



Better Water for All Network Plus

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ABSTRACT BOOK



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Oral Presentation Abstracts

ID: OP01

Title:
Micropollutant removal in an intensified nature-based treatment wetland receiving raw municipal wastewater
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Keywords:
METland; Micropollutants, Nature-based solutions; Pharmaceutical class
Aim of the research:
This study aims to develop and evaluate innovative nature-based solutions for the removal of organic micropollutants from raw domestic wastewater. Advanced electroactive media were integrated to enable in situ microbial electrochemical intensification, improving the treatment of raw municipal wastewater in constructed wetlands.
Short summary
Micropollutants (MPs), including pharmaceuticals, antibiotics and repellent chemicals, are increasingly detected in municipal wastewater and pose substantial environmental and public health risks. These contaminants persist through conventional treatment systems, and the revised Urban Wastewater Treatment Directive (EU 2024/3019) now requires quaternary treatment for micropollutant removal in larger plants. Microbial Electrochemical Technologies Intensified Treatment Wetlands (METland) offer a low-energy alternative, but their performance across pharmaceutical classes under realistic municipal loading remains poorly defined. This study evaluated the removal performance of emerging micropollutants and the underlying operational drivers in seven pilot-scale constructed wetlands operated under different combinations of hydraulic loading rate, media characteristics and resting regime. Fig. 1 shows that high removal efficiencies were achieved for stimulants (98.1–99.0%) and antibiotics (36.8–96.5%), while anticonvulsants and

sartans showed low or negative removal efficiencies (−79.1 to +81.0%). Antidepressants, β -blockers and non-steroidal anti-inflammatory drugs displayed intermediate performance (15.3–96.5%), with removal declining as hydraulic loading increased. The median removal of biodegradable classes fell from 87.0% at 0.05 m/day to 10.0% under continuous loading, indicating a strong dependence on hydraulic contact time and biofilm oxygen supply. At matched hydraulic loading, the METland system outperformed the gravel system across most compound classes, particularly for antidepressants, sartans and β -blockers, indicating that the electroconductive medium favours biotransformation-driven removal. The gravel system, however, accumulated higher sediment concentrations of cationic β -blockers, antihistamines and antidepressants, reflecting a cation-exchange retention pathway. Continuous loading suppressed removal across all classes, indicating the necessity of resting periods for sustained treatment performance. This study highlights the potential of constructed wetlands as nature-based systems for emerging micropollutant control and demonstrates the importance of optimising operational conditions in METland systems for enhanced contaminant removal.

ID: OP02

Title:
Effects of spatial extent and timescale of prescribed moorland burning on headstream water chemistry parameters
Author name(s):
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Institute of Social Sciences, Geography and Environment Segment; Sheffield Hallam University
Keywords:
Cumulative burn proportion, drinking water catchment, headstream water chemistry, prescribed burning legacy effects
Aim of the research:
The main aim of this study is to assess the spatial extent (proportion of catchment area burnt) and timescale of upland prescribed moorland burning and its effect on headwater stream chemistry parameters across four sub-catchments within the Peak District in Sheffield that are sources of drinking water.
Short summary:
Upland water catchments supply drinking water to millions of residents across the UK, yet the frequency of moorland (prescribed) burning is raising

water treatment costs and threatening headwater streams through the discharge of pollutants. Although the existing body of literature has explored the effects of prescribed burning/fires on peatland hydrology and the exportation of dissolved organic carbon (DOC), there is still a clear paucity of information on how the spatial extent and temporal scale of burning affects the headwater stream physico-chemical parameters within the catchments that supply drinking water to residents. An 8yr (2015 -2024) cumulative burn proportion derived from the Defra Moorland Change dataset will be quantified for each of the sub-catchments (Strines, Rivelin, Ewden Beck and Agden) through multi-temporal GIS (Geographic Information System) analysis. During June and July 2026, respectively, in-situ measurements of pH, electrical conductivity, temperature, turbidity and nitrates, as well as laboratory analysis of water colour, iron, aluminium, and phosphate, were conducted in triplicate at thirteen sampling locations across four sub-catchments. Spearman rank correlation will be used to test the dose-response relationship between the cumulative burn proportion for each of the sub-catchments and each of the water chemistry parameters. Preliminary results indicate that water sub-catchments having a higher proportion of catchment area burned across the 8yr period are anticipated to show elevated levels of water colour (exceeding 20 Hazen unit Drinking Water Inspectorate threshold) from the upstream and downstream sections, during summer baseflow conditions. These findings provide quantitative and spatially explicit evidence base linking proportion of catchment area to headstream water chemistry parameters in Peak District drinking water supply catchments, directly informing water companies such as Yorkshire Water's catchment management priorities with a potential for water treatment cost savings, if the burning and water colour concentrations can be identified for targeted interventions.

ID: OP03

Title:
Biocoatings for Biological Nitrogen Removal from Wastewater
Author name(s):
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Affiliation(s):
University of Surrey
Keywords:
Nitrogen Removal, Biofilms, Coatings, Denitrification
Aim of the research:
To create a synthetic, polymeric biofilm (called a biocoating), which can effectively remove nitrogen from wastewater as an alternative to traditional biological methods, and to optimise for high cell viability and denitrification

activity within biocoatings.

Short summary:

Nitrogen pollution poses a major threat to both human health and the environment. In wastewater treatment, nitrogen is removed by biofilms containing denitrifying bacteria that convert nitrite and nitrate ions to nitrogen gas. However, biofilms contain low numbers of useful bacteria and can be highly unreliable (Saini *et al.*, 2023).

Synthetic biofilms (called biocoatings), which are made using a water-based polymer, could provide a solution to these problems. Living bacteria are mixed with the water-based polymer, cast as a coating, and dried. Within the biocoating, bacteria are entrapped and cell growth is limited, which can increase metabolic activity (Flickinger *et al.*, 2017). Making viable biocoatings has two main challenges: 1) maintaining a porous and permeable microstructure to allow transport of metabolites; and 2) reducing osmotic stress on the entrapped bacteria, especially when making the coating. We have developed a novel method of partial-coagulation and wet-sintering to make biocoatings that avoids these issues. Firstly, an aqueous suspension of *Pseudomonas putida* (a model denitrifier) and colloidal polymer is coagulated with salt to form a gel coating. Then the gel coating is heated in liquid to solidify (or sinter) the coating without drying.

We have found that sintering in media, instead of water, increases the *P. putida* viability in the biocoating. The cell number in the coatings (per unit area) is raised by increasing the salt concentration. Optimising biocoatings for cell viability (using ATP assays) significantly increases their nitrite removal rate. Cells in optimised coatings have an average nitrite removal rate of 6×10^{-5} mg/L/day/CFU after 2 days, compared to sub-optimal coatings, which have a lower rate of 7×10^{-6} mg/L/day/CFU, and cells in suspension 4×10^{-5} mg/L/day/CFU. Our optimisation of biocoating formation is essential for upscaling and the application of biocoatings to the wastewater treatment industry.

ID: OP04

Title:

Applied smouldering for advancing a safe and circular economy through PFAS destruction and phosphorus recovery from UK sewage sludge

Author name(s):

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Keywords:

Smouldering combustion; Thermal treatment; Resource recovery; Wastewater treatment sludge

Aim of the research:

This research aims to demonstrate how smouldering can both (i) destroy PFAS and (ii) recover phosphorus from UK-sourced sewage sludge. A series of experiments were performed to track (i) PFAS fate in the emissions and ash and (ii) phosphorus fate in the ash and subsequent recovery potential.

Short summary:

Wastewater treatment (WWT) operations are essential in minimising water pollution – but they are notoriously energy intensive. At the same time, many valuable resources are not recovered during traditional WWT. The solid by-product from WWT, sewage sludge, concentrates many potentially valuable resources, e.g., phosphorus. Phosphorus recovery can offset the need for mineral phosphorus sources to improve fertiliser production sustainability and supply chain security. However, pollutants within sewage sludge must also be managed for safe recovery. Per- and polyfluoroalkyl substances (PFAS) are notably problematic due to their complexity and ubiquity in sewage sludge. Due to PFAS' toxic and persistent properties, small concentrations can bioaccumulate and threaten human and environmental health – e.g., through land applying contaminated sewage sludge. Therefore, a safe and circular economy demands energy-efficient technologies that can both destroy pollutants like PFAS and recover resources like phosphorus.

Applied smouldering is an emerging thermal treatment technology that can manage high moisture content (MC) WWT sewage sludge (up to 80% MC, wet mass basis) in a self-sustaining manner. Smouldering is a flameless form of combustion that is characteristically slow and low-temperature due to being oxygen transport-limited in many cases. These properties enable a highly energy-efficient form of combustion that can be harnessed for sewage sludge treatment.

The ash remaining after applied smouldering has been shown to contain valuable phosphorus that presents good potential for recovery. Moreover, this ash is essentially PFAS-free, where PFAS destruction can be promoted with small concentrations of inexpensive amendments, e.g., calcium oxide. This technology is now commercially deployed to treat PFAS-contaminated soils; however, it is not yet used for sewage sludge treatment. Applied smouldering demonstrates promise as an energy-efficient method to both destroy PFAS recover and phosphorus from sewage sludge.

This presentation will overview recent experimental results that explore this promising application through smouldering UK sewage sludge.

ID: OP05

Title:
Harnessing microalgal extracellular polymeric substances (EPS) for malting wastewater treatment and valorisation
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Keywords:
Microalgae wastewater treatment, exopolysaccharides, circular bioeconomy, biorefinery
Aim of the research:
This study aims to develop a novel microalgae-based biorefinery integrating microalgae heterotrophic cultivation in malting wastewater for simultaneous wastewater treatment, EPS recovery, and biomass harvesting via self-flocculation. The process targets COD and nutrient removal that compliance with UK discharge standards, and production of high-value biopolymers within a circular bioeconomy framework.
Short summary:
Extracellular polymeric substances (EPS) are valuable biopolymers with diverse industrial applications. This study introduces a novel microalgae-based biorefinery concept that advances wastewater treatment by utilising EPS as a multifunctional tool. Using undiluted malting wastewater as a substrate, this approach leverages EPS to enhance treatment efficiency, enable energy-efficient biomass harvesting via EPS-mediated flocculation, and simultaneously yield high-value bioproducts and clean water, thereby exemplifying complete resource utilisation within a circular bioeconomy. Initially, seven microalgae strains were screened via heterotrophic cultivation in undiluted malting wastewater. The four top-performing strains were subsequently selected for process optimisation using response surface methodology (RSM). The selected microalgae achieved over 90% chemical oxygen demand (COD) removal, with final nitrate concentrations successfully meeting UK environmental discharge limits. Furthermore, the system

demonstrated a self-flocculation efficiency of up to 90%, facilitating rapid biomass harvesting without the need for energy-intensive downstream processing.

Additionally, up to 1.4 g/L of EPS was successfully recovered from the wastewater, even under non-optimal conditions. Fourier-transform infrared (FTIR) spectroscopy confirmed the presence of key functional groups (hydroxyl, carboxyl, and glycosidic) in the extracted EPS. Further characterisation using thermogravimetric analysis (TGA) and gas chromatography-mass spectrometry (GC-MS) is currently underway to determine the most suitable industrial applications for these recovered biopolymers.

Ultimately, this EPS-driven bioprocess provides a highly scalable model for industrial wastewater valorisation. By integrating microalgae heterotrophic cultivation with real-world malting wastewater, the system produces treated effluent that meets discharge standards without requiring further processing. Transforming industrial waste streams into valuable bioproducts and clean water significantly advances the commercial feasibility of microalgal wastewater treatment. This process directly supporting the United Nations Sustainable Development Goals (SDGs) for clean water and responsible consumption and production.

ID: OP06

Title:
Closing the liquid loop: coupling hydrothermal carbonisation with phototrophic treatment to valorise olive pomace digestate process water
Author name(s):
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Cranfield University
Short summary:
Hydrothermal carbonisation (HTC) converts wet organic residues into a carbon-rich hydrochar without prior drying, but its aqueous by-product is a persistent bottleneck. This process water can represent up to 90% of the output mass, a direct consequence of the high moisture content of the digestate feedstock and carries high concentrations of dissolved organic carbon, nitrogen and phosphorus, so it is commonly discharged as an effluent, at both a cost and a eutrophication risk. Within the Horizon Europe OLinWASTE project, this work proposes an integrated train that couples HTC of olive pomace digestate, the residue left after anaerobic digestion of olive

mill waste, with phototrophic treatment, with the aim of removing the process water as a waste output rather than merely diluting or disposing of it.

The near-term contribution is a compositional characterisation of the digestate-derived process water: chemical oxygen demand, ammoniacal and organic nitrogen, phosphorus, potassium, pH, and a screen for compounds known to inhibit biological treatment, notably furanics and phenolics. This dataset defines the treatability of the stream and is a prerequisite that current HTC process-water studies often omit.

Treatment is then addressed using a culture enriched in purple non-sulfur bacteria (PNSB), which assimilate dissolved organics, nitrogen and phosphorus into settleable biomass without external carbon addition. Existing PNSB performance data, obtained on a separate influent, establishes the guild's nutrient-capture capability; validation on HTC process water is the defined next step, with removal efficiency and biomass recovery as success criteria.

This cascading configuration reframes HTC process water from a disposal liability into a recoverable resource, advancing a low-waste biorefinery for the olive oil sector and a transferable template for concentrated agro-industrial waters.

ID: OP07

Title:
Nanobubble-Assisted Recovery of Rare Earth Elements from Industrial Wastewater for Circular Water Management
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Keywords:
nanobubbles, rare earth elements, industrial wastewater, resource recovery, water reuse, circular economy
Short summary:
Rare earth elements (REEs) are essential for electronics, renewable-energy systems, electric vehicles, and advanced manufacturing. Wastewater generated by mining, metal processing, magnet production, and electronic-waste recycling can contain dilute concentrations of valuable REEs. Following initial water-quality adjustment, a selective and environmentally

compatible collector will be introduced to form hydrophobic complexes with dissolved REE ions. Nanobubbles will provide a large interfacial area for the attachment and separation of these complexes. The REE-enriched fraction will be recovered as a small-volume concentrate, while the treated water will be assessed for reuse or safe discharge. A continuous-flow laboratory system will be evaluated using synthetic wastewater and selected real industrial effluents. The recovery of REE, will be investigated in the presence of competing ions, including iron, aluminum, calcium, copper, nickel, and cobalt. Experimental variables will include pH, nanobubble concentration, bubble-size distribution, collector dosage, contact time, flow rate, and ionic strength. Performance will be assessed through REE recovery efficiency, elemental selectivity, enrichment factor, residual metal concentration, concentrate volume, energy demand, reagent consumption, and treated-water reuse potential. The project aims to establish a modular approach that combines wastewater treatment with critical-resource recovery. Nanobubble-assisted separation could reduce the volume of contaminated water requiring further treatment, recover valuable materials from dilute streams, and support more circular and resource-efficient water-management systems.

ID: OP08

Title:
Life Cycle Assessment and Techno-Economic Analysis of Emerging Wastewater Treatment Technologies
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Keywords:
Life cycle assessment; Techno-economic analysis; Wastewater treatment; Emerging technologies
Aim of the research:
This research aims to apply integrated life cycle assessment and techno-economic analysis to emerging wastewater treatment technologies, identifying environmental and economic trade-offs, key performance drivers, and opportunities for improvement to support technology development, scale-up, and informed decision-making toward more sustainable wastewater treatment systems.
Short summary:
Emerging wastewater treatment technologies can improve contaminant removal, resource recovery, and energy efficiency, but strong laboratory

performance does not necessarily translate into environmental or economic viability at scale. This research applies integrated life cycle assessment (LCA) and techno-economic analysis (TEA) to identify the conditions under which emerging technologies can become competitive with conventional treatment. Two case studies illustrate this approach.

For functionalized sponge-based adsorbents, cradle-to-gate impacts were generally comparable to or lower than conventional materials, while cradle-to-grave performance depended strongly on pollutant-removal capacity and reuse. For oil-removal applications, repeated reuse substantially reduced life-cycle environmental impacts because high sorption capacity and mechanical regeneration distributed manufacturing burdens over a longer service life. In contrast, for phosphorus recovery, regeneration alone was insufficient to achieve environmental parity with conventional treatment; break-even analysis indicated that adsorption capacity would need to increase to approximately 13.5 mg P g^{-1} to match the GWP benchmark. TEA further showed scale-up potential, with projected production costs decreasing from $\$61.5\text{--}90.5 \text{ kg}^{-1}$ at laboratory scale to $\$7.0\text{--}11.1 \text{ kg}^{-1}$ at commercial scale.

A second case study evaluated an integrated treatment train combining an anaerobic membrane bioreactor (AnMBR), hydrothermal carbonization, and nitrogen and phosphorus recovery. The integrated system had a GWP of $0.96 \text{ kg CO}_2\text{e m}^{-3}$ and a levelized treatment cost of $\$1.23 \text{ m}^{-3}$. AnMBR dominated both impacts and economics, contributing about 77% of system GWP, 96% of CAPEX, and 83% of levelized cost, primarily because of dissolved methane emissions and membrane/reactor capital. In contrast, hydrothermal carbonization provided a small but robust net GWP credit, while phosphorus recovery was the largest downstream electricity consumer.

Together, these cases show that integrated LCA–TEA can help identify quantitative performance thresholds, environmental and economic hotspots, and actionable priorities for technology development and scale-up.

ID: OP09

Title:
Validated Model to Practitioner Tool: Implementing AI-Driven Risk Governance in Biogas Facilities
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Keywords (maximum 4):
Wastewater treatment; biogas risk management, BiogAI-RMF; AI risk management.
Aim of the research:
To empirically validate BiogAI-RMF, an AI-driven risk management framework for wastewater biogas facilities, through a mixed-methods design combining PLS-SEM, fuzzy inference modelling, and practitioner interviews, and to translate this validation into practical, implementation-ready framework for AI-supported risk governance in the water sector.
Short summary:
Wastewater treatment plant (WWTP)-based biogas facilities are increasingly central to renewable energy recovery and circular wastewater management, yet interacting technical, safety, environmental, organisational, and digital risks routinely outpace what conventional, static risk-assessment tools can capture. This talk moves beyond model validation to ask a more practical question: what does it actually take to put an AI-driven risk framework into a working biogas facility? Drawing on the empirical validation of BiogAI-RMF across a 151-respondent industry survey (PLS-SEM), a hybrid Mamdani fuzzy inference system built in MATLAB, and nine semi-structured interviews with biogas safety practitioners, results show that unmanaged risks, drivers and uncertainties significantly undermine facility performance ($\beta = -0.293$, $p < 0.001$), while effective risk management is the strongest positive pathway ($\beta = 0.35$, $p < 0.001$) and fully mediates this relationship. AI adoptability contributes positively but falls short of conventional significance as a direct predictor ($\beta = 0.149$, $p = 0.09$), confirming that digital readiness alone is not sufficient without strong governance. The fuzzy inference layer converts these validated relationships into interpretable, practitioner-facing decision support, achieving 87–89% category agreement with expert-assessed outcomes. Practitioner interviews surfaced the real barriers to adoption: data quality, leadership commitment, phased rollout, governance clarity, and the ongoing need for human oversight even as AI tools mature. Together, these strands show that validating a risk model statistically is necessary but not sufficient; implementation success depends equally on how that model is packaged, communicated, and governed once it reaches the plant implementation. This talk shares what worked, what practitioners pushed back on, and what a phased AI-adoption pathway for safety-critical water infrastructure looks like in practice.

ID: OP10

Title:
A Multi-Source Deep Learning Approach to Small Water Body Detection and Delineation
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Keywords:
Small water bodies; Super-resolution; LiDAR terrain; Freshwater monitoring
Aim of the research:
To test how far the mapping of ecologically important small water bodies can be extended using only freely available data and to determine whether learned super-resolution of Sentinel-2 imagery or LiDAR terrain provides the decisive input for detecting features that standard satellites overlook.
Short summary:
Small surface water bodies sustain freshwater biodiversity and support water resilience far out of proportion to their area, yet they sit at or below the detection limit of the moderate-resolution satellites on which large-area monitoring depends. As a result, they are routinely absent from regional and national water inventories. This study tested how far these features can be mapped using only openly available data. A high-capacity deep learning segmentation model, a Residual Attention U-Net, was trained on an eleven-channel stack combining Sentinel-2 optical bands, spectral water indices, and two LiDAR terrain descriptors, slope and the Topographic Wetness Index (TWI). Two complementary information sources were assessed. Learned super-resolution, provided by the Sentinel-2 Deep Resolution 3.0 service, reconstructed the imagery from a 10 m to a 1 m pixel size, while LiDAR terrain constrained where water could physically accumulate. To separate the benefit of added pixels from that of genuine reconstruction, super-resolution was compared against simple resampling to the same 1 m pixel size, and the model was evaluated on a geographically independent test set across lowland England with performance reported by water-body size. Super-resolution sharpened delineation across every size class,

improving boundary agreement most for the smallest bodies, but added little to detection. The decisive input for detecting bodies below 500 m² was topography, which raised detection by 10 to 17 percentage points. These results show that small water bodies can be mapped reliably from open, repeatable data when terrain compensates for a spectral signal that resolution alone cannot restore, offering a scalable and low-cost route to monitoring freshwater habitats that conventional Earth observation leaves unmapped.

ID: OP11

Title:
Digital Reference Objects for Robust Benchmarking of Anaerobic Digestion Systems Under Data Uncertainty
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Keywords:
Digital Reference Objects; Anaerobic Digestion; Benchmarking; Data Uncertainty
Aim of the research:
To investigate how Digital Reference Objects (DROs) can support reliable performance assessment and benchmarking of anaerobic digestion systems by improving data consistency and reducing the impact of incomplete and uncertain operational information.
Short summary:
Anaerobic digestion (AD) is central to resource recovery and renewable energy generation within the water sector. However, reliable performance assessment remains challenging because full-scale facilities frequently operate with heterogeneous monitoring systems, incomplete datasets, and varying levels of measurement uncertainty. These limitations reduce the reliability of cross-site benchmarking and hinder data-driven operational decision-making. This project investigates the use of Digital Reference Objects (DROs) as standardised, machine-readable representations of operational data for AD systems. Unlike conventional data structures that record measurements alone, DROs explicitly capture information on data provenance, completeness, and uncertainty alongside the values themselves. This enables data quality to become an integral part of performance assessment

rather than an implicit assumption.

The proposed framework combines DROs with mass-balance-informed performance evaluation using routinely collected operational data, including feedstock loading, inflow and outflow measurements, and biogas production. Mass-balance closure is used to identify inconsistencies within monitoring records and to provide context for interpreting performance indicators derived from imperfect datasets. The approach aims to support benchmarking across facilities with differing monitoring practices while maintaining transparency regarding data limitations.

Current work focuses on defining and implementing the DRO structure and associated performance indicators for full-scale AD systems. Future validation will explore the applicability of the framework across multiple operational sites and assess its ability to produce comparable performance metrics under varying data availability conditions.

By making data quality explicit within the assessment process, the framework seeks to provide a more robust and defensible basis for benchmarking resource recovery systems, support evidence-based operational decisions, and contribute to the digital transformation of water-sector infrastructure.

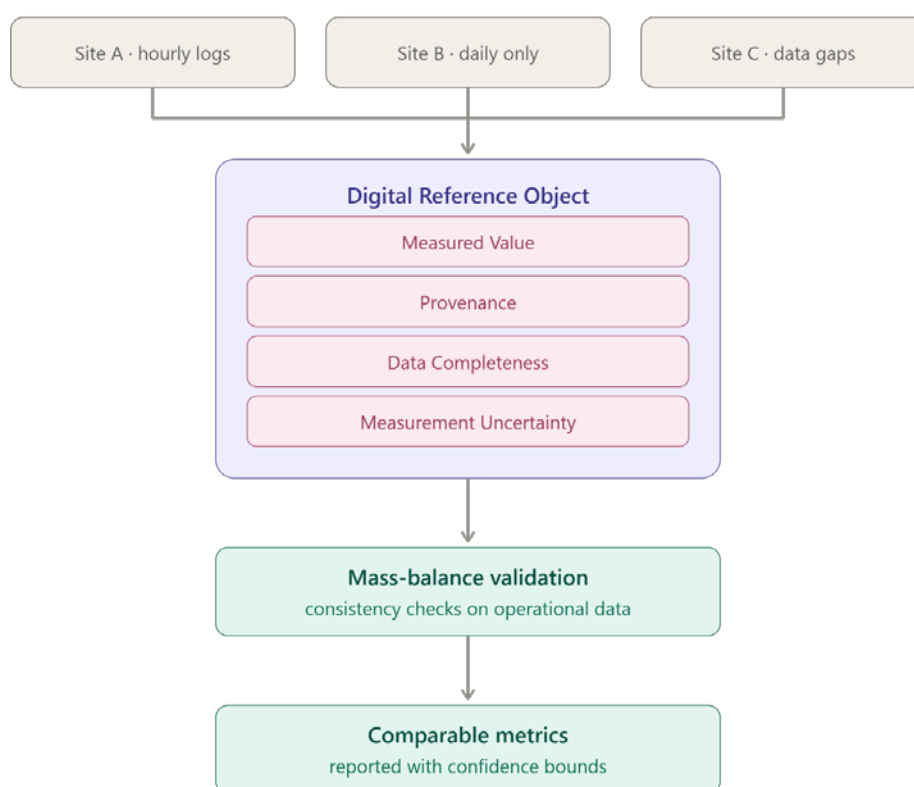


Figure 1 Data quality travels with the data, enabling interpretable cross-site benchmarking.

ID: OP12

Title:
Safe Drinking Water Kiosks at Transport Hubs: A Social Business Model to Reduce Plastic Waste
Author name(s):
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Affiliation(s):
Northumbria University London
Keywords:
Public water infrastructure; Plastic pollution reduction; Social business model; Transport hubs
Aim of the research:
A network of coach, underground, overground and rail stations would have coin/contactless-operated drinking water refill kiosks, which would sell filtered hot and cold water at affordable prices, and be funded by a self-sustaining, non-profit social business model, with single use plastic bottle usage reduced.
Short summary:
When people can get tap water, single-use plastic water bottles are still a significant source of microplastic contamination and plastic pollution in the world. The solution that is proposed for this paper is a practical and scalable solution; namely, install drinking water kiosks at high footfall transport locations such as coach stations, as well as underground and overground and rail stations in large cities throughout the UK. Each kiosk will be modeled on the “ATM” shape and will dispense chilled and hot filtered water using a high quality, multi-stage filtration process that's paid for through a small fee (10-15p for every 500ml) using smart contactless payment. Hot water access would also allow commuters to make their own hot drinks, offering a level of convenience more than available with just water. Security and reliability would be provided by CCTV and tamper resistant housing, as is standard with unattended cash machines that are widely known to the public. The proposed funding and governance structure is a public-private partnership between transport operators (such as TfL, coach and rail operators) and the city councils, where initial funding costs would be recovered from usage revenue. After the investment period (with an allowance for inflation) is paid off, the price would be lowered to cover only the maintenance of the scheme, making it a not-for-profit and socially oriented scheme instead of a commercial one. There are three expected benefits. Environmentally, the scheme could

be a significant reduction in the need to buy single-use plastic bottles, hence in the scale of micro plastic pollution and plastic waste (“plastic soup”). Commuters would pass on the high cost of station vending machines' bottled water. Socially and for wellbeing, reliable access to free-flowing safe water would lessen the burden on the shoulders of millions of people who transport water every day, would improve a culture of reusing water bottles (glass or steel or safer plastics), and would benefit public health and the everyday convenience they provide. This paper outlines the concept, funding structure, implementation path, and invites discussion on where to locate it, how to structure partnerships, regulatory issues, and designing the pilot with the Water4Allnet network of researchers, policymakers, and industry partners.

ID: OP13

Title:
Reactive Dye Removal using Integrated Adsorption and Electrochemical Oxidation
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Keywords:
Nyex 2000, Reactive dyes, Breakdown products
Aim of the research:
To evaluate the effectiveness and scalability of the Nyex Rosalox™ adsorption-regeneration process for removing reactive dyes from textile wastewater and enabling safe water reuse under conditions representative of industrial textile effluents.
Short summary:
The textile industry heavily pollutes waterways with dye-rich effluents that threaten ecosystems and human health. Reactive dyes, widely used for cellulosic fabrics, have a low fixation efficiency resulting in significant dye discharge into wastewater. Because these dyes are highly soluble and resist degradation, conventional treatment methods which often require high energy input or generate secondary sludge struggle to achieve complete mineralization, making effective removal before discharge a critical

challenge.

This study investigates the efficiency of a novel hybrid adsorption-electrochemical oxidation process (the Nyex Rosalox process; NR process) for the removal of four widely used industrial reactive dyes (Reactive Orange 16, Red 120, Blue 19, and Black 5). To investigate treatment performance under realistic industrial conditions, we assessed the effects of pH (acidic and basic), salinity (up to 5 g/L NaCl), temperature (up to 50 °C), mixed-dye systems, and the presence of additional organic compounds used during dyeing. Water reuse potential was evaluated through fabric dyeing trials using treated effluent.

The results to date indicate that using the NR process, both dyes can be completely removed without the generation of (potentially) toxic breakdown products. Performance remained robust across varied operating conditions, with up to 40% enhanced removal under acidic and alkaline conditions, while elevated temperature and competing organics had minimal impact. Consistent performance in mixed-dye systems suggests applicability to complex industrial effluents. Treated water was successfully reused for fabric dyeing without compromising performance, demonstrating the potential of this approach for sustainable wastewater remediation, industrial water reuse, and reduced freshwater demand.

ID: OP14

Title:
The role of micro-nanobubbles in dissolved air flotation for the removal of micropollutants in drinking water treatment
Author name(s):
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Short summary:
Dissolved air flotation (DAF) is widely applied for removing suspended particles, fats, oils, grease, and algae in water treatment; however, its effectiveness for dissolved emerging micropollutants remains uncertain. The unique physicochemical properties of micro-nanobubbles, including high

surface area, stability, and interfacial charge, suggest potential to enhance adsorption and flotation processes. This study investigated whether micro-nanobubbles can provide a mechanistically meaningful enhancement to conventional DAF for the removal of mixed pharmaceuticals (ibuprofen, furosemide, pristinamycin) and per- polyfluoroalkyl substances (PFAS). Bench-scale experiments were conducted to compare coagulation, conventional DAF, and micro-nanobubble-enhanced flotation under the same contaminated water conditions. At an initial concentration of 5 mg/L for pharmaceuticals and 200 ng/L for PFAS, DAF-based treatments demonstrated measurable removal, with PFOS and pristinamycin reductions of approximately 75% and 80%, depending on treatment configuration, highlighting the complexity of flotation mechanisms for micropollutants. Ongoing work focuses on hybrid nanobubble configurations and testing at lower, more realistic concentrations to better quantify the incremental role of nanobubbles in advanced water treatment, and the results will be presented at the conference.



Figure 1: DAF assembly in the study

ID: OP15

Title:
Assessment of Membrane Aerated Biofilm Reactor as a full-flow biological treatment of wastewater
Author name(s):
Blessing Mobolaji ¹ , Giulia Pizzagalli ² , Andras Nemeth ³ , Luca Alibardi ¹ , Bruce Jefferson ¹
Affiliation(s):
¹ Cranfield University, College Road, Cranfield, Bedfordshire. MK43 0AL ² Anglian Water, Lancaster House, Ermine Business Park, Huntingdon, Cambridgeshire. PE29 6XU ³ Oxymem, Moydrum Business Park, Athlone, Co. Westmeath, N37 DR79, Ireland.
Keywords:
Membrane Aerated Biofilm Reactor (MABR), Biological Nitrogen Removal

(BNR), Nitrous oxide (N ₂ O) Emissions,
Aim of the research:
This research evaluates the performance of a membrane aerated biofilm reactor (MABR) as a full-flow secondary wastewater treatment process, with particular focus on organic matter and ammonia removal, process resilience under varying hydraulic loads, and nitrous oxide (N ₂ O) emissions compared with conventional activated sludge processes.
Short summary:
The UK water industry has committed to achieving net-zero emissions by 2030, creating a need for wastewater treatment technologies that reduce both energy consumption and process-related greenhouse gas emissions. Conventional activated sludge processes (ASP) are highly dependent on aeration, which represents a major proportion of operational energy demand and associated costs. In addition, ASP can be a significant source of nitrous oxide (N₂O), a potent greenhouse gas. The membrane aerated biofilm reactor (MABR) is an emerging technology that delivers bubbleless aeration through gas-permeable membranes while providing a surface for biofilm growth. This configuration improves oxygen transfer, reduces energy requirements and sludge production, and offers opportunities for retrofitting existing treatment infrastructure. MABR may also reduce N₂O emissions by providing more controlled oxygen delivery during biological nitrogen removal. Although MABR has been widely investigated as a side-stream technology, its application as a full-flow secondary treatment process remains underexplored. This study evaluates the feasibility of replacing ASP with MABR for full-flow secondary wastewater treatment while assessing associated N₂O emissions. The system was operated under six hydraulic loading phases ranging from 1.8 to 12 m³ h⁻¹. Ammonia removal efficiencies ranged from 92.0% to 99.6%, with an average MABR removal efficiency of 98.1%, compared with 99.8% for ASP. N₂O emissions were low, with an emission factor of 0.065% of total nitrogen load, placing MABR at the lower end of the range reported for ASP systems. These findings demonstrate the potential of MABR as a low-carbon, high-performance technology capable of supporting net-zero objectives in the wastewater sector.

ID: OP16

Title:
'Clean' sink, dirty problem: the challenge of disinfecting hospital sink drains
Author name(s):
Aimee Fisher, Bing Guo, Ginny Moore, Jennifer Ritchie

Affiliation(s):
University of Surrey, Ginny Moore - UKHSA
Keywords:
Biofilm, hospital, infection control
Aim of the research:
This project investigates how sink drain biofilms respond to two disinfectants routinely used in hospital disinfection protocols and explores factors contributing to bacterial persistence and recovery. The findings, alongside future work, may help inform infection prevention policy, and healthcare plumbing/engineering design.
Short summary:
Handwashing is central to infection prevention in healthcare, yet multiple studies implicate plumbing fixtures as reservoirs of antimicrobial resistant microorganisms. Despite routine disinfection, sink drains remain contaminated with biofilms; complex aggregates of microorganisms encased in a protective extracellular matrix that form on pipe surfaces. During faucet use, contaminated droplets can disperse from the drain onto surrounding surfaces or people, posing a risk to patients. While some studies have examined dispersal, few have examined how potentially pathogenic bacteria establish within existing biofilms or how stressors such as disinfectants, sodium dichloroisocyanurate (NaDCC) or peracetic acid (PAA), impact biofilm communities and pathogen survival. This study aimed to develop a laboratory sink-drain model to determine how two commonly used sink disinfectants (NaDCC, PAA) affect biofilm architecture, bacterial community interactions and the survival of introduced pathogens. We developed a semi-continuous culture sink-drain model using synthetic hospital wastewater and chlorinated polyvinyl chloride coupons to simulate pipe surfaces. Synthetic communities comprising four common sink-dwelling species were established, and the prevalent human pathogen, <i>Pseudomonas aeruginosa</i> introduced on day 6. In untreated controls, biofilm communities remained stable following introduction of <i>P. aeruginosa</i>. Following exposure to NaDCC or PAA on day 7, numbers of biofilm-associated cells dropped close to the limit of detection; however, regrowth was detected after 24 hours. NaDCC-treated biofilms re-established to pre-treatment cell densities within 72 hours, whereas recovery was slower after PAA exposure. Distinct post-treatment biofilm architectures were observed 72 hr after disinfection. NaDCC-treated biofilms appeared as large multicellular aggregates interspersed with adherent single cells, while PAA-treated biofilms exhibited a sparse, patchy areas of re-growth. These findings highlight the necessity for disinfection protocols that prevent microbial recovery and avoid selecting for resilient biofilm architectures. Further investigation of biofilm structure and community

interactions may elucidate potential targets for effective eradication strategies and safer water infrastructure.

ID: OP17

Title:
Green approach for microplastic removal from water: Mathematical modelling and optimization
Author name(s):
Milad Mousazadehgavan
Affiliation(s):
Liverpool John Moores University
Short summary:
Microplastic contamination, particularly polyethylene terephthalate (PET), presents a persistent challenge for water treatment due to its stability and interaction with co-existing contaminants. This study proposes an integrated two-stage framework for the separation and degradation of PET microplastics, supported by experimental investigation and mathematical modelling. In the first stage, microplastics were destabilized and separated via enhanced aggregation mechanisms, achieving removal efficiencies above 65%. The introduction of acoustic waves promoted cavitation-induced nanobubble formation, improving mass transfer, reducing electrode passivation, and enhancing particle–coagulant interactions, leading to more stable floc formation. Mechanistic analysis confirmed that charge neutralization and sweep flocculation governed the process, supported by observable shifts in surface charge. In addition, the adsorption behavior of PET microplastics toward ammonium and nitrate ions was investigated, demonstrating their role as carriers of dissolved pollutants. In the second stage, degradation was enhanced through in situ generation of ferrous ions from iron electrodes, combined with hydrogen peroxide and persulfate to promote reactive oxygen species production under controlled conditions. This synergistic system facilitated oxidation of residual contaminants, with the overall hybrid process achieving removal efficiencies exceeding 90%. Characterization analyses (FTIR, XRD, and SEM) confirmed structural and morphological changes, including the formation of metal hydroxide flocs, surface modification of PET particles, and enhanced pollutant attachment after treatment. Recycled electrode materials, including aluminum and iron, were utilized to improve process sustainability. Mathematical modelling based on central composite design (CCD) using Design-Expert software demonstrated strong agreement between predicted and experimental results, enabling reliable optimization of process performance. The findings highlight

that coupling separation and degradation provides a robust and scalable strategy for microplastic removal while addressing associated contaminant transport in water systems.

ID: OP18

Title:
Impact of Polyester Microfibre Fouling on UF and NF In Hard Tap Water
Author name(s):
F. Hamidavi, S. Gadkari, J. Lee
Affiliation(s):
School of Chemistry & Chemical Engineering, University of Surrey
Keywords:
Microfibre fouling; Ultrafiltration/Nanofiltration; Tap water hardness; Calcium-mediated fouling
Aim of the research:
This study examined how tap-water hardness alters polyester microfibre fouling in UF and NF membranes over long-term filtration. Results reveal that microfibres unexpectedly mitigate fouling in tap water via calcium redistribution, shifting fouling mechanisms from pore blocking to surface deposition, most pronounced in nanofiltration.
Short summary:
Polyester microfibres are among the most common microplastic forms released during textile washing, yet their fouling behaviour in membrane systems remains insufficiently understood in tap-water matrices, where hardness ions and natural organic matter are present alongside fibres from the outset. This study investigated polyester microfibre ($211 \pm 90 \mu\text{m}$, 10 mg/L) fouling in ultrafiltration (UF) and nanofiltration (NF) using pure water (PW) and hard tap water (TW) during long-term crossflow filtration (215 h for UF; 350 h for NF) — substantially longer than most previous short-term microfibre fouling studies. To provide similar initial flux, filtration was conducted at 3 bar for UF and 6 bar for NF. Membrane surfaces and recovered foulants were characterised using SEM, EDS, water contact angle, EPS extraction (protein and polysaccharide quantification), EEM fluorescence, and ICP-OES, alongside modified Hermia modelling to track dominant fouling mechanisms over time. Under PW conditions, microfibre addition caused only modest additional fouling in both membranes. In contrast, the hard tap-water matrix caused severe fouling, with final flux declines to 77% in UF and 73% in NF. When microfibres were added to TW, long-term fouling was reduced, with final flux decline decreasing to 61% in UF and 31% in NF. Characterisation results showed that TW fouling involved

mixed inorganic-organic deposition, including calcium-rich and EPS-related foulants. In NF, calcium was more extensively redistributed to microfibre-associated deposits than in UF, with recovered microfibres showing calcium contents of 22.7 at.% and 1.2 at.%, respectively. Modified Hermia analysis further showed that fibre addition shifted fouling away from dominant internal pore restriction towards greater surface-associated deposition, particularly in NF. These findings show that microfibres can unexpectedly mitigate long-term fouling under realistic hard-water conditions by altering calcium partitioning and deposit structure, offering new mechanistic insight relevant to the design and operation of membrane systems treating microfibre-contaminated waters.

Poster Presentations

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	PP02	Impact of hydrodynamics on pilot scale Microbial electrolysis cell	Maira Anam	Newcastle University
	PP03	Linking Water Contaminant Exposure to Antimicrobial Resistance and Public Health Outcomes: A Data-Driven Review	Mahi Monjina	East Anglia University
	PP04	Handwashing basin interactions in the healthcare environment: an observational study of water infrastructure at its point of use	James Bendall-Boyd	University of Surrey
	PP05	Population-normaliser choice impacts spatial pharmaceutical signatures in near-source university campus wastewater surveillance	Frederick Bradley-Pickston	Middlesex University
	PP06	Heavy Metal Contamination and Water Quality Risks in the Osun River, Nigeria: Implications for Environmental and Cultural Heritage Protection	Michael Osagie	York St John University
	PP09	Methyl Orange Biodegradation by a Pre-Cultured Pseudomonas–Bacillus Consortium Using a PANI/r-GO-g-C ₃ N ₄ Modified Flexible Anode in a Single-Chamber Air-Cathode Microbial Fuel Cell	Afreen Ahtesham	Northumbria University
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	PP16	Investigating potential for phosphorus recovery from Hydrothermal Oxidation solid residue	Tim Auth	Anglian Water/Imperial College London
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	PP20	Fluoride-free MXene-derived membranes for electrocatalytic nitrate to ammonia conversion	Corin T. Scott	University of Bath

	PP21	Engineering Next-Generation Faradaic Electrodes for Sustainable Energy-Efficient Brackish Water Desalination by Capacitive Deionization	Satish Kumar	Indian institute of Technology Guwahati
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	PP25	Assessment of illegal dumping waste and Its impact on Urban Drainage in Ambo Town, Ethiopia	Bonsa Tafasa Mamo	AMBO-GUDAR Town Water Supply
	PP26	Seasonal Variation of Physicochemical and Bacteriological Characteristics of Groundwater Around Selected Cemeteries in Ogbomoso, Nigeria	Aderibigbe Deborah Olubunmi	Ladoke Akintola University of Technology, Ogbomoso, Nigeria
	PP27	Influence of NOM, iron oxide, and mixed fouling on ceramic membrane performance	Zara Rahim	University of Edinburgh
	PP28	Evaluating Adsorption Systems for PFAS Removal in the Presence of NOM and Co-Contaminants Using GAC and Ion Exchange Media	Ananthu Mohan	Cranfield university
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PP31	Modular Floating Duckweed Systems with Low-Cost IoT for Nutrient Recovery in Zambia	Desly Kalonga	Center for Water Sanitation and Rehabilitation
PP32	Up-flow Compact Constructed Wetland based Sewage Treatment Plant (UCCW based STP): Design, Optimization, and Field-Scale Implementation	Satyendra	Visvesvaraya National Institute of Technology (VNIT), India
PP33	Blue Carbon Ecosystems as Nature-Based Solutions for Water Quality Improvement and Sustainable Small-Scale Fisheries: Insights from Coastal India	Navya Vikraman Nair	University of Victoria
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Poster Presentation Abstracts

ID: PP01

Title:
Can the application of remote sensing improve bathing water quality assessments?
Author name(s):
Kiera McMahon, Kathy Pond, Donya Hajializadeh
Affiliation(s):
University of Surrey. Scenario (NERC funded)
Keywords:
Water Quality Remote Sensing
Aim of the research:
Determine how the application of a digital twin can identify historic patterns and create predictions of future bathing water quality including determining potential pollution sources, pathways and receptors of a specific subject site.
Short summary:
Improving coastal bathing water quality is essential for minimising potential health risks associated with recreational activities. In the UK, guidance for bathing water quality is given under The Bathing Water Regulations 2013 where microbial concentrations (Escherichia coli and Intestinal Enterococci) are measured from water samples and used to classify the designated bathing site. During bathing season, one sample is taken approximately every week. However, sampling is not thought to be representative of the whole designated bathing catchment due to the fast-changing conditions of coastal areas. Determining site-specific characteristics of an individual bathing water catchment improves the understanding and analysis of microbial contamination, providing an initial assessment of the potential faecal sources that may put the area at risk and the pathways through which these contaminants can reach the bathing waters. Remote sensing (Sentinel data) can be used to identify and predict spatial and temporal patterns of pollutant events, including contamination of faecal matter. Unlike single-point sampling, Sentinel data covers the entire bathing water catchment with data uploaded approximately every 3 days, reducing data sparsity. Along with identifying trends and predictions, it is thought that remote sensing could be used to track the source of pollution events when incorporated with a catchment-specific characteristic

assessment.

This study presents the development of a data-driven predictive tool discussing multiple data sources (remote sensing, land use, sanitary surveys and citizen science monitoring) to create a robust, site-specific source-pathway-receptor model, applied to a 'poor' water quality site in Southeast England.

ID: PP02

Title:
Impact of hydrodynamics on pilot scale Microbial electrolysis cell
Author name(s):
Maira Anam
Affiliation(s):
Newcastle University
Keywords:
Microbial Electrolysis cell, Pilot-scale, Hydrodynamics, Mass transfer
Aim of the research:
The aim of this study is to investigate the impact of stirring on the performance of pilot scale MEC. A significant decline in the performance of MEC is noticed from lab to pilot scale, attempts have been made to improve the performance of pilot-scale MEC. This study explores how fluctuating the stirring kinetics of pilot scale (1m ³) MEC reactor will effect start-up phase of MEC, biofilm formation and system overall performance.
Short summary:
Microbial electrolysis cells (MEC) are bioelectrochemical systems that uses electrochemically active bacteria to convert organic matter into value-added by-products by applying potential from external power source. Despite the promising results with lab-scale MEC systems, pilot-scale MEC struggles to reproduce the same production rate. This study examines the effectiveness and operational patterns of pilot scale MEC (1m ³) in treating return sludge liquor under different hydrodynamic conditions: Mixed at 200 rpm and 600 rpm stirring speed and Static (no mixing) as control. Impact of stirring kinetics on the start-up phase of MEC, biofilm formation and system overall performance was investigated. The diversity of biofilm composition was further analysed through high-throughput sequencing to study stirring impacts fluid flow around the anode, ultimately governing the substrate availability to biofilm by preventing mass transfer limitations. Result showed that stirring had no impact on the performance of pilot scale MEC (p<0.05) when compared to the control. These findings highlight the complex interplay between stirring-induced hydrodynamics and biofilm growth, emphasising the

need for further pilot-scale studies to optimise operating conditions and bridge the gap between laboratory and real-world MEC applications.

ID: PP03

Title:
Linking Water Contaminant Exposure to Antimicrobial Resistance and Public Health Outcomes: A Data-Driven Review
Author name(s):
Dr Mahi Monjina
Affiliation(s):
Regent European University and University of East Anglia
Keywords:
Antimicrobial resistance; Waterborne micropollutants; Public health surveillance; AI-driven detection
Aim of the research:
This paper examines evidence linking waterborne micropollutants, including PFAS and pharmaceutical residues, to the emergence and spread of antimicrobial resistance (AMR) and associated public health risks, and proposes a data-driven, potentially AI-assisted surveillance framework for early detection of contaminant-linked AMR signals in water systems.
Short summary:
Waterborne environmental pathways are also recognised as a major pathway for the emergence and spread of antimicrobial resistance (AMR), in addition to clinical antibiotic use, and are increasingly being recognised as one of the biggest global public health threats of our time. In aquatic systems, persistent chemical micro pollutants like per-and polyfluoroalkyl substances (PFAS) and pharmaceutical residues (including sub-therapeutic antibiotic residues) are added to water through wastewater discharge, agricultural run-off and poor wastewater treatment processes leading to selective pressure that can favour the emergence of resistant bacterial strains and horizontal transfer of resistance genes. This paper reviews the existing evidence base on the link between waterborne exposure and prevalence of AMR and downstream health impacts, by analysing evidence from the environmental microbiology, toxicology and epidemiological surveillance literature. It includes details on major exposure pathways, identifies key gaps in current monitoring approaches, including the absence of integrated, real-time monitoring of water quality and reporting of AMR in a clinical context, and identifies populations with increased risk. The paper builds on this evidence synthesis by proposing a conceptual surveillance and early-warning framework that

combines water quality sensor data, environmental sampling, and clinical AMR datasets, and applies natural language processing and machine learning to harness insights from these sources for the early detection of emerging resistance signals and contamination patterns that may lead to broader public health events. The framework is based on techniques that have been used in the health-data NLP community and the cybersecurity-based anomaly detection community, adapted for environmental health surveillance and enables timely coordinated responses from public health officials, water utilities, and regulators.

This work is intended to help achieve the goal of tackling the emerging problems of chemical and biological micropollutants, as well as to reignite debate on the need for interdisciplinary surveillance approaches, data-sharing mechanisms and policy implications for protecting water-related public health in the UK and beyond.

ID: PP04

Title:
Handwashing basin interactions in the healthcare environment: an observational study of water infrastructure at its point of use
Author name(s):
Mr. James Bendall-Boyd ¹ ; Dr. Ginny Moore ² ; Prof. Jane Ogden ¹ ; Dr. Manjula Meda ³ ; Dr. Jennifer Ritchie ¹
Affiliation(s):
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Keywords:
Handwashing, Healthcare Infrastructure, Bacterial Transmission
Aim of the research:
To describe user behaviour and assess how it could contribute to bacterial dissemination from handwash basins in healthcare settings. We also will quantify bacterial loads present in and on sink surfaces to assess whether ward type impacts the extent of contamination.
Short summary:
Water is a critical vector for bacterial transmission in healthcare settings. Handwashing basins (HWBs) are ubiquitous in patient wards, and their drains are frequently colonised by opportunistic pathogens, including carbapenem-resistant bacteria. During HWB use, contaminated droplets can be dispersed

from colonised drains, depositing on nearby surfaces or people, thereby increasing risk of infection to patients. Engineering controls such as rear-facing drains can mitigate risk, but human behaviour remains a major factor of onward transmission. To characterise HWB use, associated behaviours, and workflow patterns, we performed an observational study of HWB operation and assessed HWB design and microbial loads across six wards in two hospitals, capturing behavioural and environmental contextual factors. In total, 478 interactions were evaluated. The majority, 89.8%, were performed by staff (both clinical and non-clinical). We observed that 91.7% of clinical staff interactions consisted of handwashing - a rate much higher than that of non-clinical staff (51.6%) and visitors (53.3%) - with the remaining interactions involving a variety of non-handwashing activities. Furthermore, in a retrospective analysis of handwashing quality, we found the median handwashing quality score (HQS) was 2 out of a possible 4. This low HQS was largely driven by insufficient time spent performing handwashing, and a lack of post-washing hand sanitiser use (as per local guidance). We also identified that staff performed handwashing *after* giving patient care more frequently than *before* giving patient care (44.4% before vs. 90.6% after), potentially suggesting that handwashing is seen as a reactive measure of infection prevention from the patient rather than a proactive, preventative measure to protect the patient. Bacterial analysis is ongoing.

This study found that improper use of HWBs and sub-optimal handwashing are commonplace in the UK healthcare environment. Uncovering the behaviours that can potentiate transmission from HWB reservoirs is a key step in improving infection prevention and control strategies.

ID: PP05

Title:
Population-normaliser choice impacts spatial pharmaceutical signatures in near-source university campus wastewater surveillance
Author name(s):
Frederick Bradley-Pickston ¹ , Lian Lundy ¹ , Francis Hassard ² , Leonardo Pantoja Munoz ¹ , Perry Devo ¹
Affiliation(s):
Middlesex University ¹ , Cranfield University ²
Keywords:
Wastewater-based epidemiology, near-source sampling, population normalisation, campus
Aim of the research:

This study aimed to evaluate whether near-source wastewater surveillance can distinguish pharmaceutical-use patterns across university buildings, and to determine how population-normalisation methods influence spatial interpretation. It compared creatinine, ammonium-nitrogen and total suspended solids, assessed temporal trends, and explored whether pharmaceutical biomarkers aligned with national prescribing expectations during the academic semester.

Short summary (300 words max.):

Wastewater-based epidemiology is commonly applied at wastewater-treatment plants, where signals from large populations are pooled and local differences are lost, and in transit sewer degradation occurs. Sampling nearer to source, at individual buildings or small groups of buildings, could provide more spatially resolved information, but interpretation is complicated by variable flows and uncertain contributing populations.

This study investigated near-source wastewater surveillance across three functionally distinct sub-catchments on a UK university campus: residential, mixed-use, and academic. Sixty-two time-weighted composite samples were collected over a 12-week semester. Five pharmaceutical metabolites associated with antidepressants and stimulants were quantified using isotope-dilution solid-phase extraction coupled with liquid chromatography–tandem mass spectrometry. Creatinine and ammonium-nitrogen were assessed as candidate population normalisers, while total suspended solids was used as an indicator of wastewater strength.

All five biomarkers were frequently detected, and four showed significant spatial differences in raw concentrations. Ritalinic acid was highest at the mixed-use site, whereas antidepressant metabolites and modafinilic acid were elevated at the academic site. These, site rankings depended on the normalisation approach. Creatinine and total suspended solids broadly preserved the patterns observed in raw concentrations, while ammonium-nitrogen reordered several site rankings because the dilute residential wastewater contained comparatively little ammonium. This demonstrates that normalisers developed for large, well-mixed wastewater catchments may not perform reliably at building scale.

Modafinilic acid also increased during assessment periods, its abundance exceeded that expected from national prescribing data across all sub-catchments, suggesting that prescribing alone did not explain the observed signal.

The findings establish near-source campus surveillance as a feasible monitoring approach while highlighting a key interpretive risk: spatial conclusions can change according to the chosen normaliser. Reporting results using more than one normalisation method is therefore recommended, with greater confidence placed in patterns that remain

consistent across approaches for decision making.

ID: PP06

Title:
Heavy Metal Contamination and Water Quality Risks in the Osun River, Nigeria: Implications for Environmental and Cultural Heritage Protection
Author name(s):
Michael Ayokunle Osagie
Affiliation(s):
York St John University
Short summary:
The Osun River is an ecologically and culturally significant water system in southwestern Nigeria, supporting local communities while forming an integral part of the Osun-Osogbo Cultural Landscape, a UNESCO World Heritage Site. However, increasing anthropogenic pressures raise concerns regarding the deterioration of water quality and the potential risks posed to aquatic ecosystems, human well-being and the long-term protection of culturally significant landscapes. This study examines reported concentrations of selected heavy metals, particularly cadmium, lead and arsenic, in the Osun River and considers their implications in relation to established drinking-water guideline values. The study adopts a risk-oriented approach to assess the extent to which reported contamination levels indicate potential environmental and public health concerns. By contextualising measured concentrations within the wider ecological and cultural significance of the river, the research moves beyond conventional water-quality assessment to consider the interconnected risks to environmental sustainability and heritage conservation. The findings indicate substantial exceedances of relevant guideline values for some of the investigated contaminants, highlighting the need for strengthened monitoring, pollution control and integrated water-resource governance. The study further demonstrates the importance of linking water-quality monitoring with the protection of culturally significant aquatic landscapes, particularly where environmental degradation may undermine both ecosystem functions and the social and cultural values associated with rivers. The research contributes to interdisciplinary discussions on pollutant monitoring, environmental risk assessment and sustainable water governance, while highlighting the need for context-specific approaches to protecting vulnerable water systems in rapidly changing environments.

Title:
Methyl Orange Biodegradation by a <i>Pseudomonas–Bacillus</i> Consortium Using a PANI/r-GO-g-C ₃ N ₄ Flexible Anode Microbial Fuel Cell
Author name(s):
Afreen Ahtesham, Shahid Rasul, Rohana Adnan
Affiliation(s):
School of Engineering, Physics and Mathematics, Northumbria University, Newcastle, United Kingdom, School of Chemical Sciences, Universiti Sains Malaysia;
Keywords:
Microbial fuel cell (MFC), Azo dye degradation, Flexible anode, Bioelectrochemistry
Aim of the research:
To fabricate a polyaniline/reduced graphene oxide/graphitic carbon nitride (PANI/r-GO-g-C ₃ N ₄) modified flexible anode for a single-chamber air-cathode microbial fuel cell (SCMFC), enhancing electroactive biofilm formation and enabling efficient biodegradation of the recalcitrant azo dye methyl orange (MO) alongside bioelectricity generation.
Short summary:
Azo dyes such as methyl orange (MO) are persistent, toxic pollutants that resist conventional wastewater treatment (WWT). Microbial fuel cells (MFCs) offer simultaneous pollutant removal and energy recovery, but traditional anodes (carbon felt, graphite) suffer from low conductivity, limited surface area, and poor microbial adhesion. This work developed a flexible carbon-felt anode modified with a polyaniline/reduced graphene oxide/graphitic carbon nitride (PANI/r-GO-g-C₃N₄) nanocomposite via drop-casting to overcome these limitations. The composite was confirmed by Fourier-transform infrared (FTIR), X-ray diffraction (XRD), X-ray photoelectron (XPS), differential scanning calorimetry (DSC), thermogravimetric (TGA), and N₂ adsorption–desorption (BET-BJH) analyses. The modified anode was integrated into a single-chamber air-cathode MFC (SCMFC) inoculated with a pre-cultured <i>Pseudomonas–Bacillus</i> consortium and operated at pH 6.8–7.2. Performance was assessed through polarisation and power-density curves, cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), UV–visible spectroscopy, chemical oxygen demand (COD) removal, and 16S rRNA metagenomics. The PANI/r-GO-g-C₃N₄ anode delivered a maximum power density of 101.8 mW m^{−2} with over 96% COD removal. UV–visible spectra showed near-complete disappearance of the characteristic 464 nm MO peak within

72 h, confirming rapid dye degradation. CV revealed distinct redox peaks at +0.43 V (oxidation) and -0.42 V (reduction), indicating active extracellular electron transfer, while the highest specific capacitance (0.318 F g^{-1}) reflected strong biofilm attachment. EIS gave a low solution resistance ($R_s = 1.29 \Omega$) and charge-transfer resistance ($R_{ct} = 49.72 \Omega$), evidencing improved electron transfer. Scanning electron microscopy (SEM) confirmed dense biofilm growth, and metagenomics verified an enriched electroactive microbial community.

These results demonstrate that PANI/r-GO-g- C_3N_4 modification substantially improves both bioelectrochemical performance and azo-dye mineralisation, offering a promising, scalable strategy for sustainable dye-laden wastewater treatment coupled with energy recovery.

ID: PP10

Title:
Assessing Drought-Driven Rice Sowing-Window Shifts and Groundwater Stress in Cagayan Valley, Philippines
Author name(s):
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Affiliation(s):
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Keywords:
Groundwater storage; Drought monitoring; Remote sensing; Rice sowing windows
Aim of the research:
This research seeks to strengthen drought-resilient rice and water planning in Cagayan Valley, Philippines by identifying where irrigation shortages force planting beyond planned and yield-resilient windows. Linking sowing shifts with Magat reservoir stress and groundwater anomalies, it supports proactive water allocation, adaptive calendars, and sustainable groundwater safeguards under intensifying drought.
Short summary:
This study assesses how drought-related irrigation constraints shift rice sowing windows away from institutional cropping calendars and yield-based optimum planting periods in Cagayan Valley, Philippines. The region is examined as a major rice-producing area where Magat Dam storage declines highlight the risk that reservoir-based irrigation may become insufficient during El Niño-influenced dry periods, increasing dependence on groundwater as a supplementary water source.
The analysis uses three sowing-window references. Farmer consultation-

and NIA-derived rice calendars represent institutionally implemented and locally followed planting schedules. Sentinel-1 SAR and Sentinel-2 imagery extract or validate satellite-observed start-of-season patterns, allowing actual planting behavior during drought-affected periods to be compared with the reference calendar. ORYZA simulations provide yield-based optimum sowing-window baselines for evaluating whether observed planting adjustments remain compatible with climate-resilient rice production. These comparisons are interpreted with drought indicators, NIA Region II and MARIIS Magat Dam water-level records, and NASA GLDAS monthly shallow groundwater storage anomalies from 2005 to 2025.

Initial ORYZA simulations identify October–December (DOY 301–350) as the yield-maximizing peak sowing period for the dry season and April–May (DOY 110–135) for the wet season. GLDAS-derived shallow groundwater storage averaged 826.83 mm, with strong interannual variability and no clear monotonic decline. The lowest annual storage occurred in 2010 at 786.01 mm, or –40.82 mm relative to the long-term mean, followed by 2024 at 795.60 mm, or –31.23 mm. Region II palay yield increased from 3.90 metric tons/ha in 2005 to 4.89 metric tons/ha in 2025, but the lowest yield also occurred in 2010 at 3.45 metric tons/ha. This convergence is consistent with NIA-MARIIS records of Magat Dam reaching around 152.7 m, below irrigation-critical conditions, suggesting that severe drought can constrain surface-water supply, intensify groundwater dependence, and reduce agricultural performance.

ID: PP11

Title:
Life Cycle Assessment of Sputtering-Engineered WO ₃ /MnO ₂ Multilayers on Graphene for Sustainable Energy Storage Applications
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Keywords:
Supercapacitors; Life Cycle Assessment; Sustainable Materials; Energy Storage.
Aim of the research:
This research aims to develop sustainable, high-performance flexible supercapacitor electrodes by engineering WO ₃ /MnO ₂ multilayer thin films on graphene using magnetron sputtering. The study seeks to enhance

electrochemical performance, cycling stability, and mechanical flexibility while evaluating environmental sustainability through life cycle assessment for next-generation energy storage applications.

Short summary:

Sustainable energy storage technologies play a crucial role in supporting future environmental and water-management infrastructures, particularly in decentralized monitoring and treatment systems. In this study, flexible WO₃/MnO₂ multilayer thin films were deposited on graphene substrates using combined DC and RF magnetron sputtering techniques to develop high-performance supercapacitor electrodes. The optimized four-layer-by-layer (4-LBL) architecture enhanced electrical conductivity, increased electroactive surface area, and promoted efficient ion and electron transport.

Electrochemical characterization demonstrated a high specific capacitance of 494.2 F g⁻¹ at 5 mV s⁻¹ together with excellent rate capability. A symmetric supercapacitor assembled using the optimized electrode delivered a specific energy of 44 Wh kg⁻¹ at a specific power of 521 W kg⁻¹ and retained 89% of its initial capacitance after 10,000 charge-discharge cycles. The device also exhibited low internal resistance (2.40 Ω) and maintained stable performance under mechanical bending, demonstrating suitability for flexible and wearable applications.

In addition to electrochemical performance, a life cycle assessment (LCA) was conducted to evaluate the environmental sustainability of the electrode fabrication process. The results provide valuable insights into material and manufacturing impacts, supporting the development of environmentally responsible energy-storage technologies. These findings highlight the potential of sputtering-engineered WO₃/MnO₂/graphene architectures for next-generation sustainable energy systems and related environmental applications.

ID: PP12

Title:
Environmental covariates and modelling approaches for Schistosomiasis intermediate host snails: A scoping review
Author name(s):
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Keywords:
Earth observation, modelling, schistosomiasis, intermediate host snails

Aim of the research:

Schistosomiasis is a neglected tropical disease affecting approximately 240 million people globally. While treatments exist, prevention is a greater priority than cure, and prevention begins with knowing where risk is highest. This research explores the possibility of using Earth observation data and machine learning to map the habitats of schistosomiasis intermediate host snails, identifying high-risk areas before people are harmed.

Short summary:

Schistosomiasis remains one of the world's most prevalent neglected tropical diseases, affecting an estimated 240 million people globally, with the highest burden concentrated in sub-Saharan Africa, South America, and South and Southeast Asia. While considerable research has focused on disease transmission and treatment efficacy, comparatively little attention has been paid to where people first encounter the parasite. Effective risk assessment therefore depends on accurate spatial mapping of intermediate host snail habitats. Satellite-derived environmental data and machine learning offer powerful tools for this purpose, yet their full potential remains underexplored.

This study presents findings from an ongoing scoping review of over 70 peer-reviewed studies examining satellite-derivable environmental data and machine learning approaches for snail habitat distribution and suitability modelling. The review draws on four major academic databases, with searches structured around five thematic dimensions: the target disease; intermediate host snail species; spatial outcomes such as distribution, suitability, and mapping; satellite-collectable environmental variables; and modelling approaches. Studies were not restricted by parasite species, recognising that different species share broadly comparable methodological approaches. Preliminary findings reveal several important gaps, including a strong geographic concentration of studies relative to the global disease burden, persistent trade-offs between spatial resolution and geographic coverage, and a growing but still limited uptake of machine learning methods in recent work.

These gaps highlight a critical opportunity for very high resolution (VHR) satellite imagery to capture fine-scale environmental features relevant to snail microhabitats. By identifying where current methodologies fall short, from geographic coverage and spatial resolution to modelling approaches, this review provides a foundation for future research directions. Ultimately, addressing these gaps could contribute toward more accurate disease risk mapping and field work, in the longer term, a dynamic global schistosomiasis risk map to guide public health intervention at scale.

ID: PP13

Title
Leakage Detection and Localisation in Water Distribution Networks using Deep Reinforcement Learning
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Keywords:
Water Leakage Detection, Water Leakage Localisation, Machine Learning, Deep Reinforcement Learning
Aim of the research:
This research aims to develop a deep reinforcement learning framework capable of detecting and localising leaks in water distribution networks directly from sensor data and evaluating the framework's performance across benchmark network topologies of increasing complexity.
Short summary:
Globally, water leakage remains a persistent challenge for water utilities, with non-revenue water losses placing increasing pressure on ageing infrastructure. Conventional hardware and software-based methods, such as acoustic sensors, supervised ML, can struggle to scale across large networks, generalise across operating conditions and require labelled datasets. Deep reinforcement learning (DRL) offers a promising alternative, framing leak detection and localisation as a sequential decision-making problem. Although, DRL has been extensively explored in fields such as robotics, its application to water distribution networks is limited particularly for joint leakage detection and localisation. This research formulates leak detection and localisation as a Markov decision process and develops a multi-head Deep Q-Network framework to solve it. Custom Gym-compatible environments, coupled with EPANET and WNTR hydraulic simulations, provide pressure, flow and demand-related observations at each timestep. Leak scenarios vary in location, severity, onset and duration, with leakage magnitude generated using dynamically sampled emitter coefficients. The agent learns first to identify leak presence and subsequently to localise the leaking junction. Localisation performance is evaluated using topological distance and pipe-path distance reported as a spatial measure. Experiments on the Anytown evaluate both fully observed and sparse sensor-based configurations. Under sparse sensor-based observability on Anytown using 6 pressure sensors across 19 junctions, the agent achieves

near-perfect leak detection with F1=99.98%, MCC=99.9% and localisation with 91.2% of leak exactly localised at node level. Net3 experiments further assess scalability to a more complex network, while work is continuing the larger D-Town and L-Town benchmarks and increasingly realistic partial-observability conditions.

The research contributes a simulation-based DRL framework for leakage detection and localisation, adding empirical evidence to an area of water infrastructure management where reinforcement learning remains largely underexplored, particularly for leak localisation

ID: PP14

Title:
Enhancing environmental sustainability and protection based on predictive phytoremediation control of wastewater systems using emotional ML
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Keywords:
artificial intelligence, IoT, wastewater, machine learning, Malaysia
Aim of the research:
The aim of the present research is to integrate new generation Emotional Artificial Neural Network (EANN), Gaussian Process Regression (GPR), Boosted Regression Tree (BRT), Hybrid Neuro-Fuzzy (HNF), and Wide Neural Network (WNN) models to predict oxidation reduction potential in phytoremediation of wastewater systems.
Short summary:
Water pollution remains a critical environmental issue with profound implications for ecosystems. Integrating field investigation, experimental lab, and soft computing approaches represents a novel contribution, enhancing the application of advanced machine learning models in environmental sustainability efforts and decision-making regarding the suitability of treated wastewater. This study assesses the efficacy of machine learning techniques, including Emotional Artificial Neural Network (EANN), Gaussian Process Regression (GPR), Boosted Regression Tree (BRT), Hybrid Neuro-Fuzzy (HNF), and Wide Neural Network (WNN), in predicting Oxidation Reduction Potential (ORP) during phytoremediation of wastewater. The findings reveal EANN's superior predictive accuracy of 95.6%, surpassing other techniques in phytoremediation systems. EANN also exhibits significantly lower error rates compared to GPR, WNN, BRT, and HNF, improving prediction accuracy by 4.18%, 18.63%, 8.87%, and 8.76%, respectively, and reducing errors by 13.88%, 37.46%, 34.84%, and 11.91%, respectively. These results underscore the EANN's effectiveness in enhancing ORP prediction accuracy, which is crucial for assessing wastewater remediation suitability. The study suggests that integrating advanced machine learning models improves predictive capabilities and aids in decision-making regarding the suitability of treated wastewater for various applications, thus advancing environmental sustainability efforts. This research aligns with the missions of sustainable development goals (SDGs) and environmental protection agencies (EPA) by aiming to improve water quality and ecosystem health through innovative technological solutions.

ID: PP15

Title:
Hyper-mesophilic temperature optimizes anaerobic digestion performance via feedstock-dependent microbial modulation
Author name(s):
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Affiliation(s):
University of Surrey
Keywords:
Hyper-mesophilic Anaerobic Digestion, Microbial Community, Temperature, Resource Recovery
Aim of the research:
To clarify how hyper-mesophilic environments and temperature shifts alter feedstock-dependent AD performance and core microbial mechanisms, revealing AD functional resilience to guide targeted industrial anaerobic digestion optimization.
Short summary:
Background & Aims: Anaerobic digestion (AD) is a key biotechnology for net-zero and circular economy, with temperature and feedstock as core regulators of biogas production. This study aimed to elucidate how hyper-mesophilic (40-50°C) conditions and temperature shifts affect agricultural AD performance, and the underlying microbial mechanisms linked to feedstock properties. Methods: Two feedstock types (starch-rich G, lignocellulose-rich M) were tested in CSTR digesters under 35/45/55°C and temperature shift regimes. We combined process performance monitoring (methane yield, VFA, IA/PA, viscosity) with multi-omics analyses (16S rRNA sequencing, PICRUSt2) to characterize microbial communities and functional pathways. Results: 45°C achieved the highest methane yield and system stability, with minor IA/PA fluctuations and low viscosity. Starch-rich feedstock showed larger methane yield drops upon temperature shifts but faster recovery, yet high susceptibility to 55°C with propionic acid accumulation. Hyper-mesophily enriched acetoclastic methanogens (Methanosarcina) and AM-dominant gene profiles; 55°C shifted to hydrogenotrophic methanogenesis (Methanothermobacter) and thermophilic taxa (Thermotogota). Lignocellulose-rich feedstock at 45°C exhibited enhanced cellulose/hemicellulose degradation genes, while starch-rich feedstock had enriched debranching enzymes. Conclusions: Hyper-mesophilic (45°C) is the optimal temperature for agricultural AD, with feedstock type mediating microbial community structure, functional pathway expression and system resilience to temperature fluctuations. This work provides microbial-guided strategies for temperature optimization in industrial agricultural AD systems.

ID: PP16

Title:
Investigating potential for phosphorus recovery from Hydrothermal Oxidation

solid residue
Author name(s):
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Affiliation(s):
Anglian Water/Imperial College London
Keywords:
Hydrothermal Oxidation, sludge, phosphorus
Aim of the research:
Multiple studies have investigated methods for recovery of phosphorus from incinerated sewage sludge ash. My proposed research seeks to apply a version of two-stage acid leaching to the solid residue from hydrothermal oxidation to analyse the yield of phosphorus, as well as potentially the waste product for use in construction aggregate.
Short summary:
Phosphorus is mined extensively, with supplies already running low in many areas of the world. Furthermore, concerns about micropollutants in sludge applied to land as fertiliser motivate an alternative method for recovery of phosphorus. Hydrothermal oxidation is a promising form of advanced thermal conversion which generates useful products from sewage sludge, including acetic acid, ammonia and hydrogen. Phosphorus in the solid residue is another potential revenue stream, but multiple extraction methods (cation adsorption, organic solvent extraction, ion exchange resins) each have their drawbacks. Single-stage acid leaching involves direct treatment of incinerated sewage sludge ash (ISSA) with, e.g., sulphuric acid, which dissolves phosphorus but also metal(loid)s, complicating downstream purification. A two-stage acid-leaching method has been developed for incinerated sewage sludge ash (ISSA) by Fang et al. (2018). First, ethylenediaminetetraacetic acid (EDTA) is used to leach metal(loid)s, removing them from the ash matrix. Limited P is extracted in this step because of preferential binding based on ionic charge and size. Sulphuric acid is then used to extract most of the P by dissolving phosphate minerals, releasing P into solution. After leaching, pH adjustment (using NaOH or Ca(OH)₂) is used to precipitate phosphorus as calcium phosphate for fertiliser use. My research aims to replicate this process with the solid residue from HTO. I first seek to do a compositional analysis of HTO residue in comparison to ISSA; it has been heated to between 175C and 250C, significantly lower

than the temperatures at which incineration occurs, and it is a wet process, so phosphorus availability will differ. I then seek to do a run of HTO samples with the 2-stage acid leaching process, ultimately analysing the results via X-ray diffraction, X-ray fluorescence, and Inductively Coupled Plasma Optical Emission Spectroscopy. I also aim to analyse the remaining solid residue after leaching for suitability as a construction aggregate.

References

Fang, L., Li, J., Donatello, S., Cheeseman, C.R., Wang, Q., Poon, C.S. & Tsang, D.C.W. (2018) Recovery of phosphorus from incinerated sewage sludge ash by combined two-step extraction and selective precipitation. *Chemical Engineering Journal*. 348, 74–83. doi:10.1016/j.cej.2018.04.201.

ID: PP17

Title:
Enhancing the removal of phosphorus from waste-water streams through the sonocrystallisation of struvite
Author name(s):
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Keywords:
Struvite, Phosphates, Dairy Effluent, Sonocrystallisation
Aim of the research:
Phosphates are being removed from dairy manure streams via the ultrasound-enhanced precipitation of struvite. This project aims to optimise the operating conditions of this process to maximise phosphate recovery while minimising chemical pre-treatment and energy use.
Short summary:
A drive for more sustainable phosphorus sources in fertilisers, alongside increasing pressure to minimise phosphate environmental pollution has led to an increased interest in the phosphorous recovery of wastewater streams. One technology is the crystallisation of struvite (magnesium ammonium phosphate) from wastewater, which can be used directly as a fertiliser. In order to enhance phosphorous removal from waste streams, as well as produce crystals with more favourable physical properties, ultrasound has been proposed as a solution. Sonocrystallisation of struvite has been shown to be beneficial, but only on small scale, batch systems. Dairy manure slurries

have high concentrations of phosphorous, famously difficult to process, and are present in large quantities in the local area with no other treatment avenues, and as such were selected as a feedstock.

Optimisation experiments with synthetic manure have allowed for minimisation of sonication time, while additionally enhancing phosphate recovery by 30%, even at lower pH values. Evaluation of kinetics shows a four times increase in reaction rates and significant reductions of induction time when sonication is applied.

Preliminary pilot scale testing with dairy manure slurry showed promising results, with an increase of between 25-50% phosphorus recovery when sonicated, depending on final pH. The poor settleability and high suspended solids however poses challenges, including pH control and crystal recovery.

ID: PP18

Title:
Low-Cost Electrospun Photothermal Membranes for Solar-Driven Water–Electricity Cogeneration
Author name(s):
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Affiliation(s):
University of Surrey, Guildford, United Kingdom
Keywords:
Solar interfacial evaporation; Electrospinning; Water purification; Thermoelectric generation
Aim of the research:
To develop a low-cost electrospun membrane evaporator for efficient solar-driven seawater production, while investigating how membrane structure influence evaporation and whether the resulting temperature gradient can be used for simultaneous thermoelectric power generation.
Short summary:
Solar-driven interfacial evaporation offers a low-energy route for seawater desalination and wastewater treatment, but practical performance depends on efficient light absorption, water transport, vapour release and heat management. In this study, electrospun Nylon membranes were combined with multi-walled carbon nanotubes (MWCNTs) by vacuum filtration to form a lightweight photothermal evaporator. The hydrophilic fibrous substrate continuously supplies water, while the MWCNT layer provides more than 95% broadband absorption across 250–2500 nm and converts solar irradiation into localised heat.

Optimisation of membrane grammage, fibre structure and MWCNT loading produced a maximum evaporation rate of $2.05 \text{ kg m}^{-2} \text{ h}^{-1}$ under one-sun irradiation. Oxygen-plasma treatment improved surface wettability and further increased the rate to $2.13 \text{ kg m}^{-2} \text{ h}^{-1}$. To recover part of the low-grade heat that would otherwise be lost to the bulk water, a thermoelectric generator was integrated beneath the evaporator. The temperature difference between the solar-heated interface and the water-cooled side generated stable electrical output. Load-resistance measurements showed a clear maximum-power region near electrical resistance matching, confirming the feasibility of coupling clean-water production with waste-heat electricity generation. This multifunctional platform provides a scalable approach for solar water purification and small-scale energy recovery.

ID: PP20

Title:
Fluoride-free MXene-derived membranes for electrocatalytic nitrate to ammonia conversion
Author name(s):
Corin T. Scott
Affiliation(s):
University of Bath
Keywords:
MXene, electrocatalysis, nitrate, ammonia
Aim of the research:
Developing sustainable, fluoride-free synthesis methods for MXenes, and stabilising MXene membranes with polymers of intrinsic microporosity (PIMs). These membranes can be applied for wastewater treatment, such as the circular electrochemical nitrate reduction reaction to ammonia (eNtRR).
Short summary:
The circular conversion of aqueous nitrate waste to valuable ammonia using an electrocatalytic membrane could potentially alleviate environmental risk and simultaneously supplement green ammonia production. MXenes are 2D nanomaterials which have been investigated for extensive electrochemical and water treatment applications, often as membranes. However, their synthesis presents a major bottleneck to further research and application, typically requiring harsh HF/fluoride-containing etching conditions and lengthy delamination procedures. Reported fluoride-free synthesis methods suffer from low yield and quality, hindering facile construction and resulting strength of MXene membranes. Here, environmentally friendly low-concentration basic alkylammonium etchants

allow for simultaneous delamination for a more efficient synthesis. Additionally, Polymers of Intrinsic Microporosity (PIMs), rigid polymers with high porosity and processability, are used for the construction of layered PIM-EA(H₂)-TB/MXene membranes, preserving MXene membrane properties, improving stability and strength, whilst unique pore structures affect reactivity and catalysis.

ID: PP21

Title:
Engineering Next-Generation Faradaic Electrodes for Sustainable Energy-Efficient Brackish Water Desalination by Capacitive Deionization
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Keywords:
Capacitive Deionization (CDI); Brackish Water Desalination; Faradaic Charge-Assisted Electrodes; Sustainable Water Treatment
Aim of the research:
To engineer next-generation redox-active carbon electrodes that overcome the limitations of conventional capacitive deionization, delivering high desalination efficiency, low energy consumption, and long-term stability for sustainable freshwater production, contributing to UN SDG 6 (Clean Water and Sanitation) and SDG 9 (Industry, Innovation and Infrastructure).
Short summary:
Freshwater scarcity has intensified the demand for energy-efficient desalination technologies for low salinity water treatment. Capacitive deionization (CDI) has emerged as a promising alternative because of its low energy consumption, ambient operating conditions, and reversible electrosorption mechanism. However, conventional activated carbon electrodes suffer from limited ion-storage capacity, sluggish charge-transfer kinetics, and poor long-term electrochemical stability. This study presents the engineering of two generations of faradaic charge-assisted carbon-based electrodes to enhance desalination performance through synergistic capacitive and pseudocapacitive charge-storage mechanisms. The first-generation electrode consisted of a sustainable three-dimensional cellulose fiber-supported Fe₃O₄ nanoparticle-modified activated carbon (Fe₃O₄-AC/CF) composite synthesized via a green approach. The porous cellulose framework promoted efficient electrolyte diffusion, while uniformly dispersed Fe₃O₄ nanoparticles introduced reversible Fe²⁺/Fe³⁺

redox-active sites for enhanced ion storage. Under optimized conditions (1.2 V), the electrode achieved a salt adsorption capacity (SAC) of **68.57 mg g⁻¹**, a salt adsorption rate (SAR) of **1.15 mg g⁻¹ min⁻¹**, a charge-transfer resistance of **5.67 Ω**, a coulombic efficiency of **99.99%**, and a low specific energy consumption of **1.94 kWh m⁻³**.

To further improve desalination performance, a second-generation Fe-GO/AC electrode was developed by integrating iron nanoparticle-modified graphene oxide with activated carbon through a scalable one-pot synthesis. The conductive graphene oxide network accelerated electron transport, while iron nanoparticles provided abundant faradaic active sites, significantly enhancing charge-transfer kinetics and electrosorption efficiency. The optimized Fe-GO/AC electrode exhibited a specific capacitance of **241 F g⁻¹**, a charge-transfer resistance of **1.85 Ω**, and an SAC of **109.8 mg g⁻¹** for a 1000 mg L⁻¹ NaCl solution at 1.2 V, with excellent regeneration stability over **100 adsorption-desorption cycles**.

These findings demonstrate that faradaic charge-assisted carbon electrode engineering significantly improves ion transport, charge-storage capability, and desalination efficiency, providing a scalable and energy-efficient strategy for next-generation CDI systems for sustainable brackish water desalination

ID: PP22

Title:
Biochar-Amended Constructed Wetlands for Heavy-Metal Removal from Airport Runoff: Evidence and Research Needs
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Keywords:
Biochar; constructed wetlands; wastewater treatment; airport runoff
Aim of the research:
To critically evaluate biochar-amended constructed wetlands for heavy-metal removal from contaminated runoff, with particular emphasis on copper and zinc, by synthesising evidence on treatment performance and retention mechanisms, and identifying the knowledge gaps that must be addressed for their application to airport runoff treatment.

Short summary:

Airport runoff can mobilise heavy metals from aircraft operations, ground vehicles and infrastructure into receiving waters. Copper (Cu) and zinc (Zn) are of particular concern because of their persistence and potential ecological effects. Their effective removal without increasing the energy and chemical demands of water treatment presents an important sustainability challenge.

Constructed wetlands (CWs) offer a low-energy, nature-based treatment approach, but conventional substrates may have limited capacity for sustained metal retention. Biochar could enhance this function by transforming the wetland substrate into a more reactive treatment medium. Its porous structure and surface chemistry promote metal retention through adsorption, ion exchange, surface complexation and mineral precipitation.

Published evidence demonstrates considerable, but highly variable, treatment potential. Across reported biochar-filled CW studies, Cu removal ranged from approximately 22–45%, while Zn removal ranged from 67–100%. This variability is scientifically important: treatment performance depends on biochar properties, water chemistry, hydraulic loading and competing contaminants. Consequently, high removal observed under controlled conditions cannot be assumed to translate directly to complex runoff systems.

A critical gap therefore exists between established material-scale metal retention and system-scale application. Biochar-amended CWs remain insufficiently evaluated for Cu and Zn removal under representative airport-runoff conditions, particularly under mixed-contaminant loading and extended operation. Bridging this gap requires moving beyond conventional batch adsorption towards realistic evaluation of treatment systems. This synthesis defines the evidence base and research priorities for ongoing.

ID: PP23

Title:
Reclaiming the Rain: Quantifying the Multifunctional Subsurface and Sediment Benefits of Leaky Dams
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Affiliation(s):
University of Surrey, Suffolk County Council, CIWEM, Association of SuDS Authorities
Keywords:
Multifunctional Benefits Leaky Dams
Aim of the research:

The research demonstrates how Leaky Woody Dams regulate sediment, nutrients, and subsurface water storage across UK catchments, using multi-year sensor data to evidence their wider multifunctional benefits of water-quality and drought-resilience alongside flood resilience. It provides practitioners with scalable, empirical insight to support integrated, climate-resilient catchment management.

Short summary:

As the UK flood sector shifts toward Nature-Based Solutions, a critical evidence gap remains regarding the multifunctional benefits of Leaky Woody Dams (LWDs) beyond hydraulic peak attenuation. Addressing urgent water quality and availability challenges requires an interdisciplinary systems approach to water engineering. This research, conducted as part of a postgraduate program at the University of Surrey, presents a comparative analysis of LWD performance across three UK catchments, integrating multi-year sensor data with primary field research supported by the Suffolk County Council 'Reclaim the Rain' project.

To tackle pollutant measurement, monitoring, and risks, high-frequency turbidity and flow data are paired with hysteresis analysis to decode complex sediment dynamics. Findings indicate that while LWDs effectively intercept "near-source" particulate matter during moderate events, they are dynamic systems that remobilize stored material during high-magnitude storms; a vital consideration for long-term catchment and water quality management. Furthermore, a strong correlation ($r > 0.95$) between total phosphorus and turbidity confirms that trapping sediment directly mitigates downstream nutrient risks.

Crucially, this work highlights engineering innovation and implementation by demonstrating how low-cost sensor networks can drive smarter catchment decision-making. Primary soil moisture monitoring in Suffolk reveals a significant 3–8% increase in volumetric water content at depths of 600–1000mm. This proves that LWDs facilitate lateral seepage into riparian banks, recharging the "subsurface sponge" to support ecosystem baseflows and drought resilience rather than relying solely on vertical infiltration.

By quantifying subsurface water storage and sediment regulation, this framework moves beyond traditional silos. It provides practitioners, policymakers, and communities with the scalable, empirical data needed to leverage Biodiversity Net Gain (BNG) and Environmental Land Management schemes (ELMs); ultimately unlocking integrated funding to build equitable, climate-resilient water systems for both people and ecosystems.

ID: PP24

Title:
The fate of phosphate (and chlorine) in drinking water distribution systems
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University of Sheffield / Spring
Keywords:
Chemicals, chlorine, lead, networks phosphate
Aim of the research:
To improve the understanding of distribution chemicals and their impacts on water quality.
Short summary:
Chemicals are added to treated drinking water to protect water quality during long residence times within ageing drinking water distribution systems (DWDS). The impacts and benefits of this, phosphate dosing to mitigate lead exposure risks in particular, in operational systems are not fully understood and hence dosing practices may not be optimal. Regulatory sampling data from the water treatment works (WTW) outlet and at customers taps from six contrasting systems for a six-year period were analysed (2014-2020). Results showed the expected variation in chlorine decay throughout the DWDS as a function of the source water, network infrastructure and residence time. Phosphate concentrations had no measurable change detected from the WTW to the customer tap, irrespective of seasonal dose. As phosphate concentrations at the WTW increased seasonally, at times doubling, the phosphate concentrations at the tap followed suit, questioning the effectivity of this increased seasonal dosing. This is significant given the increasing costs, decreasing availability and wider environmental concerns around phosphate.

ID: PP25

Title:
Assessment of illegal dumping waste and Its impact on Urban Drainage in Ambo Town, Ethiopia
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Keywords:

Urban Sanitation; Solid Waste; drainage; Flooding
Aim of the research:
To assess illegal solid waste dumping practices in Ambo Town and examine their impact on urban drainage system, seasonal flooding, environmental sanitation, and public health, with the aim of identifying priority intervention areas and supporting evidence based-urban sanitation planning.
Short summary:
Rapid Urbanization and inadequate solid management have increased pressure on urban drainage system in many Ethiopian Towns. In Ambo Town, Illegal disposal of household, commercial and market waste into drainage channels and nearby rivers has become a major environmental concern, contributing to drainage blockage, flooding during rainy season and deteriorating public health conditions. This assessment was conducted as a part of city wide inclusive sanitation (CWIS) field assessment to identify illegal sold waste dumping hotspots and evaluate their impacts on urban drainage and surrounding community. Field observations, photographic documentation and site inspection were carried out across several location, including almost all kebeles of Ambo Town as well as section of Huluka River, were assessed. The assessment found that drainage channel are widely used as informal dumping sites for household waste, market refuse, plastics and other solid waste. In several location of Ambo Town, drainage channels were partially or completely blocked, reducing storm water flow capacity and increasing flood risk during the rainy season. Waste accumulation also created unsanitary condition, unpleasant odours, and potential breeding sites for disease vectors, negatively affecting nearby residents and businesses. The findings highlights the urgent need to strength solid waste collection services, improves community awareness and behavioral change, enforce environmental regulations, and integrate drainage maintenance into urban sanitation planning. The assessment demonstrates how simple field-based evidence can support local authorities in prioritizing interventions that improve urban resilience, protect public health and promote sustainable city-wide sanitation.

ID: PP26

Title:
Seasonal Variation of Physicochemical and Bacteriological Characteristics of Groundwater Around Selected Cemeteries in Ogbomoso, Nigeria
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Keywords:
groundwater, cemetery, water quality, season
Aim of the research:
The aim of the research is to evaluate how the variation in seasons affect the physicochemical and bacteriological characteristics of groundwater around selected cemeteries in Ogbomoso, Oyo State, Nigeria
Short summary:
Groundwater is one of the natural resources with different physicochemical parameters that are essential for the wellbeing of individuals. However, ground water is usually impacted by anthropogenic activities, hence, this study was to evaluate the seasonal variation of physicochemical and bacteriological characteristics of groundwater around selected cemeteries in Ogbomoso, Oyo State, Nigeria. Samples were collected during rainy and dry seasons in two wells around two cemeteries and another well far from the cemeteries which is the reference. The physicochemical parameters of the samples were analyzed immediately according to standard methods while some were kept and digested for heavy metals analysis. The results revealed that the water was generally near-neutral to slightly alkaline, with pH values ranging from 6.68 in the rainy season to 8.77 in the dry season, which is within recommended limits. Turbidity was relatively low to moderate, varying between 2.89 and 7.59 NTU, while electrical conductivity increased during the dry season, reaching a maximum mean value of 132.60 $\mu\text{S}/\text{cm}$, indicating higher ionic concentration. Indicators of organic pollution were pronounced in the dry season, as biochemical oxygen demand and chemical oxygen demand increased to mean values of 6.47 mg/L and 35.7 mg/L, respectively, exceeding recommended limits. Heavy metal assessment showed low chromium concentrations (≤ 0.03 mg/L) and iron levels close to permissible values, whereas lead concentrations reached 0.06 mg/L, exceeding recommended limits. Bacteriological analysis revealed significant microbial presence, with total colony counts up to 70.67 cfu and detectable <i>Escherichia coli</i> and <i>Staphylococcus aureus</i> , indicating fecal contamination and potential public health risks. Overall, the groundwater from cemetery-associated wells showed physicochemical alterations and microbial contamination, indicating potential health risks. Groundwater around the cemeteries should be situated far from the sites of burial in order to safeguard the well water quality.

Title:
Influence of NOM, iron oxide, and mixed fouling on ceramic membrane performance
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University of Edinburgh, Heriot Watt University, and Scottish Water
Keywords:
Ceramic membranes; Fouling; Inorganic; Organic
Aim of the research:
This research aims to quantify how natural organic matter (NOM), iron oxide colloids, and mixed NOM-iron systems influence flux decline, rejection behaviour, and fouling reversibility in ceramic membranes. It also evaluates how a conditioning step can reduce the substantial initial variability observed in membrane permeance and rejection.
Short summary:
Natural organic matter (NOM), iron oxide colloids, and their mixtures are key foulants in drinking-water treatment, yet their individual and combined impacts on ceramic nanofiltration (NF) membranes remain insufficiently understood. This study examines how these foulants influence water and solute transport in tubular ceramic NF membranes operated under controlled crossflow conditions. Initial membrane performance varied substantially across nominally identical modules and was further complicated by instability during foulant-free operation. In low-ionic-strength water, permeance declined markedly over the 48-hour period and rejection increased from negligible levels to values characteristic of a fully charged surface, indicating progressive hydration and charge development. A conditioning step was therefore required to stabilise both permeance and rejection, reducing baseline variability and enabling reproducible comparison of subsequent fouling behaviour. NOM alone caused pronounced flux decline (55%) and disrupted solute rejection, consistent with strong adsorption, pore constriction, and restructuring of the membrane's electrostatic environment. In contrast, iron oxide colloids interacted only weakly with the ceramic surface, producing negligible changes (<5%) in flux or rejection. When NOM and iron oxide were present together, fouling behaviour was governed primarily by NOM. Mixed fouling produced a moderated form of NOM-driven flux decline (45%). Hydraulic cleaning restored membrane performance to varying degrees depending on foulant type. Iron-oxide runs showed no distinct change, while NOM-induced fouling showed limited recovery (<2%). Mixed fouling similarly

exhibited limited reversibility (<5%), reflecting the dominance of organic adsorption over particulate deposition.

Overall, the results demonstrate that NOM is the principal driver of ceramic NF fouling, iron oxide contributes minimally, and combined fouling behaves as a softened variant of NOM-only fouling. The conditioning step proved essential for reducing baseline variability and enabling mechanistic interpretation. These insights highlight the interplay between membrane surface chemistry and foulant behaviour and support the development of more robust ceramic NF processes for drinking-water treatment.

ID: PP28

Title:
Evaluating Adsorption Systems for PFAS Removal in the Presence of NOM and Co-Contaminants Using GAC and Ion Exchange Media
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Keywords:
PFAS, Activated carbon, Drinking water treatment
Aim of the research:
To evaluate the performance of single- and two-stage adsorption systems, comprising GAC (granular activated carbon) and IEX (ion exchange) media, for the simultaneous removal PFAS, DOC and pesticides from UK surface water, and to identify treatment configurations and operating conditions capable of effective multi-contaminant control.
Short summary:
Per and polyfluoroalkyl substances (PFAS) are persistent contaminants that present a significant challenge to conventional drinking water treatment. In real water matrices, PFAS occur as complex mixtures alongside natural organic matter and other micropollutants, which can reduce adsorbent capacity and alter breakthrough behaviour. This study used rapid small-scale column test (RSSCT) to compare single and two stage adsorption configurations for the simultaneous removal of PFAS, dissolved organic carbon (DOC) and pesticides from partially treated surface water. Eight PFAS and two pesticides were assessed using breakthrough behaviour, load-normalised removal and apparent second-stage adsorption contributions. PFAS removal was strongly governed by compound physicochemical properties and media configuration. Short-chain PFAS showed the earliest breakthrough and remained the limiting compounds across all configurations

tested. The two-stage granular activated carbon (GAC) configuration, F400 (stage-1) followed by F400 (stage-2) provided the best all-round performance across PFAS, DOC and pesticides. Among GAC-ion exchange (IEX) hybrid configurations tested F400 GAC followed by TP109 IEX provided the strongest PFAS control except for the zwitterionic fluorotelomer 6:2 FTAB. No single configuration simultaneously optimised PFAS, DOC and pesticide removal. GAC-GAC lead-lag configurations provided the most practical basis for multi-contaminant control in the tested water matrix, supporting further investigation of carbon media sequence and empty bed contact time (EBCT) optimisation.

ID: PP29

Title:
Metal-Metal Antagonism and Synergy: Copper and Cadmium Co-Exposure Alters Plant Physiology and Bioaccumulation
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Short summary:
Heavy metal mixtures pose greater risks to agroecosystems than individual metal contaminants; however, the interactions between essential and non-essential metals and their regulation by chemical and hormonal amendments remain poorly understood. This study investigated the interactive toxicity of non-essential cadmium (Cd) and essential copper (Cu), and evaluated the mitigating effects of EDTA (5 mM) and indole-3-acetic acid (IAA; 5 µM) in sunflower (<i>Helianthus annuus</i>) and maize (<i>Zea mays</i>). Exposure to Cd and Cu (50 mg kg ⁻¹), individually or in combination, significantly inhibited plant growth and disrupted physiological processes. Combined metal exposure reduced chlorophyll content and altered hormone balance, antioxidant-related metabolites, and osmoprotectant accumulation, with stronger responses observed in sunflower. Notably, IAA decreased by >60% in sunflower under combined stress, whereas maize showed increased IAA under single-metal exposure, indicating species-specific stress regulation. Metal accumulation patterns revealed a dynamic transition

from antagonistic to synergistic interactions: Cu reduced Cd uptake by 63% in maize during early exposure, while prolonged Cd exposure enhanced Cu accumulation by approximately five-fold in maize and two-fold in sunflower. Sunflower exhibited greater Cd tolerance, whereas maize demonstrated higher Cu accumulation capacity. Application of EDTA and IAA partially alleviated metal toxicity by improving chlorophyll retention and shoot growth compared with combined metal stress alone. These findings demonstrate that Cd–Cu interactions are highly species-dependent and temporally dynamic, highlighting the importance of understanding mixed-metal behaviour for developing sustainable strategies to manage metal-contaminated agricultural systems and protect ecosystem health.

ID: PP30

Title:
Jeevarekha: Reframing Urban Water Corridors as Living Ecological Infrastructure through Systems Thinking and Nature-Based Solutions
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Short summary:
Urban water resilience is increasingly challenged by fragmented governance, ageing infrastructure, climate variability, and the continued separation of ecological processes from urban development. In many semi-arid Indian cities, historically interconnected networks of lakes, canals, wetlands, and drainage corridors that once regulated hydrology, supported biodiversity, sustained livelihoods, and shaped cultural landscapes have progressively been reduced to engineered drainage infrastructure. While nature-based solutions are increasingly promoted for climate adaptation, their integration with historical water systems, indigenous knowledge, and urban design remains underexplored, particularly in rapidly urbanising secondary cities. This research investigates the 25 km Purnaiah Nāla in Mysuru, India, as a representative urban water corridor and explores how neglected drainage infrastructure can be reimagined as a multifunctional blue–green ecological spine. Using a qualitative, multi-scalar methodology that combines archival research, spatial and systems mapping, field observations, stakeholder interviews, and comparative precedent analysis, the study examines the corridor across watershed, city, and neighbourhood scales to identify hydrological discontinuities, governance fragmentation,

and socio-ecological opportunities.

The principal contribution of the research is the development of the Jeevarekha (Line of Life) Integrative Framework, a systems- based approach that synthesises ecological limits, ethics of care, indigenous water knowledge, and nature-based solutions into an operational methodology for regenerative urban water planning. Through a transect-based spatial strategy, the framework demonstrates how context-sensitive interventions including floodplain restoration, groundwater recharge landscapes, riparian ecological corridors, regenerative agriculture, and community stewardship can collectively enhance water resilience, biodiversity, public health, climate adaptation, and everyday human-nature relationships.

Grounded in the case of Mysuru yet transferable to ongoing global nature-climate-community discourses in urban contexts, the research argues that regenerating urban water corridors is not solely an ecological or engineering challenge, but a socio-ecological design and governance challenge requiring integrated, place-based approaches. By bridging landscape ecology, urban design, indigenous knowledge, and collaborative stewardship, the study contributes an interdisciplinary framework for reimagining urban water corridors as living ecological infrastructure and shared civic commons, for resilient and climate-adaptive water futures.

ID: PP31

Title:
Modular Floating Duckweed Systems with Low-Cost IoT for Nutrient Recovery in Zambia
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Keywords:
wastewater treatment, nature-based solutions, duckweed, nutrient recovery
Aim of the research:
This research validates and optimizes a modular floating duckweed system integrated with low-cost IoT monitoring to enhance nitrogen and phosphorus removal from peri-urban wastewater in Lusaka. It evaluates engineering performance of decentralized nature-based treatment while assessing biomass productivity as a resource recovery co-benefit.
Short summary:
Peri-urban areas of Lusaka discharge over 70% of wastewater untreated, driving eutrophication and nitrate levels exceeding 29 mg/L in

shallow wells. Conventional duckweed systems suffer from biomass sinking, irregular harvesting, and limited process control under tropical variability, constraining reliable nutrient removal.

This study addresses these engineering challenges through MoDuck — a modular floating wetland fabricated from locally available materials (HDPE pipes, foam, bamboo, permeable mesh). The design maintains *Lemna spp.* on the surface for consistent nutrient uptake and simplified harvesting. Integrated low-cost Arduino/Raspberry Pi IoT sensors monitor temperature, pH, turbidity, and biomass density in real time. Sensor data enables feedback control for harvesting cycles and process optimization.

Preliminary bench-scale trials with real Lusaka wastewater demonstrated effective biomass retention, rapid growth, and measurable nutrient uptake over 10–14 day cycles. Following the advancement to the semi-finals of the project to the World Food Forum Youth Innovation Transformative Research Challenge, with additional funding the replicated pilot trials will quantify system performance: targets include $\geq 70\%$ Total Nitrogen and $\geq 60\%$ Total Phosphorus removal, alongside biomass productivity and long-term stability under variable conditions.

This investigation contributes to the development of scalable, data-driven nature-based solutions for decentralized wastewater treatment. By combining modular physical design with digital monitoring, the system offers improved robustness and control compared to existing approaches, supporting engineering advances in resource recovery and climate-resilient water management in resource-limited settings.

ID: PP32

Title:
Up-flow Compact Constructed Wetland based Sewage Treatment Plant (UCCW based STP): Design, Optimization, and Field-Scale Implementation
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Short summary:
The increasing demand for compact, low-energy, and decentralized sewage treatment systems has highlighted the limitations of conventional wastewater treatment technologies. This study presents the design and

development of a patented technology, namely Up-flow Compact Constructed Wetland-based Sewage Treatment Plant (UCCW based STP), which integrates primary, secondary, and tertiary treatment processes within a single compact unit. The system was operated for 720 days under varying hydraulic retention times (HRTs) to evaluate its long-term performance and treatment efficiency. Optimum performance was achieved at 36 h HRT, with removal efficiencies of TSS (96%), BOD (90%), COD (86%), TN (70%), TP (65%), and FC (99%). To further improve process efficiency, a hybrid configuration consisting of an Up-flow Floating Surface Constructed Wetland (UFSCW) followed by an Up-flow Constructed Wetland (UCW) was developed, which reduced the optimum HRT to 24 h while maintaining comparable treatment performance. Statistical optimization using response surface methodology confirmed the reliability and robustness of the system. The developed technology requires only ~1 m²/KLD of land area and minimal energy input, making it suitable for decentralized applications. Field-scale implementation at multiple sites ranging from 3 to 400 KLD demonstrates its scalability and practical applicability for decentralized wastewater treatment. The technology aligns with national sustainability goals and supports India's vision for sustainable sanitation under the Viksit Bharat 2047 mission.

ID: PP33

Title:
Blue Carbon Ecosystems as Nature-Based Solutions for Water Quality Improvement and Sustainable Small-Scale Fisheries: Insights from Coastal India
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Short summary:
Water quality degradation is one of the most pressing threats to coastal ecosystems and the livelihoods of millions of people who depend on small-scale fisheries. While engineering interventions often focus on end-of-pipe treatment and pollution control, increasing attention is being given to nature-based solutions that simultaneously improve ecosystem health, enhance water quality, and strengthen community resilience. Blue carbon ecosystems, including seagrasses, mangroves, and salt marshes, offer significant

potential to provide these multiple benefits, yet their role in integrated water governance remains underexplored. This research examines the interconnected relationships among blue carbon ecosystems, water quality, ecosystem services, and small-scale fisheries using case studies from coastal India. Drawing on a mixed-methods approach that combines water quality assessment, ecosystem service analysis, participatory stakeholder engagement, governance analysis, and social-ecological systems thinking, the study explores how healthy coastal habitats contribute to nutrient cycling, sediment stabilization, carbon sequestration, biodiversity conservation, and fisheries productivity while supporting local livelihoods. Building on the Social-Ecological Vulnerability–Viability Nexus (SEVVN) Framework, the research demonstrates how improvements in water quality and ecosystem condition can create pathways from vulnerability toward more resilient and sustainable coastal communities. The findings highlight that effective water management requires integrating ecological restoration with governance, community participation, and locally grounded knowledge rather than relying solely on technical interventions. The study contributes to broader discussions on interdisciplinary water governance by illustrating how blue carbon ecosystems can function as nature-based infrastructure for improving coastal water quality while advancing climate adaptation, biodiversity conservation, and equitable fisheries management. It offers practical insights for policymakers, practitioners, and researchers seeking integrated approaches to achieving sustainable water management and resilient coastal social-ecological systems. The work demonstrates how combining engineering, environmental science, and participatory governance can generate actionable knowledge to support both ecosystem restoration and water security in rapidly changing coastal environments.

ID: PP34

Title:
Lab-Scale Treatment of Synthetic Textile Wastewater Using Okra Seed and Pod as Natural Coagulants
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Keywords:
textile wastewater; okra seed; natural coagulant; bioflocculation; sustainable water treatment

Short summary:

Textile wastewater contains dyes, suspended solids, and organic pollutants that can adversely affect aquatic ecosystems and public health. Conventional chemical coagulants may be costly and can generate chemically contaminated sludge. This preliminary laboratory study evaluated okra (*Abelmoschus esculentus*) seed and pod powders as locally available, biodegradable treatment materials for synthetic textile wastewater.

Okra seeds and pods were washed, dried, pulverised and sieved. Batch treatment experiments were conducted using dosages of 0.2–0.5 g per 50 mL of synthetic textile wastewater under varying pH and contact-time conditions. Treatment performance was evaluated using pH, turbidity, chemical oxygen demand (COD) and biochemical oxygen demand (BOD). Percentage removal was calculated relative to the untreated wastewater.

The untreated wastewater had a turbidity of 50 NTU, COD of 500 mg/L and BOD of 300 mg/L. At the highest tested dosage of 0.5 g, okra seed treatment reduced turbidity to 7 NTU, COD to 200 mg/L and BOD to 70 mg/L, corresponding to removal efficiencies of 86.0%, 60.0% and 76.7%, respectively. Okra pod treatment reduced turbidity to 8 NTU, COD to 250 mg/L and BOD to 70 mg/L, representing removal efficiencies of 84.0%, 50.0% and 76.7%, respectively. Both materials improved wastewater clarity, while okra seed produced the greatest turbidity and COD reductions.

Okra seed and pod powders demonstrated potential as low-cost natural treatment materials for reducing particulate and organic pollution in synthetic textile wastewater. Further controlled experiments, including replication and independent optimisation of dosage, pH, mixing and contact time, are required before practical implementation.