GHGs), volatile organic compounds (VOCs), ammonia, and hydrogen sulfides emitted from agricultural activities.

Biochar offers practical applications such as odor mitigation and enhancing soil fertility. While challenges such as feedstock variability, optimizing pyrolysis conditions, and ensuring scalability remain, there are clear pathways to overcome these hurdles. This understanding lays the foundation for advancing biochar production in Cyprus and other Mediterranean regions to tackle urgent environmental and agricultural challenges.

KEYWORDS

Municipal woody biomass, Biochar production, Sustainable applications, Agricultural odor control, Mediterranean feedstocks.

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FOOD WASTE AND FOOD LOSS

Fermentation-Driven Enhancement of Berry Pomace: Proximate Composition and Functional Properties Evaluation

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ABSTRACT

This investigation centers on the change of berry pomace via fermentation, aimed at augmenting its nutritional profile and functional characteristics, within the framework of a circular economy paradigm. By employing a thorough proximate composition analysis, the study assesses the moisture, ash, protein, fat, and fiber contents of pomace derived from ten distinct berry varieties. Additional evaluations encompass pH, acidity, and water activity determinations, which are pivotal for appraising the shelf-life and microbial stability of the resulting fermented products. The research further investigates functional attributes such as water retention, swelling capacities, and alterations in color and texture subsequent to fermentation. The results indicate that fermentation enhances the physico-chemical properties of berry pomace, positioning it as a promising candidate for novel food applications. This optimized utilization aids in waste minimization and fosters the advancement of sustainable food systems. The study additionally assesses the prospective application of fermented berry pomace in food products, underscoring its significance in the formulation of sustainable and health-enhancing food additives. The findings reveal that fermentation not only enhances the nutritional and functional attributes of berry pomace but also facilitates the development of new, value-added products within the food sector, thereby promoting both environmental sustainability and economic feasibility.

KEYWORDS: Berry Pomace, Fermentation, Proximate Composition, Functional Properties, Sustainable Food Production

PAPER ID: cest2025_00045

Innovative Technologies and their Role in Reducing Pre-Consumption Food Loss

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ABSTRACT

Food losses (FL) at the pre-consumption stages reach up to 14% according to the FAO. Although these losses may seem like a relatively small fraction of total FL, are often underestimated, contributing significantly to challenges to global food security and environmental sustainability. Emerging technologies can play a significant role in tackling inefficiencies across the supply chain, from the field to the point of commercialization. These difficulties are diverse and context-dependent, requiring the adoption of multiple solutions. Integration of novel technologies in a smart system adapted to the food chain, can prevent deterioration of commodities and set the base for a transformative shift toward more resilient and efficient food systems. Precision agriculture, powered by Artificial Intelligence (AI), the Internet of Things (IoT) sensors, and Geographic Information Systems (GIS) can lead to more data-driven farming practices, leading to significant advancements in crop monitoring, resource management, and decision-making processes. Blockchain can be seamlessly integrated into this system, improving food traceability, transparency, and ensuring the quality and safety of commodities. This research presents the capability of incorporating such novel technologies in the pre-consumption stages of the food supply chain along with the challenges, benefits, and limitations, compared to real-world applications in the food sector.

KEYWORDS: Food Loss, Artificial Intelligence, Internet of Thing, Food supply chain, Smart Food System

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FOREST ECOSYSTEMS

Mapping What People Value: A Review of Societal Demand for Forest Ecosystem Services in Europe

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ABSTRACT

Forest ecosystems provide a diverse selection of ecosystem services (FES), including carbon sequestration, biodiversity conservation, water regulation, and recreational opportunities. However, these services are increasingly threatened by climate change, deforestation, and unsustainable management practices. A clear understanding of societal demand for FES is essential for designing effective policies and management strategies that ensure their sustainable provision.

This study presents a literature-based review of the current state of knowledge on FES in Europe, drawing on empirical research and case studies published from 1980 to the present. The review synthesizes how different FES are valued across bioclimatic regions and stakeholder groups, examining spatial and temporal dynamics. Particular attention is paid to the evolution of the FES concept within environmental governance, and to the integration of demand-side perspectives in forest policy frameworks. By mapping the scale of research findings and identifying existing knowledge gaps, this work lays the groundwork for future empirical studies and contributes to ongoing policy discussions at EU level.

KEYWORDS: Forest Ecosystem Services; Societal Demand; Choice Experiment

PAPER ID: cest2025_00367

HEALTH AND PLASTICS

Surface Charges of Polystyrene Nanoplastics Affect Their Distribution in Mice

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ABSTRACT

Micro- and nanoplastics can enter the human body through ingestion, inhalation, and skin contact, and their distribution within the body and impact on health have attracted widespread attention. This study aimed to examine how particle size and surface charge influence the biodistribution of polystyrene nanoplastics (PS NPs) in mice following intravenous administration. Our results indicate that the majority of fluorescent PS NPs, regardless of their charge or size, predominantly accumulated in the liver, which is pivotal for filtration. Notably, negatively charged COOH-PS NPs exhibited significant accumulation in the lungs 30 min post-injection, in contrast to positively charged NH₂-NPs. Specifically, 100 nm COOH-PS NPs demonstrated marked lung accumulation, implying that these anionic particles can more effectively traverse the vascular endothelial barrier. Subsequently, we analyzed the protein corona composition on the surface of nanoplastic particles and discovered vitronectin and fibrinogen as crucial plasma proteins interacting with negatively charged PS NPs. This corona facilitates integrin αIIbβ3 receptor-mediated phagocytosis by lung endothelial cells, accounting for the localization of PS NPs in the lungs. These findings underscore the significance of considering both surface charge and protein corona composition in assessing the safety of nanoplastics.

KEYWORDS: polystyrene nanoplastics, protein corona, magnetic isolation, lung accumulation, integrin receptors

PAPER ID: cest2025_00247

Unveiling the presence of MNPs within the human body

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ABSTRACT

Micro and nanoplastics (MNPs) have emerged as critical contaminants of both the environment and human health. The current work synthesizes data from several studies to elucidate MNP occurrence in blood, saliva, and urine. Findings highlight polypropylene (PP), polyethylene terephthalate (PET), and polystyrene (PS) as frequently identified polymers of varied sizes and morphologies, with potential for systemic distribution and partial excretion. However, the lack of standardized extraction protocols and analytical procedures for their analysis hinders cross-study comparisons, underscoring the urgent need for uniform methodologies. Further exploration of additional biological matrices such as stool, cerumen, breast milk, and meconium, remains imperative to develop a comprehensive understanding of MNP exposure and associated health risks.

KEYWORDS: Microplastics, Nanoplastics, Blood, Urine, Saliva

PAPER ID: cest2025_00291

HEAVY METALS IN THE ENVIRONMENT

Microbial activity in mine tailing dump in South-West Sardinia (Italy)

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ABSTRACT

Abandoned mines represent a major environmental concern worldwide, posing serious risks to human health and ecosystems. In this study, microbial abundance and dehydrogenase activity were evaluated in surface substrates collected from a highly contaminated (Zn, Pb and Cd) tailing dump and in the surrounding areas. The heterotrophic community inside the studied site was found to be severely impaired as compared to control sectors located at the border and outside the tailing dump. The analysis of the microbial community composition by sequencing of the ribosomal genes is currently in progress. Overall, the study will allow us to identify the microbial components most severely affected by the extreme environmental conditions present in the mine tailings.

KEYWORDS: mine tailings, metals, microorganism, toxicity, NGS

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Complementary approaches to characterize rhizospheric microbial diversity of *Pistacia lentiscus* in a highly contaminated mine tailing dump

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ABSTRACT

Among phytoremediation strategies, phytostabilization takes place at the root-substrate interface, where excluder-type metallophytes and their root-associated microorganisms reduce metal mobility and bioavailability. The effectiveness of this process largely depends on the structure and function of the rhizospheric microbiome. To better understand the factors influencing phytostabilization under real field conditions, a multifactorial approach is essential. In this study, we conducted an integrative analysis of the microbial diversity and enzymatic activity in the rhizosphere of *Pistacia lentiscus*, an excluder-type metallophyte naturally growing in a highly contaminated (Zn, Pb and Cd) mine tailing dump and in surrounding area. Our findings provide insights into the ecological role of root-associated microbiomes in metal-contaminated environments and support their relevance for site-specific remediation strategies.

KEYWORDS: ribosomal genes, BIOLOG, mining area, phytoremediation, bacteria, fungi

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Nickel-induced multimetal uptake in two microalgal species

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ABSTRACT

We investigated the effect of Ni(II) uptake on two microalgal species, *Chlorella sorokiniana*, and *Chlamydomonas reinhardtii*, in 1 - 6 ppm Ni(II) enriched tris-acetate-phosphate (TAP) growth medium. Even though increased uptake of Ni(II) was observed for both algal species, accompanied by growth suppression at high Ni(II) concentrations, multi-elemental trace analysis revealed a significant, Ni concentration-dependent, uptake of incubation media essential metals as well. For both algal species, Zn uptake concentrations increased by approximately 20 times when going from control, no Ni(II), to cultures incubated with increasing Ni(II) concentrations. Overall, Zn uptake was determined to be approximately 3 orders of magnitude higher than Ni(II) uptake when high concentrations of Ni(II) were present. Similar uptake trends were observed for Cu and Co for both algae species, even though uptake concentrations were much lower than those of Zn. For *Chlorella sorokiniana*, increased Fe uptake relative to Ni(II) uptake was observed (2 orders of magnitude higher), as was the case for Mn (1 order of magnitude higher). This induced increase in uptake of some of the growth media metals was attributed to their liberation from EDTA in TAP medium, following the addition of Ni(II), which has a higher stability constant (K_f) with EDTA and was added at comparable or higher than them concentrations. Calculated levels of free Ni(II) and free metals in the medium matched the observed metal uptake trends as determined using multielemental inductively coupled plasma mass spectrometry. The lipid unsaturation level and relative ω -3 fatty acids concentration of both microalgal species, based on ¹H Nuclear Magnetic Resonance analysis, decreased with increasing Ni(II) concentration. Unsaturation levels for individual lipid classes [monogalactosyldiacylglycerol (MGDG), digalactosyldiacylglycerol (DGDG), and sulfoquinovosyldiacylglycerol (SQDG)] in *Chlamydomonas reinhardtii* cells were also studied using positive ion mode electrospray mass spectrometry. At the highest Ni(II) concentrations, an overall reduction in unsaturation levels was observed for all 3 lipid classes.

KEYWORDS: Metal stress, microalgae, lipid unsaturation, mass spectrometry, NMR

PAPER ID: cest2025_00402

LIFE CYCLE ANALYSIS (LCA)

Life Cycle Assessment of grape production. Potential environmental benefits of an alternative solution for fungal diseases control

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ABSTRACT

In the project Grape4Vine an innovative solution was developed. In detail, the Grape4vine project aims at exploiting winegrowing byproducts that would be normally treated as wastes, to produce biotechnological means for controlling downy mildew and powdery mildew in the circular economy context. In detail, the Grape4Wine solution is based on dsRNA (double-stranded RNA) able to induce RNA interference (RNAi) and silencing pathogen or plant genes necessary for infection and thus avoid the onset of plant disease. However, to assess the sustainability of the proposed solution, the first step is to quantify the impact of fungal disease control during grape cultivation. In this context, the aim of this study is to evaluate the environmental impact of grape cultivation by paying particular attention to pest and disease control. To this purpose, the Life Cycle Assessment approach was applied to data collected in different viticulture farms located in northern Italy.

KEYWORDS: Life Cycle Assessment, Precision viticulture, Pesticide Application, Sustainability

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Environmental Impact Assessment of Halloumi Cheese Production: A Life Cycle Approach

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ABSTRACT

Halloumi, a traditional Cypriot cheese with a PDO label, is recognized for its quality and authenticity. Its production follows strict national and European standards, boosting its reputation and demand. The study used the Life Cycle Assessment (LCA) methodology to evaluate the environmental effects of Halloumi production in a small-scale Cypriot industry. OpenLCA software was used, and a cradle-to-gate approach was applied. Primary data were collected through questionnaires, while secondary data came from AGRIBALYSE 3.0.1 and ECOINVENT 3.4 databases. The analysis focused on eight impact categories based on the EF 3.0 Method. Findings showed that energy consumption had the highest environmental impact. Thermal energy contributed 11.23% to ozone depletion, while electrical energy accounted for 11.86% of water use. To explore sustainable solutions, a second LCA was conducted, replacing oil with wood residue pellets and using photovoltaics for 35% of electricity production. This alternative scenario significantly reduced the environmental impact of both thermal and electrical energy. The results highlight that switching to renewable energy can make Halloumi production more sustainable and energy-efficient. Overall, the study provided valuable insights and recommendations for reducing Halloumi's environmental footprint. By improving energy use, the industry can minimize its impact while maintaining high-quality production.

KEYWORDS: LCA, PDO product, Halloumi

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Sustainability Assessment in an Industrial Symbiosis Case Study: Olive Mills and Olive Mill Waste Biorefineries

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ABSTRACT

This study presents an innovative, integrated approach for the valorization of Olive Mill Waste (OMW) within the framework of circular economy and sustainable development. By combining laboratory and pilot-scale experimental data, we designed a scalable OMW biorefinery capable of extracting high-value products while minimizing waste. The process begins with the extraction of two valuable components: secondary oil, produced through acidification, and a phenolic-rich extract containing bioactive compounds such as tyrosol and hydroxytyrosol. The phenolic compounds were isolated using ultrafiltration and adsorption/desorption techniques with resins. These extraction processes were simulated and optimized using Aspen Plus to ensure efficiency and scalability. All residual solid and liquid streams generated during the extraction process were further utilized as feedstock for composting, resulting in the production of a high-quality soil amendment. This closed-loop approach ensures a zero-waste system, aligning with circular economy principles. To evaluate the feasibility and sustainability of the biorefinery, a comprehensive techno-economic analysis was conducted to estimate production costs and assess profitability across different scales. Additionally, a Life Cycle Assessment (LCA) was performed to identify environmental hotspots and propose strategies for improving the overall environmental performance of the process. The results demonstrate that the proposed biorefinery is a feasible, cost-effective, and environmentally friendly solution for OMW management. By transforming waste into valuable products, this approach not only addresses the environmental challenges associated with OMW disposal but also contributes to the sustainable utilization of agricultural by-products. This study highlights the potential of integrated biorefineries to drive innovation in waste valorization and promote sustainable industrial practices.

KEYWORDS: olive mill waste utilization, biorefinery development, techno-economic study, LCA

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MICROPLASTICS IN THE MARINE ENVIRONMENT

Microplastic ingestion in *Scomber colias* from Saronikos Gulf

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ABSTRACT

Microplastics are synthetic polymer particles less than 5 mm in size and represent a growing environmental concern due to their easily consumable nature and tendency to accumulate in marine organisms. Saronikos Gulf, located in the Aegean Sea between the Argolida and Attica peninsulas, serves as a major maritime route and is subject to elevated anthropogenic pressures compared to offshore environments. In this study, a total of 60 *Scomber colias* (Atlantic chub mackerel) were collected from the Saronikos Gulf during the summer of 2021 to assess the presence, abundance, and characteristics of ingested microplastics. Sample processing and analysis were conducted following the Medsealitter protocol. The total length of *S. colias* specimens ranged from 208 to 236 mm, with body weights between 77 and 128 g. Microplastic abundance ranged from 1 to 5 particles per individual. Most of detected microplastics were classified as fragments, with black, blue and red being the most frequently observed colors. Our findings confirm the widespread occurrence of microplastics in *S. colias* and support its use as a bioindicator species of the pelagic ecosystems. Continued monitoring is recommended to assess spatial and temporal variability in microplastic pollution and associated ecological implications.

KEYWORDS: *Scomber colias*, marine pollution, microplastics, Saronikos Gulf, Mediterranean Sea

PAPER ID: cest2025_00364

Monitoring plastic and Hg pollution impacts on two commercial species from the North Evoikos Gulf

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ABSTRACT

This study examines the presence of microplastics (MPs) and mercury (Hg) concentrations in 230 *Boop boops* L., and 203 *Nephrops norvegicus* L., sampled from the North Evoikos during the years 2021, 2022 and 2024. Microplastics were detected in 56.1% of *B. boops*, with a mean abundance of 1.74 MPs/individual, and in 79.3% of *N. norvegicus*, with a mean of 3.72 MPs/ individual. Polymer composition analysis revealed species-specific differences in the dominant MP types. Mercury concentrations remained within the permissible limits established by European regulatory standards, with mean levels of 0.32 mg/kg w.w. in *N. norvegicus* and 0.05 mg/kg w.w. in *B. boops* indicating no immediate risk to human health (THQ <1).

KEYWORDS: *Scomber colias*, marine pollution, microplastics, Saronikos Gulf, Mediterranean Sea

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Hazards of microplastics to the marine ecosystem: BioPlast4Safe project remarks

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ABSTRACT

The project BIOPLAST4SAFE, titled "Biomonitoring of biodegradable micro and nanoplastics: from the environment to humans in a one health perspective", promotes the study of characteristics, fate and potential (eco)toxicological effects of plastics, with a specific focus on biodegradable polymers as a potential EU strategy for mitigating plastic pollution. Within this project the feedback from different marine organisms to the plastic threat, mainly microplastics, has been explored.

These synthetic organic polymer particles differing in size, shape, surface texture, chemical composition (polymers and additives) and specific density may affect the exposed biota in a variety of ways (e.g., reduced food uptake, lower energy reserves, affected physiological functions, effects at organism and population levels). In addition, microplastics affect the surrounding environment, being vectors of chemical and biological agents transferring pollutants, invasive species and pathogens in the environment.

In this contest, biological effects of microplastics obtained by fragmentation of biodegradable (e.g., polylactic acid - PLA) and non-biodegradable (e.g., polypropylene - PP) products were studied using a battery of marine species, from different taxonomic and trophic levels. Here we review and compare the first results related to the ecotoxicological effects of PP and PLA, calculating Effect Concentrations (ECs), while Predicted No Effect Concentrations (PNECs) values were derived from the EC50s, according to the ECHA guideline (2008). Some sublethal and lethal effects were observed in representative organisms of the food web as producers, consumers and decomposers, in acute and chronic exposures. Furthermore, PLA and PP showed similar ecotoxicity, speculating about the effectiveness of biodegradable polymers in mitigating plastic pollution.

In conclusion, further microplastic ecotoxicity assessment are needed, preferably including at least three trophic levels, to support an Environmental Risk Assessment (ERA) procedure of microplastics.

KEYWORDS: effect assessment, microplastic, marine environment.

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Monitoring of (micro)plastics in *Posidonia oceanica* meadows and banquettes: state of the art and future research trends

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ABSTRACT

Marine plastic pollution has well-recognised impacts in the loss of biodiversity and the degradation of coastal and marine ecosystems. Despite this, the threat of plastic pollution on seagrasses is still under-explored worldwide, compared to other marine species and habitats. Only recent efforts have been dedicated to this topic, with the first study published in 2017. Available literature highlighted that microplastics can affect seagrass plant growth, photosynthesis, nutrient cycling and habitat biodiversity, causing much concern. Few studies regard the endemic species *Posidonia oceanica* and investigated macro-/microplastics, only in the field (no laboratory experiments), mainly considered the plants alive instead of dead tissues. However, *Posidonia* beach wracks (i.e. *banquette*) are potential accumulation hot spots for microplastics and their monitoring can contribute to the plastic pollution assessment in Mediterranean coastal areas and improve the protection measures of *P. oceanica* habitats against the current plastic pollution crisis. To this end we setup and carried out in situ surveys and samplings of different banquettes across the Mediterranean basin: Favignana Island (Sicily, Italy); Akrotiri Bay (Cyprus); Sardinia (Italy); Lazio Region (Italy). The microplastic characterization in *Posidonia* leaf tissues by stereomicroscopy and Micro-Raman spectroscopy is in progress and results may provide important information about distribution patterns of microplastics and transfer dynamics between terrestrial and marine compartments.

KEYWORDS: plastic pollution, seagrass, mediterranean sea, banquette, monitoring.

PAPER ID: cest2025_00391

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

Effects of tire wear particles on lichen viability

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ABSTRACT

Tire wear particles (TWPs) are one of the dominant sources of microplastics. When TWPs enter ecosystems, they can leach certain plastic additives that may be potentially toxic to the environment. However, little is known about the effects of TWPs on non-target organisms. This study aims to determine the effects of extracts derived from TWPs on lichens using different physiological and biochemical parameters. Each lichen species was exposed to five different concentrations of leachates for 1 hour, and endpoints were measured every 24 hours for 3 days. TWP leachates were toxic to lichens. Our results indicate that TWP leachates negatively affect lichen viability, although more field data on TWPs and their leachate concentrations are needed to fully assess the environmental impacts of TWPs.

KEYWORDS: lichen, tyre wear particles, leachate

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The impact of ozonation on PET and PVC microplastics in model urban wastewater

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ABSTRACT

In the field of environmental pollutants, microplastics (MPs) present one of the biggest challenges. Several studies investigated different removal options of MPs and investigated its toxic impacts on the environment. One of the main sources of MPs pollution is wastewater. Different advanced oxidation processes (AOPs) are being investigated regarding MP treatment in wastewater, especially ozonation. Several studies found that it caused degradation of certain MPs. Therefore, a study was run using polyethylene terephthalate (PET) and polyvinyl chloride (PVC) MPs in model wastewater. 6 h ozonation was accomplished at two different ozone doses. Total organic carbon (TOC) and chemical oxygen demand (COD) were determined for samples during ozonation. It was found out that in both MPs-containing model wastewater, TOC and COD increased. This indicates that ozonation has led to the degradation of MPs. Wastewater containing PET had up to 85% higher TOC values compared to PVC containing wastewaters. After ozonation PET-containing wastewater had up to 29% higher COD values than the PVC-containing one. It can be concluded that the higher ozone dose, the more effective MPs degradation is.

KEYWORDS: degradation, microplastics, ozonation, PET, PVC, wastewater

PAPER ID: cest2025_00319

PLASTICS IN AGRICULTURE AND AQUACULTURE

Regulatory and Mitigation Strategies to Combat Microplastic Pollution in Agricultural Ecosystems

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ABSTRACT

Microplastic contamination is a growing concern that affects environment and human health. Agriculture has been identified as a major source of microplastics (MPs) released into the environment, hence mitigating it will require a big paradigm shift across numerous sectors. The most recent research on the origins of MPs in agricultural ecosystems and the dangers they bring is reviewed in this study. Research gaps and future trends are reviewed, along with the regulatory, mitigation, and intervention methods needed to combat plastic pollution of agricultural ecosystems. In conclusion, there is currently a dearth of information regarding the origins and migration routes of MP in agricultural ecosystems, and further study is needed in a variety of farming environments with varying soil and climate conditions.

KEYWORDS: Microplastic Pollution, Agriculture, Mitigation Strategies

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End of life pesticide plastic containers management

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ABSTRACT

Pesticides are widely used as they can reduce crop production losses, improve crop yield quality and increase nutritional value of the resulting food products. Pesticides are typically sold in plastic containers frequently made of HDPE or PET. Twelve and a half (12.5) million tonnes of plastics are used in agriculture sector globally per year. The environmental issue generated by the inadequate management and disposal of empty agrochemical containers (EACs) derived from the agricultural sector has been highlighted by the United Nations Food and Agriculture Organization (FAO). According to EACs only 30% are collected through management schemes. However remain unclear and unsolved what the remain containers ends. Its is well known that plastic containers have been used to store pesticides, herbicides, and fertilizers by the agricultural industry. Once these are used, these containers imply an environmental risk due to their inappropriate disposal in ravines, bodies of water, municipal garbage dumps, roads, or even through incineration. Actions lead to negative ecological impacts, such as water bodies poisoning, visual pollution, and atmospheric pollution. The paper highlight the existing management practices in isolated communities as the revalorization of these containers could offer an opportunity to promote sustainable practices within circular economy framework.

KEYWORDS: end of pesticide containers, agricultural industry, circular economy, hazardous waste

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PLASTICS IN THE ENVIRONMENT

Feeding habits and microplastic ingestion of Bogue in Mediterranean Sea

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ABSTRACT

This study examines the feeding habits of the bogue (*Boops boops*, L.) and the presence of microplastics (MPs) in the gastrointestinal contents in the North Evoikos Gulf, a region characterized by intense anthropogenic and industrial activity. Seasonal sampling of 230 individuals was conducted during 2022 and 2024. The protocol Medsealitter was used to assess MPs presence, abundance, size, type, color. Diet analysis revealed an opportunistic feeding behavior, with Crustacea being the dominant prey (53.6%). Microplastics, detected in 56.1% of the samples (mean: 1.74 MPs/individual), were the main plastic items found (97%). Most of them were fibers, black in color. Polyethylene (36%) and polypropylene (21%) were the most common polymers. No correlation was found between the microplastics number and biological parameters (length, weight, stomach content weight). A low positive correlation was found between the microplastics number and condition factor, which possibly suggests no effect of microplastics on the species.

KEYWORDS: Pollution, Microplastics, Bogue, Feeding, Mediterranean

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Acknowledgements: This research is part of a MSc thesis conducted in the Department of Biology, National and Kapodistrian University of Athens

Microplastics in sandy beaches of Thermaikos Gulf: quantification and spatial distribution

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ABSTRACT

This study looks into microplastic pollution along the coast of the Thermaic Gulf. Samples were collected from eight locations and analyzed for their amount, size, shape, and where they were found. The highest levels appeared in tourist-heavy areas, while fibers were more common in places with fishing activity. Most microplastics were found in the midlittoral zone, likely due to how water moves and deposits them. The results point to tourism as a major source of pollution and highlight the need for regular monitoring and better measures to protect the marine environment.

KEYWORDS: Microplastics, Microplastic pollution, Beach sediments, Thermaic Gulf

PAPER ID: cest2025_00419

POLLUTION CONTROL AND CONTAMINATED SITES

Remediation of Lead-Contaminated Sand through Cerussite Formation and its Effects on Sand Shear Strength Properties

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ABSTRACT

This study addresses the effect of CO₂ synthesised carbonate minerals use in situ to remediate lead (Pb)- contaminated soil and their effect on the soil mechanical properties. A spiked sandy soil sample contaminated with 3,000 ppm of lead nitrate (Pb(NO₃)₂) was subjected to injection of hydroxide (NaOH) solution and CO₂ gas, which resulted in the formation of lead carbonate (PbCO₃) minerals, identified as cerussite by scanning electron microscope (SEM) and X-ray diffraction (XRD) investigations. After 8 hours, more than 99% of the lead was converted to lead carbonate and successfully separated from the soil, showing the high promise of using the proposed in situ synthesis method for lead-contaminated soil remediation. On the other hand, direct shear tests of the soil showed some small reduction in the peak angle of friction at 15% cerussite contents, presumably due to the increased fines content; however the peak angle of friction was still high. This finding is important as depending on the soil use after decontamination, good mechanical properties of the soil may be a primary requirement.

KEYWORDS: Lead contaminated soil, carbonate mineral synthesis, CO₂ sequestration, cerussite, shear strength.

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Acknowledgement

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RECYCLING OF MATERIALS TO NEW PRODUCTS

A novel synergistic bioleaching approach to phosphor powder recycling

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ABSTRACT

Efficient scalable rare earth separation processes are a topic of great importance as technologies such as renewable energy and electrical vehicles begin to take root. To assist in the amelioration of this issue this paper reports a method by which low pH and high pH leaching are used synergistically to separate rare earth elements from phosphor powders.

KEYWORDS: Phosphor Powder, *A. chroococcum*, *At. ferrooxidans*, Yttrium.

PAPER ID: cest2025_00002

Pulp mill sludge-based organomineral fertilizer: performance evaluation on the early growth of *Eucalyptus globulus*

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ABSTRACT

This study aimed to evaluate the performance of an innovative pulp mill sludge-based organomineral fertilizer (OrgM) in comparison with a conventional mineral fertilizer (Min). We also assessed its combination with a controlled-release fertilizer (CRF) and potassium sulfate (K). A greenhouse trial was conducted in 50 L pots, utilizing three fertilization treatments (Min, OrgM, and OrgM+CRF+K), to evaluate their effects on the early growth of *Eucalyptus globulus* and nutrients leaching.

The highest plant growth was obtained with OrgM, compared to mineral fertilization (Min). After five months, total plant biomass was 662.5 g/plant and 439.6 g/plant in the "OrgM" and "Min" treatments, respectively. This trend was consistent across the other growth parameters measured. During the same period, the "Min" treatment caused the greatest loss of nutrients through leaching (5 g N, 2.2 g P, and 3.3 g K/pot), which was significantly higher than that observed in the "OrgM" treatment (0.61 g N, 0.10 g P, and 0.54 g K/pot). The combination of OrgM with CRF and K had no relevant effect. Results show that the nutrients in the pulp mill sludge-based organomineral fertilizers were used more efficiently, resulting in greater growth of *Eucalyptus globulus*.

KEYWORDS: pulp mill sludge, organomineral fertilizer, fertilizer efficiency, nutrients leaching

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Low-value production residues from the cork industry: potential raw materials for the growing-media industry?

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ABSTRACT

The cork industry produces several low-value production residues unsuitable for high-end applications due to properties like high density and mineral contamination. This study explores the potential use of two residues: high-density cork granulates (CG) and cork inner bark (CI) as components in growing-media for soilless culture. Their physical and chemical properties were characterised following European Standards. Both materials showed high porosity and low water retention, making them suitable for improving aeration and drainage in substrates. They also contributed essential nutrients, which may reduce the need for additional fertilisation. These results highlight the potential of these raw materials as sustainable, renewable alternatives in growing-media, supporting circular economy strategies and enhancing resource efficiency.

KEYWORDS: Cork, residues, growing-media, soilless culture.

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RENEWABLE ENERGY SOURCES

A geospatial multi-criteria analysis for wind turbines and photovoltaic modules optimal siting on the island of Kos

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ABSTRACT

The need to increase the share of renewable energy sources (RES) by 2030 raises the issue of determining the optimal sites for various RES units. Especially for wind turbines (WTs), there is a relevant legislative framework that requires the evaluation of distances from buffer zones. Using a combined model of Geographic Information Systems (GIS) and Multi-Criteria Decision Making (MCDM) in the present study, the results identify the optimal sites for both WTs and photovoltaic modules (PVs) on the island of Kos. Criteria are selected, their weights are estimated using the Analytic Hierarchy Process (AHP), buffer zones are extracted and the final results are classified into three zones, based on the legislation criteria, as well as, on the altitudes and on the maximum wind or solar potential. According to the results, Zone C, for the WT scenario, occupies 6 km², while the same area for the PV scenario is 13 km².

KEYWORDS: GIS-MCDM model, AHP method, RES penetration, RES optimal site selection

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SMART CITIES

UCI4SmartCity Project: Urban Cleanliness Index for Smart Cities

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ABSTRACT

Public spaces accumulate residues from natural and human activities, impacting aesthetics and contributing to pollution. Street cleanliness shapes a city's image, requiring significant resources. To improve cleaning efficiency, mechanisms are needed to identify cleanliness factors, support preventive actions, and monitor service quality. UCI4SmartCity provides decision-support tools to Porto Ambiente, the company responsible for solid waste management in Porto, aiming to: (a) develop an Urban Cleanliness Index (UCI) based on public perception; (b) create an Android app for data collection; and (c) identify and quantify waste using machine learning (ML). This novel approach addresses inefficiencies in cleaning, which account for 10–20% of municipal budgets. A new UCI model, reflecting local standards, will assess service performance and guide sweeping schedules. The project uses pattern recognition to characterise areas by litter types. Two methods support UCI data collection: a mobile app for public reporting and image uploads, and ML for waste classification using the collected images. These enable real-time litter detection and improved cleaning response. Expected impacts include improved cleanliness, operational efficiency, and public engagement. UCI4SmartCity complies with data protection laws and promotes transparency. By integrating technology and community participation, it supports sustainable development goals, enhancing Porto's sustainability and quality of life.

KEYWORDS: Data Science; Decision Support Tools; Statistical Analysis; Urban Cleanliness Index.

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SOIL AND GROUNDWATER CONTAMINATION AND REMEDIATION

Can Microalgae Revitalize Phytotoxic Soils?

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ABSTRACT

Microalgae represent a variable group of photoautotrophic microorganisms that include both prokaryotic cyanobacteria and eukaryotic algae. Compared to higher plants, algae have faster growth, higher photosynthetic efficiency and the ability to colonize different ecological niches. The advantage of using microalgae for bioremediation or recultivation compared to higher plants mainly lies in their simple cell structures, easier access to CO₂ and nutrients and ability to grow in extreme environments.

The goal of this study was to design and apply biotechnologies for the revitalization of phytotoxic soils based on the use of cyanobacteria and microscopic algae. Microalgal strains isolated from biocrusts from the Lítov post-mining dump (Northern Czechia), or others coming from algae collections were tested in laboratory experiments for the growth on soils. Their physiological state (photosynthetic activity, cell growth and division), and growth conditions (temperature, light intensity, pH, nutrition) were monitored and optimized. The lab-scale experiments were followed with selected strains (*Nostoc*, *Desmonostoc*, *Trichormus*) in greenhouse experiments on phytotoxic soils from the Lítov Dump by various ways of application. Soil analyses were conducted to evaluate the initial physical, chemical, and biological soil quality. Soil pH was lower than 3, microbial respiration and biomass were low, but not as low as could be expected for toxic substrates. Content of available nutrients, especially that of dissolved nitrogen and phosphorus, was very low. All strains tested in greenhouse experiments grew on the phytotoxic soil. The most successful was *Trichormus* applied with expanded clay.

KEYWORDS: post-mining revitalization, phytotoxic soils, biocrusts, cyanobacteria, algae

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Identification and Quantification of Polycyclic Aromatic Hydrocarbons in Soil from the Vinča Landfill (Serbia)

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ABSTRACT

Vinča landfill, the biggest sanitary landfill in Serbia, causes many environmental implications. The investigation of polycyclic aromatic hydrocarbons (PAHs) is of main importance due to the frequent landfill burning. In this study, eight soil samples (<630µm) from *Vinča* landfill were analysed using gas chromatography coupled with mass spectrometry (GC-MS) to determine the PAH concentrations in the soil. The PAH concentrations varied significantly across the samples, reflecting the differences in their respective environments. The range of PAH concentrations is 3.09E-05–2.15E-02 mg/kg. All 16 PAHs were identified in the samples, although naphthalene, acenaphthene, and fluorene were detected only in trace amounts. The plot of Ant/(Ant + Ph) versus Flu/(Flu + Py) ratios indicated that the PAHs mostly originate from petrogenic sources as well as biomass and coal combustion.

KEYWORDS: landfill, PAH, soil, waste, origin.

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Influence of Bamboo-Derived Biochar on Soil Hydraulic Conductivity and Chloride Transport: Experimental and Numerical Analysis

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ABSTRACT

Soil health plays a crucial role in the viability of agricultural systems, food security and the sustainability of ecosystems. It directly influences crop productivity through its effects on soil structure, nutrient cycling, microbial activity, and water retention. Recent studies have highlighted the potential of biochar as a soil amendment to increase soil health. By improving soil physical and chemical properties, increasing microbial biomass, and promoting carbon sequestration, biochar contributes significantly to the restoration and maintenance of productive soils, thereby supporting resilient agricultural systems. Additionally, biochar plays a significant role in the remediation of contaminated soils and water.

This study examines the impact of biochar application as a soil amendment on key soil properties, including water holding capacity (WHC) and soil hydraulic characteristics such as hydraulic conductivity (k), saturated hydraulic conductivity (K_s), and saturated water content (θ_s). Silica sand was utilized as the test soil, whereas bamboo-derived biochar was employed as the soil amendment. A plexiglass column with a diameter $d = 4.4$ cm was used, corresponding to a cross-sectional area of $A = 15.2$ cm² and a length of $L = 42.5$ cm. Initially, the column was deaired to avoid the presence of trapped air pockets within the column. Then, the sand or sand/biochar mixture was homogeneously injected into the column. Next, water was injected downwards with the use of a dual-action piston pump (Shimadzu model LC-20AD) at a constant flow rate until saturated conditions were reached. At that point, the pressure difference ΔP (Pa) between the injection (upper part) and the ejection (bottom part), estimated by a differential pressure transducer (PX26-005DV (0–5 psi) by Omega Company), reached a steady state. The experiments were carried out at 25 °C. Darcy's law was used to estimate the saturated hydraulic conductivity K_s . The experimental results revealed that the addition of biochar increased the hydraulic conductivity (k) from 4.80 Darcy to 7.22 Darcy, increased the saturated water content from 0.26 to 0.45, and increased the saturated conductivity (K_s) from 0.27 cm/min to 0.44 cm/min.

The experimentally derived data were subsequently used as input parameters in the HYDRUS-1D model to simulate the effects of biochar on the soil water storage capacity and the transport of chloride ions (Cl^-). Numerical modeling of the unsaturated (vadose) zone via HYDRUS-1D allows for the estimation of water balance components, providing a valuable tool for assessing the efficiency of irrigation practices. HYDRUS-1D is widely utilized by researchers and practitioners worldwide to model the response of soil water dynamics to both natural processes and anthropogenic influences. Compared with the base scenario (no biochar), the numerical simulations revealed an increase in the volumetric water content when bamboo biochar (5%) was added, especially for θ values greater than 0.15. The cumulative infiltration also increased throughout the entire simulation period. Additionally, a time delay is observed in the vertical profile of the chloride concentration, which is attributed to the deceleration of the flow movement.

KEYWORDS: Agroecology, amendments, biochar, Sustainable agriculture, soil.

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Acknowledgments

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**RESEARCH
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SOLID WASTE MANAGEMENT

Textile recovery opportunities from the Cyprus military sector

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ABSTRACT

Waste management practices in the military sector must be reconsidered considering the increased demand for sustainable solutions in critical infrastructure. There is a need to propose and adopt Zero Waste to Energy strategy for the Cyprus Ministry of Defence as defence sector face several challenges considering circular economy action plan, SDGs and European Green Deal strategy. The proposed framework covers every stage of the textile lifetime, including design, procurement, maintenance, reuse, and recycling, focusing on the circular economy concepts. The use of cutting-edge technology, like smart materials and thermal disassembly systems, promotes resource efficiency and minimized environmental impact. According to preliminary research, a Zero Waste to Energy facility could greatly reduce textile waste, reduced greenhouse emissions, and recover energy. This study offers a strategic approach that may be applied to other critical infrastructure areas and aids in the creation of sustainable defence logistics.

KEYWORDS: Climate Change, Flood Risk, GSSHA Model

PAPER ID: cest2025_00337

SPATIAL ENVIRONMENTAL PLANNING

Multifunctional Forest Management and Carbon Mapping in Communal Lands: A Sentinel-2 and InVEST-Based Assessment in NW Spain

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ABSTRACT

Agroforestry ecosystems combine diverse land uses, enhancing forest multifunctionality and offering effective strategies to address climate change, fire prevention, and biodiversity conservation. This research aims to promote multifunctional forest management by integrating an agroforestry system in the Communal Forest Lands in Joint Ownership of Baroña (CMVMC Galicia, NW Spain), balancing productive, ecological, and social uses. Land uses and covers for 2024 were classified using satellite imagery and field data, achieving a classification accuracy of 89%. Carbon storage was estimated using the InVEST tool, showing that the Coniferous forest class stores the highest carbon stock, with 98,606 tn. The proposed methodology supports territorial planning and sustainable forest management by enabling the quantification of ecosystem services. These results provide a scientific basis for implementing measures to mitigate climate change impacts and improve environmental governance in communal forest systems.

KEYWORDS: ecosystem services, forest carbon storage, remote sensing, land cover change, multifunctionality

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Multifactor Simulation and Evaluation of Future Land-Use in the Atlánticas Islands (NW Spain) with a Temporal–Spatial Fusion Network (TSFN)

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ABSTRACT

Land cover change (LULC) in the Atlánticas Islands of Galicia (NW Spain) is reshaping biodiversity and local livelihoods. We apply a Temporal Spatial Fusion Network (TSFN) to hindcast 2015–2020 and forecast 2020–2040 land use and cover under 3 policy scenarios: Benchmark (BS), Development Priority (DPS) and Ecological Priority (EPS). TSFN reaches κ 0.99 in BS, κ 0.97 in DPS and κ 0.99 in EPS, outperforming an ANN-CA baseline at κ 0.90. Although the overall mosaic shifts by <5 %, 2 clear trajectories emerge. Cropland, with its food production service, dropped 6 % during 2005–2020 and is set to fall another 14 % by 2040 as scrub expands. Regulating and cultural services also weaken water supply –45 %, waste treatment –43 %, climate regulation –27 %, recreation –40 % and biodiversity protection –38 % in DPS. EPS cushions $\approx$ 25 % of these losses but cannot halt cropland decline. By ingesting near real time multispectral data, TSFN provides detailed multiscenario maps that give park managers a solid basis to balance tourism, resource extraction and conservation in this oceanic reserve.

KEYWORDS: Land use/land cover (LULC) forecasting, Multiscenario modelling, Ecosystem service valuation (ESV), Remote sensing (RS), Spatial planning.

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SUSTAINABILITY AND THE SDGs

Seeds of Change: School Gardens on the Road to Environmental Justice.

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ABSTRACT

This study examines a grassroots intervention at a primary school in Acharnes, Greece, where community stakeholders collaboratively reimagine the schoolyard as a shared green space. Through interviews, group discussions, and children's drawings, the research explores how participatory environmental practices address urban ecological challenges and social sustainability. The study investigates community-driven green space development's potential to enhance environmental consciousness, promote spatial justice, strengthen social networks, and reconnect urban communities with ecological systems. Preliminary findings highlight school gardens as critical urban ecological interventions supporting both environmental regeneration and social cohesion.

KEYWORDS: Community gardens; Sustainability; Collaboration; Green urban spaces; Participatory Urbanism

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SUSTAINABLE PRODUCTION AND MANAGEMENT OF BIOMASS

Circular Economy for Biowaste Exploitation of Famagusta-Larnaka district: The ecoFABULAnds project

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ABSTRACT

The ecoFABULAnds project (Innovating for future-proof agroecological, biodiverse, and sustainably productive landscapes of Europe, under the call “Accelerating farming systems transition» (AGROECOLOGY, Theme 2: Implementing agroecology at the landscape level”) aims to drive transformative change in European agricultural landscapes through agroecological innovation and circular economy principles. Spanning five diverse Living Labs (Germany, Italy, Ireland, Hungary and Cyprus) the initiative supports multi-actor, community-driven efforts for sustainable, inclusive, and resilient agrifood systems. A key focus is placed on rethinking food production and consumption through regionally adapted, bottom-up solutions that stimulate innovation, economic growth and behavioral change in alignment to regional and national agendas.

The Cyprus Living Lab, situated in the Famagusta-Larnaca districts, serves as a model for circular economy approaches in resource-constrained environments. Central to its strategy is the valorization of agricultural and organic waste through the production and mainly application practices of compost and biochar as soil amendments. These bio-based inputs not only improve soil health and fertility but also contribute to carbon sequestration, water retention, and long-term land productivity. Cyprus leads a critical review of local biomass practices, drawing on the island’s rich agroecological traditions to identify and adapt sustainable innovations. Through inclusive stakeholder dialogues and co-creation workshops, the project will propose locally relevant strategies that will integrate waste recovery with soil regeneration. This approach will strengthen the regional circular economy by closing nutrient loops and reducing dependency on synthetic inputs. By advancing practical, scalable solutions that link waste management with agroecological transformation, ecoFABULAnds Cyprus will demonstrate how circular practices can revitalize Mediterranean agricultural systems, enhance food system resilience, and foster environmental stewardship at the landscape level.

KEYWORDS: Agroecology, amendments, biochar, compost, Cattle manure management, Sustainable agriculture

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Acknowledgments

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SUSTAINABLE WATER RESOURCES MANAGEMENT WITH NATURE-BASED SOLUTIONS

Effect of a microbial fuel cell on methane emission from eutrophicated urban lagoons sediment

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ABSTRACT

Lakes and water reservoirs are considered hotspots of GHG emissions, mainly methane with a flux of 91.6 Tg CH₄-C/year. Moreover, several studies have shown that lake eutrophication causes an increase in the amount of organic matter present in both the water column and sediments, increasing CH₄ emissions from freshwater ecosystems to the atmosphere. Therefore, these freshwater ecosystems are an important site for biogeochemical processes that contribute significantly to the global GHG budget. For this reason, it is not only important to limit eutrophication to preserve fragile water supplies, but also to avoid accelerating climate change. The main objective of this research proposal was to evaluate the effect of a microbial fuel cell on the emission of CH₄ from a eutrophicated urban lagoon. This bioelectrochemical system produces electricity through electrons derived from redox reactions catalyzed by bacteria that degrade the organic matter present in sediment, so that under anaerobic-anoxic conditions the organic matter will be degraded by the electrogenic pathway and not by the CH₄ production pathway. To carry out this study, analyses of physicochemical parameters such as COD, N-NH₄⁺, N-NO₃⁻ were performed on the water samples collected. In sediments, in situ parameters such as Oxide Reduction Potential (ORP) (mV), dissolved oxygen (mg/L), pH and organic matter (ignition method) were measured. Regarding the quantification of CH₄ emissions from the systems under study, the static chamber method was used where 10 mL gas samples were taken from the reactors once a day twice a week after start-up and were analyzed by gas chromatograph (AOC 20i and flame ionization detector). Finally, the microbial fuel cell electrical performance was evaluated by measuring the voltage difference between anode and cathode (Ecelda) recorded through an external 100ohm electrical resistance using a multimeter with data acquisition system (Model 2700, Keithley Instruments Inc., Ohio, USA).

KEYWORDS: microbial fuel cell, aquatic ecosystems, methane emission, eutrophication

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Mapping of Shallow Groundwater Resources in Al-Hofuf, Eastern Saudi Arabia, Using Vertical Electrical Sounding for Sustainable Water Management

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ABSTRACT

Sustainable water resource management in arid regions necessitates effective identification and characterization of groundwater aquifers. This study employs the Vertical Electrical Sounding (VES) method to map and assess shallow aquifer systems in the Al-Hofuf area of eastern Saudi Arabia, contributing to nature-based groundwater management strategies. Utilizing 20 VES measurements with the Schlumberger electrode configuration (AB/2 up to 400 m), the research delineates subsurface geoelectric layers and correlates them with aquifer properties. The resistivity values (25–138 $\Omega\cdot\text{m}$) indicate the presence of the Al-Khobar karstified and fractured limestone aquifer at depths ranging from 65 to 138 meters. Derived hydraulic parameters reveal significant groundwater potential, with conductivity (2–35 m/day), transmissivity (1–99 m^2/day), and permeability (3.05×10^{-9} to $1.33 \times 10^{-6} \text{ m}^2$) peaking at VES points with high porosity (up to 0.66). These aquifer zones exhibit enhanced fluid movement and storage capacity, which is critical for maintaining a resilient water supply system. The integration of geoelectrical techniques with groundwater chemistry data illustrates the effectiveness of VES in characterizing aquifers in data-scarce environments. This approach provides a cost-effective, non-invasive, and scalable solution for sustainable groundwater management, aligning with nature-based solutions in arid landscapes.

KEYWORDS: Nature-based solutions, groundwater sustainability, vertical electrical sounding, hydraulic properties, Al-Khobar aquifer, Saudi Arabia.

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Exploring the Efficacy of Slow Sand Filtration for Sustainable Water Purification

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ABSTRACT

Slow sand filtration (SSF) demonstrates adaptability and resilience when applied to variable river water sources, making it a promising potential solution for sustainable water purification. This study investigates SSF's ability to remove *E. coli*, nitrates (NO₃), and phosphates (PO₄) over 12 weeks, with a focus on its performance under fluctuating water quality conditions.

Results reveal progressive improvements in contaminant removal. Notably, SSF maintained consistent performance across varying river samples, showcasing its robustness against changes in turbidity, nutrient concentrations, and organic loads. SSF not only improves microbial water quality but also mitigates nutrient pollution, reducing risks of eutrophication in downstream ecosystems.

KEYWORDS: *E. coli*, Microbial Resilience, Variable Water Quality, Biofilm Development, Nutrient Concentrations, Sustainable Filtration

PAPER ID: cest2025_00167

TRANSPORTATION AND THE ENVIRONMENT

Smart container tracking: A sustainable path for modern port management

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ABSTRACT

The rapid expansion of global trade and the increasing complexity of supply chains have highlighted the necessity for robust ICT solutions in modern logistics. Traditional methods of managing container movements are no longer sufficient to address inefficiencies, delays, and environmental concerns. In this context, ICT-driven systems enhance visibility while providing automated processes and enabling better-informed decision-making. These technologies not only streamline operations but also contribute to sustainability by optimizing resource utilization and reducing emissions. As ports become critical hubs in global commerce, the adoption of ICT solutions is essential to the effort to meet the growing demands for efficiency, transparency, and environmental stewardship. To that end, the ORA digital platform presents a pioneering solution for optimizing container logistics at port terminals by leveraging IoT technology and advanced data analytics. ORA integrates GPS-enabled devices, sensors, and API calls to provide real-time visibility and operational insights, enhancing environmental and logistical performance. ORA's interactive dashboard allows stakeholders to visualize container movements and analyze operational statistics. This data-driven approach reduces operational inefficiencies and minimizes the environmental impact of container logistics. Through combining cutting-edge IoT infrastructure with robust data visualization tools, ORA offers a transformative framework for modernizing port operations and contributing to sustainable trade practices.

KEYWORDS: Smart Container, IoT, Operations Optimization, Data-driven Decision-making, Port Management.

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Acknowledgements

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Environmental protection: do alternative cryogenic fuels for Marine Transportation offer a local solution?

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ABSTRACT

The need for replacing fossil fuels that have been at the heart of mobility all of the 20th and at the dawn of the 21st century is becoming urgent owing to the constantly increasing climate change. This will be done through the gradual transition to the clean and renewable sources of energy that already climb the hierarchy of motion options; to this end, visions such as the "Green Deal" and the "FitFor55" package (the EU's plan for the green transition) are conceived not only to support the European energetic equilibrium, but also cope for mishaps such as the pandemics, the regional wars and the altering global financial situation. It became obvious that issues such as energy security, the cost of energy for the citizen and business, and the need for a strong industrial and transportation base, had been sidelined from the political agenda or, even, taken for granted in the recent years.

Research shows that the use of both H₂, NH₃, stored in cryogenic conditions, can decarbonize the transport industry, at least locally (e.g. ports). Though, an additional problem in the adoption of the new fuels is the incomplete studying of their hazardous properties and namely their fire and explosion potential both during their production and storage, but also in their transportation modes. Big fires of fuel oil, LPG and LNG have been already studied; this is not the case for the massive use of hydrogen or ammonia for transportation fuel, however.

NH₃ has been used as fertilizer for decades, with accidents reported leading to severe injuries and deaths, due to its flammability and/or toxicity; on the other hand, H₂ is highly explosive in certain concentrations. Large-scale implementation in the maritime environment raises additional concerns on effects of spills on and into water.

The feasibility of emerging NH₃/H₂ technologies must be checked through the production of experimental data and models for NH₃/H₂ releases on and into water and the development or risk trends and input to standardization.

Indeed, current research focuses on the implementation of new value chains for ammonia as a zero-emission fuel and energy carrier, by improving safety systems design and procedures for the control and management especially of refrigerated or semi-refrigerated liquid ammonia spills on and into water. The goal is to promote the implementation of ammonia on the waterways by demonstrating the effectiveness of the improved handling systems.

The "green" production and the renewable character of these fuels themselves remain also open questions, especially when referring to indices like the "well-to-wake" (WtW) and the "tank-to-wake" (TtW) emissions. IMO can regulate the use of fuels on the basis of their WtW GHG footprint. This would not constitute a direct regulation of fuel suppliers, but would create demand for lower GHG footprint fuels, just like the sulphur regulation created demand for low sulphur fuels.

KEYWORDS: cryogenic, marine fuels, H₂, NH₃, well-to-wake

PAPER ID: cest2025_00170

WASTE-TO ENERGY

Waste to energy: waste incinerated and CO₂ behind in the case of WTE plant in Lithuania

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ABSTRACT

Incineration of municipal waste for electricity and heat recovery allows reducing the amount of waste in landfills, however the question arises whether this energy recovery method is superior in terms of CO₂ emissions compared to traditional energy production methods. Though there are examples of such comparisons in the other countries, Lithuanian case is underestimated. Therefore, this study aims to analyse the amount and structure of waste incinerated in one of the WTE plants in Lithuania as well as and related CO₂ emissions, compared to the use of traditional fuel sources for energy production and landfilling. The study employs data from WTE plant on waste volumes and structure as well as national emission factors for different types of energy and fuels. Selected WTE plant incinerated 256 thousand tons of waste annually during 2018-2024 period. Majority of waste incinerated is local municipal waste. Depending on the waste volumes and structure of waste incinerated WTE plant produced some 2600 – 2860 TJ of energy. Correspondingly, CO₂ emissions fluctuate around 291 CO₂t/PJ. However, comparing emissions per energy unit only in the energy production stage, WTE appears to be not the most efficient CO₂ approach to produce energy. Hence, the whole life approach is needed to make comprehensive comparison between different fuel types regarding CO₂ emissions as well other benefits should be considered.

KEYWORDS: Waste to energy, municipal waste, CO₂ emissions, WTE plant

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Impact of Biochar Amendment on Pilot-Scale Anaerobic Digestion of Agro-Industrial Waste with Digestate Recirculation.

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ABSTRACT

This study evaluated the impact of biochar amendment on the performance of a pilot-scale anaerobic digester treating a mixture of olive pomace mill wastewater, cheese whey, and chicken manure under digestate recirculation. The 180 L mesophilic reactor operated for 160 days at a hydraulic retention time of 20 days, with biochar added to the feedstock at 10 g L⁻¹. Process monitoring included measurements of biogas production rate, methane content, and key physicochemical parameters (pH, TS, VS, sCOD), while microbial community dynamics were assessed via 16S rRNA amplicon sequencing and real-time PCR. Biochar addition led to a modest reduction in biogas production rate (from 290.7 ± 17.5 L d⁻¹ to 273.8 ± 14.3 L d⁻¹), but enhanced methane content from 70 % to 73 %. Notably, the relative abundances of *Methanothrix* and *Methanospirillum* increased substantially (from 47.1 % to 74.1 % and 2.2 % to 5.6 %, respectively), indicating strengthened direct interspecies electron transfer pathways. These findings demonstrate that biochar can selectively enrich syntrophic methanogenic consortia and improve methane yield, offering a promising strategy for optimizing pilot-scale anaerobic digestion of agro-industrial residues.

KEYWORDS: biochar, anaerobic digestion, DIET, methane enhancement

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WASTEWATER TREATMENT

A Comparative Study of ED and BPED Technologies for Ammonia Recovery from Wastewater.

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ABSTRACT

Ammonia is a common pollutant in wastewater, and its removal is essential to prevent environmental issues such as odors and eutrophication, which can harm aquatic ecosystems and human health. While traditional treatment methods are energy-intensive and costly, ammonia has garnered attention as a carbon-free hydrogen source in the context of the global shift toward carbon neutrality. Wastewater, particularly supernatant from anaerobic digesters and leachate from sludge dewatering, often contains high ammonia concentrations, offering a potential feedstock for hydrogen production. This study compares electrodialysis (ED) and bipolar membrane electrodialysis (BPED) systems for ammonia recovery, aiming to obtain a sustainable hydrogen source from environmental public infrastructures. Energy consumption, current efficiency, pH changes, and ammonia recovery rates were thoroughly evaluated for both processes. Results show that BPED leads to higher pH and ammonium hydroxide accumulation, making it suitable for processes like membrane distillation. However, BPED exhibited higher energy consumption and lower current efficiency compared to ED. The findings suggest that both systems have distinct advantages and can contribute to ammonia recovery in wastewater treatment, supporting the development of sustainable ammonia recovery strategies for hydrogen production.

KEYWORDS: Ammonia, Wastewater, Net-Zero, ED, BPED

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Assessment of Tannery-Derived Pollution in the Sinos River Basin, Brazil

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ABSTRACT

The leather industry is water-intensive and generates highly polluted wastewater. Brazil, with the world's largest commercial cattle herd, is a leading leather producer. The state of Rio Grande do Sul holds a prominent position in national exports, with a high concentration of tanneries in the Sinos River Basin. Thus, this study aimed to assess tannery wastewater treatment practices in the basin, quantify pollution loads, and evaluate their impact on surface water quality. Data from the State Environmental Agency were collected, including treatment technologies, discharge volumes, guideline exceedances, and pollutant concentrations. Frequent violations involved thermotolerant coliforms, nitrogen, total chromium, chemical oxygen demand (COD), oils and greases, and suspended solids. Pollution loads ranged from 27.2 kg/year (total chromium) to 94.5 t/year (COD), indicating a contribution from tanneries to basin contamination.

KEYWORDS: Tannery; Wastewater; Sinos River Basin; Surface water pollution.

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Municipal Biosolids in Agriculture: A Physicochemical and Ecotoxicological Investigation

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ABSTRACT

The disposal of sludge from wastewater treatment plants (WWTPs) is increasingly constrained by stringent landfill regulations. Biosolids, the treated residuals from WWTPs, offer a sustainable alternative for agricultural applications when their quality meets safety standards. This study evaluates the physicochemical properties and ecotoxicological effects of biosolids from three WWTPs in Northern Greece. Metal concentrations and toxicity to *Daphnia magna* neonates were assessed using the EN 12457-2 leaching test. The results showed low metal concentrations, below regulatory limits, but revealed mild toxicity to *D. magna*, regardless of biosolid origin or season. These findings highlight the need for further improvements in biosolid treatment for safe agricultural use.

KEYWORDS: Biosolids, metal leaching, soil amendments

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Balancing Oxygen and Microbial Activity: The Role of Aeration in Enhancing Deammonification Efficiency

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ABSTRACT

The deammonification process is an energy-efficient solution for nitrogen removal in wastewater treatment, relying on the synergy between ammonia-oxidizing bacteria (AOB) and anammox bacteria while suppressing nitrite-oxidizing bacteria (NOB). This study aimed to enhance the process by identifying aeration strategies that suppress NOB while maintaining anammox bacteria's high activity.

The research was carried out across four experimental series. These series varied in aeration strategies, including continuous and intermittent aeration, with different R ratios and dissolved oxygen (DO) concentrations. Following the implementation of these aeration strategies in the reactor, batch tests, and next-generation sequencing were conducted.

The results demonstrated that switching from continuous aeration to intermittent aeration ($R=1/2$, $DO=1.5$ mg O_2/L) significantly suppressed NOB activity from 17.6 mg N/gVSS·h to 8.2 mg N/gVSS·h. Simultaneously, these conditions maintained high anammox activity (52.1 mg N/gVSS·h), highlighting the process's robustness under low oxygen concentrations. Increasing DO concentration to 2.5 mg O_2/L caused an increase in AOB (57.8 mg N/gVSS·h) and anammox (65.2 mg N/gVSS·h) activity together with a decrease in NOB activity (5.9 mg N/gVSS·h). However, further decreases in the duration of aerated phases ($R=1$) led to a decline in anammox activity. Under continuous aeration, *Nitrospira* abundance was the highest, correlating with elevated NOB activity. The highest abundance of *Nitrosomonas* was observed with the intermittent aeration strategy ($R=1/2$, $DO=2.5$ mg O_2/L), aligning with higher AOB activity. Interestingly, the abundance of anammox bacteria (*Candidatus Brocadia*) remained comparable across all experimental stages, despite notable differences in their activity levels.

This discrepancy suggests that microbial abundance alone may not fully reflect metabolic activity, emphasizing the importance of combining NGS with batch tests for a comprehensive evaluation of microbial processes. These findings also highlight the critical role of aeration strategy and DO control in balancing microbial communities and optimizing deammonification performance.

KEYWORDS

batch test, NGS, deammonification.

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Preliminary Research on the Removal of Organic Compounds from Leather Tanning Wastewater

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ABSTRACT

Leather tanning consists of many processes, most of which are carried out using water, in which variety of chemical compounds, mineral tannins (including chromium (III) salts) and vegetable tannins, dyes etc. are added. In combination with organic matter of animal origin it results in wastewater that is very difficult to treat. Coagulation and advanced oxidation processes are commonly used methods for the treatment of tannery wastewater.

The aim of this study was to pretreat tannery wastewater by removing organic compounds determined by COD. For their treatment, a coagulation process using iron (FeCl_3) and aluminium ($\text{Al}_2(\text{OH})_5\text{Cl}$) coagulants and advanced oxidation processes (AOPs) used of Fenton reagents were applied. Studies using the Fenton process were conducted applying different doses of iron (VI) sulphate (II) FeSO_4 with a constant hydrogen peroxide H_2O_2 dose of 3000 mg/L. The type and the dose of the coagulant were the basic parameters of the coagulation process subject to optimization. Doses in the range of 1.0 - 6.5 mL/L were adopted. An even better reduction of organic compounds was obtained in a hybrid system: Fenton reaction and coagulation. In that case, the COD value in the pretreated wastewater was 4010 mg/L.

KEYWORDS: leather tanning, industrial wastewater, coagulation, AOP

PAPER ID: cest2025_00085

Comparison of Ceftriaxone, Ofloxacin, and Metformin Adsorption onto Activated Carbon from Aqueous Solutions

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ABSTRACT

Pharmaceutical compounds have been widely identified as organic pollutants in wastewater with adverse effects on the environment. This paper focuses on three active substances: ceftriaxone, ofloxacin, and metformin. The main reason for the interest is their ability to be excreted 80-90% unmetabolized, contributing to their high concentration in wastewater. One of the most frequently used removal methods is adsorption, while activated carbon is an etalon for adoptive materials. The batch experiments were performed with an initial concentration of 50 mg/L, and the concentrations of ceftriaxone, ofloxacin, and metformin were determined using spectrophotometric methods. Ceftriaxone and ofloxacin exhibited over 90% removal efficiency at neutral pH, while metformin required an acidic environment for the adsorption to take place. This study aims to compare the distinct way in which the substances respond within the adsorption onto activated carbon, including the influence of adsorbent mass, initial concentration and potential mechanism for every situation. The toxic effect generated of pharmaceutical compounds makes it primary to investigate the optimal parameters for their removal.

KEYWORDS: Activated carbon, adsorption, ceftriaxone, pharmaceutical compounds

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Simple synthesis route of oxides mixt – CNF composites used as adsorbent for pharmaceutical pollutants removal

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ABSTRACT

It is commonly known that pharmaceutical compounds are organic pollutants found in wastewater that have a negative impact. This paper is focused on removal ceftriaxone using copper-zinc oxide composites, obtained by a facile chemical coprecipitation method. Copper oxides, particularly CuO (copper (II) oxide) and Cu₂O (copper (I) oxide), have been studied for their adsorption properties in various applications, including environmental remediation, catalysis, and gas sensing. On the other hand, mixt oxides copper-zinc have excellent properties for removal dyes, that can be extended on different pharmaceutically compounds. The adsorption process has gained more popularity in wastewater treatment because the process is non-toxic, cheap and highly efficient. In the present study, carbon nanofiber materials (CNF) were decorated with copper oxide nanoparticles. The obtained nanomaterials were used as adsorbents for ceftriaxone (CF) at a concentration of 10 mg/L, achieving a removal rate of 54%. CuO-CNF samples (uncalcined and after calcination) were characterized by characteristics were examined using XRD, SEM, EDS, SAED, and FTIR methods. The CF adsorption process on the synthesized composite samples was accurately described by the Freundlich isotherm and second-order kinetic models as well as the Langmuir-Hinshelwood (L-H) isotherm model equation. The synthesized nanoparticles possess excellent CF adsorption capacity and therefore these nanoparticles can be used as cheap, promising alternatives to traditional wastewater treatment techniques.

KEYWORDS: Adsorption, Nanoparticles, Pharmaceutical compounds, Wastewater treatment

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SEM-EDX characterization of iron-modified plum stones biochar

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ABSTRACT

It has been shown that biochar, an inexpensive and eco-friendly material made by pyrolyzing biomass, has the ability to eliminate pollutants from water and wastewater. The efficacy of raw biochar as adsorbent and catalyst in advanced oxidation processes is limited, but it is significantly increased by modification. Various physical and chemical methods employed before, during, or after biochar production is among the many that have been investigated. By adding iron compounds, biochar's surface area is increased and new contact points are formed, improving its capacity for adsorption. Iron-biochars are valuable due to their exceptional ability to remove pollutants. Iron functionalized biochar prepared by post-pyrolysis surface Fe modification of plum stones. In this study, SEM-EDX analysis was performed to determine the surface morphology and elemental composition of plum stones biochar and FeCl₃ impregnated biochar. After coprecipitation with Fe salt, Fe-BPS showed irregular structure with improved porosity. Content of iron significantly increased in Fe-BPS. Iron-based biochar's adsorption ability and catalytic activity work in concert to remove pollutants from wastewater via two mechanisms. Therefore, iron is added to the plum stone biochar to increase its adsorption capacity and reactivity, which makes it possible to remove a variety of organic and inorganic pollutants efficiently

KEYWORDS: SEM-EDX, plum stones biochar, iron-modified plum stones biochar

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Membrane-Based Treatment of Hydrothermal Carbonization Effluent from Municipal Biowaste

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ABSTRACT

The treatment of hydrothermal carbonization (HTC) liquor derived from municipal solid waste (MSW) remains a key challenge due to its high organic load. This work compares, for the first time, the direct application of polymeric microfiltration (MF) and ultrafiltration (UF) with a multi-stage cascade configuration (MF → UF → nanofiltration, NF) for MSW depuration. Single-stage UF proved effective for turbidity removal (>97%) but achieved limited reductions in organic content. By contrast, the cascade system significantly enhanced performance, with COD, TOC, and TN removals reaching 89%, and >93% when optimized.

KEYWORDS: HTC, Anaerobic digestion, Digestate, Ultrafiltration, Nanofiltration

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Acknowledgements

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Microalgae cultivation in ammonia rich digestate subjected to different pretreatment stages

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ABSTRACT

Anaerobic digestion has been beneficial for the energy valorization of a broad variety of residues. However, the effluent from the digesters, the digestate, usually has high ammonia nitrogen, requiring additional measures for its management. Photosynthetic microalgae assimilate nitrogen, and can be used for the treatment of digestate, while grown biomass can be valorized in the formation of added value products. The aim of this work was the examination of the efficiency of *Chlorella sorokiniana* for the treatment of various digestate samples subjected to subsequent treatment stages. Results showed that *Chlorella* can efficiently be used in digestate, although high ammonia content may inhibit growth. Cells composition depends on operation conditions as well as on substrate properties.

KEYWORDS: microalgae; digestate; nitrogen recovery

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Nanocomposite Polymeric Membranes with Bio-Graphene and Enzymes for the Sustainable Mitigation of Biofouling

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ABSTRACT

In this study, nanocomposite polyethersulfone (PES) membranes were engineered to reduce biofouling during wastewater treatment. Green bio-graphene (bG) was synthesized via liquid-phase exfoliation of graphite in the presence of chitosan, enhancing its antimicrobial properties. Three antimicrobial agents—bG, α -amylase, and lysozyme—were incorporated into the PES casting solution, and the process was optimized using the phase inversion method to maximize antimicrobial efficacy. The biocatalytic performance of the optimized membranes was then evaluated. Enzyme reusability tests showed that α -amylase retained approximately 42% of its activity after eight cycles, while lysozyme activity significantly declined. Storage stability tests revealed that the membranes maintained over 60% of their catalytic activity after three weeks and exhibited strong antibacterial activity for up to two weeks. The biocatalytic nanocomposite membranes exhibited higher anti-biofouling and antimicrobial performance than the neat PES membrane, ensuring stable performance in challenging wastewater environments.

KEYWORDS: Membranes, biofouling, wastewater, nanocomposite membranes

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Valorisation of sewage sludge extracts: a sustainable approach for nutrient removal and algal cultivation

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ABSTRACT

The increasing generation of sewage sludge from urban wastewater treatment plants poses both environmental challenges and opportunities for resource recovery. This study explores the valorization of secondary sludge as a nutrient source for the cultivation of the microalgae *Chlorella sorokiniana*, with the aim of recovering nitrogen, phosphorus, and proteins. A combined alkaline and ultrasonic pretreatment was applied to enhance the solubilization of organic matter and intracellular compounds. The treated sludge extract was subsequently used as a cultivation medium under mixotrophic conditions. Growth performance and nutrient removal efficiency were assessed through pigment analysis and monitoring of key parameters such as ammonium, nitrate, phosphate, and chemical oxygen demand. The findings support the potential of integrated sludge pretreatment and microalgal cultivation as a sustainable strategy within the framework of circular bioeconomy, offering dual benefits of waste reduction and biomass production with added value.

KEYWORDS: sewage sludge, microalgae cultivation, *Chlorella sorokiniana*, pretreatment, circular bioeconomy

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WATER AND WASTEWATER REUSE

Wastewater Reclamation – opportunities and challenges

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ABSTRACT

Water scarcity poses a growing global challenge, intensified by climate change, population growth, and rising water demand. Municipal wastewater reclamation offers a sustainable solution, transforming waste into a resource. This study, conducted within the ReNutriWater project, evaluates the potential of reclaimed water to supplement fertilizer nutrient demand, focusing on nitrogen (N), phosphorus (P), potassium (K), and total organic carbon (TOC). Treated wastewater from a large municipal WWTP was disinfected using three methods: chlorination, ozonation, and UV irradiation. Results indicate that ozonation provides the most effective microbial disinfection but reduces nutrient concentrations more than chlorination or UV. Nutrient retention was highest following UV and chlorination, with potassium showing the greatest potential for meeting plant nutrient requirements. The study underscores that nutrient levels in reclaimed water depend on both the disinfection method and the operational parameters of the treatment plant. Thus, optimized WWTP control strategies can enhance nutrient recovery and support water reuse. This work highlights key challenges and opportunities for integrated water and nutrient recycling systems.

KEYWORDS: water scarcity, municipal wastewater, water recovery

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WATER AND WASTEWATER TREATMENT AND REUSE

CuO nanoparticles as modifiers for membranes for anaerobic membrane digestion

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ABSTRACT

Membrane separation technologies offer a promising solution for anaerobic digestate treatment but are limited by membrane fouling and reduced flux. This study investigated the use of CuO nanoparticles (NPs) on ultrafiltration membranes to mitigate fouling and improve separation performance during digestate treatment. CuO NPs were synthesized via a sonochemical process and deposited onto NADIR® UP150 T membranes. The modified and unmodified membranes were evaluated using anaerobic sludge from a pilot-scale anaerobic digester under two operational modes: continuous and intermittent with reverse flow cleaning. Results showed that although modified membranes had slightly lower initial permeate flow rates, they exhibited greater stability over time and reduced fouling rates compared to the unmodified membrane. Under intermittent cleaning, the unmodified membrane displayed the highest cleaning impact, with a 100% increase in permeate flow post-cleaning, versus 66.7–88.9% for coated samples. The findings suggest that CuO-modified membranes can provide a trade-off between fouling resistance and flux performance, particularly in systems with limited cleaning capacity.

KEYWORDS: membranes, anaerobic digestion, digestate treatment, CuO nanoparticles

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A Novel Automated Water Pretreatment System for Microbial Preconcentration and DNA Extraction Using Monolithic Adsorption Filtration (MAF)

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ABSTRACT

Nowadays, there is an urgent need for rapid and efficient microbial monitoring in water resources. This need has become especially critical due to new EU directives mandating zero pathogen presence in drinking and reuse water. This work introduces an innovative, automated pretreatment system that integrates high efficiency preconcentration with direct DNA extraction of pathogens, utilizing Monolithic Adsorption Filtration (MAF) technology. The system demonstrates strong potential for in-line deployment within water reuse and safety management plans. This paper outlines the core methodology and presents key performance metrics validating its potential applicability in real-world scenarios.

KEYWORDS: DNA extraction, Monolithic Adsorption Filtration (MAF), Pathogen Preconcentration, Water Monitoring

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WATER POLICY, MANAGEMENT AND SOCIETY

CYANOACTION – COST Action CA23160, Effective Lake management: reducing cyanobacteria by actions in the catchment

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ABSTRACT

Increasing occurrence of toxic cyanobacterial blooms globally as a consequence of anthropogenic activities in freshwater threatens not only aquatic balance but also water security and quality. Moreover, the blooms cause significant economic losses to the water, health, tourism, and fishing industries. The implementation of thorough monitoring strategies for cyanobacteria, along with the evaluation of the risks of bloom incidents, and a plan for prevention and control measures, have become a necessity. With an array of in-lake control methods available, but little guidance on their efficiency makes it difficult to choose. Long term prevention through decreasing nutrient input from the catchment is crucial in reducing blooms and would be possible by the transition towards more sustainable agricultural practices, but it requires implementation strategies.

The COST action, CYANOACTION, started in the autumn of 2024, aims to increase and broaden capabilities throughout Europe for effective and sustainable management of water resources using a catchment-wide approach. To achieve this, CYANOACTION seeks to establish a unique network of experts, end users, and stakeholders. Gathering and distributing information on early warning detection methods and experience in the effectiveness of both long and short-term control methods will underpin Decision Support Tools for water managers and authorities. These tools will ensure the selection of appropriate methods tailored to specific water bodies. The overarching goal is to increase the mutual exchange between scientific knowledge and management practices in order to decrease cyanobacterial blooms while considering the diverse characteristics of water bodies, their catchment, and the regulatory frameworks across Europe.

KEYWORDS: cyanobacterial blooms, control methods, monitoring, prevention.

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WATER TREATMENT

Adsorption of Cd²⁺ Using Brick-Sludge Composite: A Circular Economy Approach

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ABSTRACT

Cadmium (Cd), a highly toxic element, often contaminates drinking water through Cd²⁺ impurities in galvanized pipelines and cadmium-based solders. This study presents a sludge-brick composite for Cd²⁺ decontamination, aligning with circular economy principles. Using Response Surface Methodology (RSM), key parameters such as pH, mixing time, and sludge proportion (V/V) were optimized, with adsorption capacity (q_e) as the response variable. The q_e was evaluated by testing 0.1 g of the material in a 10-cc water sample at pH 7 over 1 hour. 50 g of sludge was dispersed in 250 cc of deionized water using ultrasound for 20 minutes. The prepared solution was then combined with an additional 250 cc of deionized water and stirred at 70°C for 2 hours at a speed of 300 rpm. Subsequently, sludge percentage, the solution's pH and mixing time with 1 g of brick powder were adjusted based on the RSM pattern. The results of the RSM modeling indicated that a quadratic model with an R² value of 0.8 and a predicted R² of 0.7 provided a reliable framework for response optimization. ANOVA analysis revealed that sludge percentage had the greatest impact on adsorption efficiency, with an F-value of 5.17. pH was identified as the second most influential factor, followed by the mixing time of sludge and brick powder. The optimization analysis, achieving a desirability of 1, revealed that the highest Cd²⁺ adsorption performance onto the composite occurs under the following conditions: pH 7, a sludge-brick mixing time of 10 hours, and a sludge proportion of 48% during adsorbent synthesis.

KEYWORDS: *Design of Experiments; Heavy Metal Ions; Construction and Demolition Waste; Characterization; Synthesis; Mathematical Modeling.*

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Prototype for Removal of Residual Chlorine, Hardness and Manganese from Drinking Water

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ABSTRACT

Residual chlorine, while crucial for water disinfection, can lead to skin irritation and hair degradation over time. Additionally, water hardness exacerbates dermatological conditions such as atopic dermatitis and hair breakage, and elevated manganese concentrations can be toxic, negatively impacting neurological health. This study aimed to develop a domestic-use prototype designed to improve water quality. The methodology involved constructing the prototype using ion exchange resins and granular activated carbon and evaluating its effectiveness in removing residual chlorine, hardness, and manganese from synthetic solutions. The adsorption capacity of the filtration bed was assessed through the breakthrough curve. The prototype reduced 99±0.02% residual chlorine, 97±0.00% hardness, and 98.5±1.00% manganese in synthetic solutions. The average breakthrough time was 1,020 minutes, while the average saturation time was 1,440 minutes, with a solution flow rate of 136.03 cm³.min⁻¹. The results demonstrate the prototype's potential for improving specific quality parameters in potable water.

KEYWORDS: Drinking water; Residual chlorine; Hardness; Activated carbon; Ion exchange resin.

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