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Day 1: Plenary Presentations

Untangling Plastics: Reaching the Post-plastic Age for Sustainability

Bob Gedert*

Xavier University, Ohio, United States

Abstract

Untangling plastics: Reaching the post-plastic age for sustainability plastics are made from fossil fuels, and in every step in a piece of plastic's lifecycle, from creation to destruction, it negatively impacts our Earth. And yet, more and more plastics are being produced every day, even as we scrounge for ways to reduce carbon emissions. We can no longer afford to ignore the connection between plastic and climate change. Untangling plastics is a comprehensive investigation of the manufacturing, use, and disposal of plastics and their impact on the health of the environment and human beings. Bob Gedert pulls from current research and his forty-five-year career in the recycling industry to reveal how our current methods for addressing the issue of plastics have been insufficient and instead supplies real solutions for how we can adopt greener ways of living. With step-by-step plans to phase plastics out of society, Bob provides actionable strategies and resources so individuals can change their consumer practices to slow the effects of environmental destruction. Our planet has already been irreversibly damaged by the impact of plastics, and we will never successfully limit climate change if we can't untangle ourselves from the creeping web of plastics.

Keynote Presentations

Mining the Species-rich Clarion–Clipperton Fracture Zone is Unnecessary; Minerals can be Recovered by the Circular Economy

Eugene D. Gallagher[1]* and George D. F. "Buz" Wilson[2]

[1]*School for the Environment, University of Massachusetts Boston, Massachusetts, United States*

[2]*Saugatuck Natural History Laboratory, Michigan, United States*

Abstract

The Clarion–Clipperton fracture zone (CCFZ) spans ~6 million km^2 of the equatorial Pacific and harbors exceptional benthic diversity driven by polymetallic-nodule habitat heterogeneity. A single 0.25 m^2 box core may contain just ~100 macrofaunal individuals yet ~60 species-most new to science—with high turnover yielding few species shared among samples just kilometers apart. The species richness of CCFZ benthic macrofauna exceeds that of rainforest trees and ranks among the highest benthic diversities reported globally at any depth. Sedimentation rates near ~1 mm per thousand years imply that mining scars would persist for centuries. Benthic species adapted to little or no sedimentation could be harmed by plumes resuspended by collectors. Mining activities may also affect midwater pelagic communities through noise and dispersed nodule fragments, some of which are measurably radioactive. Economically, the case for nodule mining is weakening. Battery-chemistry shifts have reduced dependence on several target metals, and nickel alone is unlikely to justify multibillion-dollar capital outlays. In contrast, circular-economic strategies, especially by-product recovery from existing mines—could meet domestic demand for critical metals and rare-earth elements while creating jobs and avoiding irreversible ocean-ecosystem loss. We argue that National Oceanic and Atmospheric Administration and other federal policymakers should reject seabed-mining licenses and instead prioritize: (1) retention of multistage, science-based licensing and environmental review; (2) transparent, peer-reviewed publication of environmental data; and (3) investment in by-product recovery and geometallurgy. The CCFZ's irreplaceable biodiversity, together with robust circular-economy alternatives, provides compelling scientific and economic grounds to forgo mining altogether.

Resource Recovery for a Circular Economy: Case Studies from E-waste, Agro-waste, Wastewater, and Hazardous Waste Remediation

Sukalyan Sengupta*

University of Massachusetts Dartmouth, United States

Abstract

The circular economy is a critical component of sustainable environmental management. To achieve this goal, the recovery of critical resources from various waste streams is necessary. We will present case studies from the domains of aquaculture, e-waste recycling, wastewater treatment, and hazardous waste remediation, demonstrating the potential of innovative treatment processes that are both sustainable and economically viable in recovering critical resources.

Specific applications will include:

- Recovery of critical metals (e.g., lithium, cobalt, and manganese) from end-of-life lithium-ion batteries;
- Recovery of nutrients (nitrogen and phosphorus) from aquaculture effluents;
- Recovery of nutrients (nitrogen and phosphorus) from municipal wastewater;
- Recovery of heavy metals (e.g., copper, lead, mercury, nickel, and zinc) from hazardous waste sites; and
- Improved process stability of anaerobic digesters to handle toxics in the influent without compromising energy potential (methane output).

Financing Energy Transition: Deploying Microgrids for Priority Communities with Zero Upfront Cost

David Burchfield*

Burch Energy Services, Burch Holding Company, United States

Abstract

Across the United States, billions of dollars in cost-effective building energy improvements remain undeployed each year, not because the technology is unavailable, but because traditional financing structures fail to align incentives between building owners, lenders, and utilities. As a result, buildings continue operating with inefficient systems, energy costs rise, and progress toward resilience and decarbonization goals remains slow. This presentation introduces a scalable model for deploying microgrids and integrated building energy infrastructure in commercial, institutional, and multifamily buildings serving priority communities, without requiring upfront capital from building owners. The approach combines energy efficiency upgrades, distributed generation, and battery energy storage within microgrid systems financed through project-specific special purpose vehicles. Through energy service agreements, building owners redirect a portion of their existing utility expenditures toward financing the energy infrastructure while receiving guaranteed operational savings and improved energy resilience. The model integrates engineering design, project finance, and digital supervisory control through a full-stack platform capable of designing, constructing, and operating energy assets across their lifecycle. This structure reduces financial barriers that have historically prevented large-scale sustainability investments while enabling more reliable and resilient building operations. Drawing on project development and energy engineering experience across more than 100 building energy audits and infrastructure projects within utility programs and public agencies, this presentation illustrates how integrated financing and engineering approaches can accelerate deployment of distributed energy systems and climate infrastructure, while ensuring underserved communities can participate in the energy transition without bearing the upfront financial burden.

Packaging Extended Producer Responsibility as a Catalyst for Circular Economy Transformation

Chris Bradley*

Veritiv, United States

Abstract

Packaging is the first major material stream undergoing comprehensive extended producer responsibility (EPR) reform across the globe and it is becoming the blueprint for broader circular economy transformation. While often discussed within the packaging industry, packaging EPR has implications far beyond it. By shifting financial and operational responsibility upstream to producers, these frameworks are redesigning how recycling systems are funded, how materials are selected, and how waste is valued within economic systems. With more than 60 countries implementing packaging EPR and multiple U.S. states adopting fee-modulated structures tied to recyclability, post-consumer content, and material type, packaging has become the testing ground for aligning environmental performance with economic accountability. This keynote explores how packaging EPR accelerates material innovation, influencing recycling infrastructure investment, and reshaping supply chain decisions through life cycle assessment modeling. From fiber-based alternatives to advanced mono-material plastics and bio-based solutions, material evolution is increasingly driven by recovery compatibility and regulatory economics—not just performance and cost. Using packaging as a case study, this session offers a broader framework for understanding how producer responsibility policies can transform waste systems into circular material ecosystems. The lessons emerging from packaging EPR are not sector-specific-they are structural signals for the future of resource management worldwide.

Featured Presentations

Microplastic Residue in Recycled Food Co-products from Mechanical Depacking Systems: A Simulation Study for Animal Food

Faranak Beigmohammadi[1,2*], Mark Early[1,2], Katie Updegraff[1,2], Tien Pham[1,2], Greg Curtzwiler[1,2], Ian Edhlund[3] and Keith Vorst[1,2]

[1]Polymer and Food Protection Consortium, Iowa State University, Farmhouse Lane, Ames, United States

[2]Department of Food Science and Human Nutrition, Iowa State University, Farmhouse Lane, Ames, United States

[3]United States Food and Drug Administration, Center for Veterinary Medicine, Office of Surveillance and Compliance, Division of Food Compliance, United States

Abstract

This study is the first to determine the potential generation and transfer of microplastic (MP) into depacked food co-products from various food packaging using a commercial depacking system. Barium sulfate ($BaSO_4$, 564 ± 108 nm) was dispersed into four polymer types, including low-density polyethylene (LDPE), high-DPE (HDPE), polypropylene (PP), and polystyrene (PS). Polymers containing $BaSO_4$ were converted into food packaging matching their traditional packaging. A depacker separated packaging from food co-products. Inductively coupled plasma-optical emission spectroscopy (ICP-OES) was applied to quantify $BaSO_4$ as a MP indicator. Depacked foods were digested using an enzymatic approach to maintain the morphology of MPs then characterized using a three-dimensional surface profiler. $BaSO_4$ concentration in recovered food from HDPE, LDPE, and PP was below method limit of detection (≤290.65 n $BaSO_4$/g depacked food or ≤22.13 µg MP/g depacked food). The concentration in depacked food from PS was measured at 1278.65 ± 17.7 µg/g corresponding to low recovery of PS from the depacker. MPs were detected using three-dimensional surface profiling in depacked food from PS after enzymatic digestion. Packaging waste mass recovery from depacking was significantly greater ($p < 0.05$) for film packaging materials than more rigid/brittle materials suggesting mechanical properties of packaging materials, such as rigid vs flexible containers, can influence MP generation and packaging recovery during depacking. This study also developed a novel method using barium-doped plastic to analyze the release of MPs from food co-products using ICP-OES.

Zero-waste Approach for Converting Plant-based Agri-food Byproducts to High Value Biobased Products

Yanyun Zhao*, Jooyeoun Jung and Jerry Lin

Oregon State University, Corvallis, Oregon, United States

Abstract

Each year, more than 1.3 billion tons of food are wasted globally, including up to 45% of the world's fresh produce, with losses spanning the entire supply chain—from agricultural production (~16%) and processing (~40%) to retail and consumption (~44%). Among these waste streams, plant-based agri-food byproducts stand out for their untapped potential, being rich in fiber and functional compounds ideal for transformation into high-value biobased products and renewable energy. These fibers are particularly suited for creating biodegradable, compostable packaging as sustainable alternatives to single-use plastics, while the organic-rich liquid residues generated during and after extraction can be recovered and converted into bioenergy. Our goal is to implement innovative, zero-waste manufacturing approaches that reduce environmental impact and create new revenue opportunities by valorizing materials traditionally treated as waste. This presentation will highlight research focused on developing scalable, economically viable, and environmentally responsible technologies to upcycle plant-based agri-food byproducts into sustainable packaging materials and products, as well as other value-added products, contributing to a more circular and commercially viable bioeconomy.

Developing Sustainable Pathways for Intensive Horticulture Waste Recovery and Reuse: A Regional Case Study

Ewan Leighton[1*] and Andrew Scheuer[2]

[1]*North Coast Local Land Services, Australia*

[2]*Costa Berries, Australia*

Abstract

Intensive horticultural production across New South Wales (NSW) generates substantial volumes of organic and plastic waste, posing significant challenges for growers and industry stakeholders. Waste streams include plastic mulch, irrigation tubing, pots and crop residues. While participation in recycling and stewardship initiatives is increasing, management practices remain fragmented across industries and regions. On the NSW North Coast, regionally coordinated initiatives led by Costa Group - via its berry operations - demonstrate practical progress toward circular waste solutions. At Costa's large berry site in Corindi, a recycling system for tunnel films has been established in partnership with plastics recycler Coffs Harbour paper and oil. Operating for over five years, the program integrates freight within a broader waste management strategy and adopts a farm-scale approach to waste management. Complementary efforts include a plastic washing system capable of cleaning 3,500 pots per day using minimal water, extending the life of reusable pots, and a partnership with a local landscape supplies business to shred old pallets, crates, and plant residues into mulch and potting media. These initiatives highlight the value of regional coordination, shared logistics, and long-term collaboration between growers, recyclers, and government. However, the dispersed, small-scale structure of NSW's intensive horticulture—characterized by a patchwork of small and medium-sized farms—continues to make collection logistics complex and costly. Limited local recycling infrastructure and small waste volumes per site constrain economies of scale, underlining the need for coordinated regional aggregation and stronger partnerships to advance sustainable waste management across the sector.

Food Nitrates and Nitrites: Understanding and Mitigating Health Concerns

Soraya Paz-Montelongo[1*], Samuel Alejandro-Vega[1], Javier Darias-Rosales[1], Natalia Pérez-Rodríguez[2], Carmen Rubio[1], Ángel J. Gutiérrez[1] and Arturo Hardisson[1]

[1]Department of Area of Toxicology, University of La Laguna, La Laguna, Tenerife, Canary Islands, Spain

[2]Medical Oncology, University Hospital Nuestra Señora de Candelaria, Santa Cruz De Tenerife, Canary Islands, Spain

Abstract

Nitrates and nitrites are chemical compounds naturally present in the environment and are used as additives in the food industry, mainly as preservatives in processed meat products. The main sources of nitrates in the diet are green leafy vegetables (spinach, lettuce), beets and drinking water. Nitrites, on the other hand, are found to a lesser extent naturally and come mainly from the conversion of nitrates in food or by direct addition. The main sources of nitrates in the diet are green leafy vegetables, beets and drinking water. Nitrites, on the other hand, are found to a lesser extent naturally and come mainly from the conversion of nitrates in food or by direct addition. In recent years, an increase in the nitrate content of certain types of food has been detected, which may pose a health risk to consumers. The acceptable daily intake established by the European Food Safety Authority is 3.7 mg/kg body weight for nitrates and 0.07 mg/kg bw for nitrites. Health risks associated with excessive nitrite intake include methemoglobinemia, especially in infants. In addition, under acidic conditions and in the presence of amines, nitrites can form nitrosamines, potentially carcinogenic compounds. On the other hand, nitrates themselves have low acute toxicity, but their conversion to nitrites in the body is the main factor of concern. In this oral communication, we will address data obtained by the toxicology area of the University of La Laguna, on the content of nitrates and nitrites in different foods and their possible health risk.

Improving Recycled-content Comparability in Copper Products Through Process-based Boundary Alignment

Jessica Sanderson[*]

Copper Development Association, Mc Lean, Virginia, United States

Abstract

Accurate recycled-content reporting in copper products depends on a clear definition of the process boundary, rather than on organizational or facility-specific boundaries. Current practice varies in how scrap generated during casting and scrap generated during subsequent metalworking transformations are classified, resulting in inconsistent and sometimes non-comparable recycled-content values for products with identical material flows. This paper establishes a process-based interpretation of the semi-fabrication boundary, grounded in International Organization for Standardization (ISO) 14021 and ISO 14040, and evaluates the methodological implications of boundary choice using scenario-based material-flow modeling across representative forming routes. The scenarios illustrate how alternative process boundaries change the treatment of scrap generated before and after a defined transformation step and, in turn, influence recycled-content outcomes. Results show that differences in recycled-content values arise primarily from the amount of material removed during downstream forming operations, highlighting the importance of distinguishing transformation steps within the semi-fabrication sequence. The analysis supports adopting a consistent casting boundary for recycled-content accounting in copper semi-fabrication. Anchoring recycled-content determination to a clearly defined process step strengthens alignment with ISO system-boundary principles, improves comparability across product forms, and enhances the reliability of recycled-content reporting in life cycle assessment and environmental, social, and governance disclosures.

Evaluating Sustainable Packaging: How Decisions Actually Get Made

Kaitlin Jones[*]

Veritiv, United States

Abstract

This session takes a practical look at how packaging decisions are actually made inside companies—and how those decisions show up in real-world recycling systems. It will walk through the key factors teams are balancing every day, including cost, performance, logistics, sustainability goals, and compliance requirements, as well as how different groups (procurement, sustainability, operations) influence the final direction. A core focus will be the gap between what packaging is designed to

do and what actually happens after use. Many formats are technically recyclable, but don't always get recovered the way they were intended. This session will explore why that happens, including challenges related to infrastructure, material choices, and regional differences. Using real examples, this session offers a grounded view of how decisions made upstream directly impact what happens downstream—and what it takes to better align packaging choices with how recycling systems actually work.

Digital Twins for Deconstruction and Material Flow Optimization in a Circular Economy: Fusion of Technical, Regulatory, and Market Dimensions

Mazdak Nik-Bakht*

Department of Building, Civil, and Environmental Engineering, Concordia University, Canada

Abstract

The construction sector is one of the largest contributors to global waste and embodied carbon, yet end-of-life (EOL) decisions for built facilities remain dominated by demolition rather than circular deconstruction. A major barrier is not technical feasibility, but the lack of structured, accessible, and actionable information about the existing material/assemblies' inventory, how components are connected, and how they can be recovered, reused, or resold. This presentation introduces an integrated body of work comprising the underlying approach, methodological framework, and a functional product, including algorithms and a software solution, built around a knowledge graph–driven digital twin that combines building information modeling (BIM) and geographic information systems (GIS) to enable performance-based deconstruction planning for circular construction. The proposed approach integrates three interdependent pillars: (i) engineering data extracted and enriched from BIM with relevant EOL attributes such as condition, environmental impact, and warranty information; (ii) regulatory knowledge capturing federal, provincial, and municipal requirements governing demolition, safety, heritage, and material reuse; and (iii) market intelligence linking buildings, manufacturers, retailers, and secondary material marketplaces to support supply–demand matching for reclaimed components. Algorithms automatically transform enriched BIM data into a "Deconstruction Knowledge Graph" that captures interdependencies among building elements, enabling automated sequencing, stability-aware disassembly planning, and value recovery assessment. After optimizing deconstruction at the facility level using BIM-based digital twins, the framework is extended through GIS-enabled material flow analysis to support circularity at the urban scale. Archetype-based stock models estimate recoverable material flows and spatially match sources and sinks of reclaimed components. This integration synchronizes deconstructed assemblies with reuse markets and recovery infrastructure, enabling data-driven circular construction ecosystems.

Day 2: Keynote Presentations

Transforming Phased-out Urban Infrastructure with Artificial Intelligence-enabled Resource Recovery and Precision Agriculture

Yongsheng Chen[1*], Bonnie W. and Charles W. Moorman

Nutrients Energy Water Center for Agriculture Technology, School of Civil and Environmental Engineering, Georgia Institute of Technology, Georgia, United States

Abstract

Rapid advancements in autonomous mobility, electrification, and edge computing are reshaping urban landscapes and accelerating the retirement of traditional infrastructure such as parking lots and underutilized commercial spaces. These emerging gaps create a timely opportunity to reimagine urban systems by integrating decentralized resource recovery with precision agriculture to better align material flows within cities. This talk introduces an artificial intelligence (AI)-enabled framework that transforms phased-out urban spaces into productive, sustainable assets by linking circular resource streams with high-efficiency urban farming. Our approach leverages artificial intelligence to optimize decentralized recovery of water, nutrients, and energy, while simultaneously enhancing precision agriculture through real-time sensing, predictive control, and data-driven optimization. This integrated system addresses pressing challenges, including environmental degradation, resource scarcity, and urban food insecurity, by enabling efficient recycling, reducing greenhouse gas emissions, and boosting local food production. Through illustrative case studies and system-level analysis, we demonstrate how AI serves as a key enabler, improving operational performance, increasing resilience, and promoting circular economy principles across both recovery and agriculture domains. By repurposing phased-out infrastructure into adaptive, resource-positive hubs, cities can significantly reduce their ecological footprint and build more sustainable, resilient, and livable urban ecosystems. This vision highlights how technology and sustainability can converge to redefine the future of urban development.

Mechanical Properties of Chicken Feather Modified Soy Protein Resin and Jute Fabric-reinforced Hybrid Green Composites

Anil N. Netravali* **and Adith N. Shankar**

Cornell University, Ithaca, United States

Abstract

Agricultural waste and byproducts offer a great avenue for replacing commonly used, but environmentally unfavorable, petroleum-based polymers and composites. Millions of tons of chicken feathers are generated every year and most of them end up in landfills or simply piled on ground to decay. In this research chicken feather fiber (CFF), soy protein isolate (SPI), and jute fabric (JF) have been used to create fully sustainable, hybrid 'green' composites. This presentation details these green composites with and without the commonly used toxic crosslinking agent glutaraldehyde (GA), and their respective mechanical properties. Results showed that as CFF loading increased from 0% to 30%, the tensile fracture strain and stress of CFF/SPI resins decreased from 4.0 to 1.4% and from 25.2 to 14.3 MPa, respectively. This indicates that CFF acted only as filler with very little reinforcement value. JF/(CFF/SPI) composites showed much higher tensile properties compared to CFF/SPI resins, as expected. Their fracture strain and stress values ranged from 4.3% to 5.8% and from 26.6 to 22.0 MPa, respectively, as CFF loading increased from 0% to 30%. While CFF loading did not significantly affect the flexural properties of JF/(CFF/SPI) composites, their flexural modulus did increase. With any addition of CFF, CFF/SPI resins and JF/(CFF/SPI) composites showed higher mechanical properties than their GA-crosslinked counterparts, demonstrating that the toxic crosslinker was unnecessary. These mechanical properties of JF/(CFF/SPI) composites are equivalent to commonly used wood-based products such as particle boards and plywood and, hence, could be good as their 'green' replacement.

An Online, Open Bibliography of Research on Extended Producer Responsibility

Reid Lifset*

Yale University, United States

Abstract

Extended producer responsibility (EPR), an environmental policy strategy that makes producers responsible for the costs of end-of-life management of their products, emerged approximately 30 years ago. It has been applied to e-waste, packaging, batteries, and a vast variety of other difficult to manage wastes. It has been adopted in Europe, North and South America, and Asia and is being considered by some countries in Africa. It has gained renewed prominence in the United States with its adoption by seven states for management of packaging. A great deal has been written about the strategy, its strengths and weaknesses, the variations in its implementation, and the outcomes it has generated. While some of these documents have been published in academic journals, most are "gray literature," that is, self-published reports by disparate organizations (e.g., white papers, consulting studies, and government reports). Despite the capability provided by Google searching, such literature is notoriously difficult to identify systematically and especially to compile in an organized and accessible form. The result is that research is duplicated repeatedly and useful insights from existing studies are overlooked. The reinventing of the wheel (or even the failure to notice the existing wheels) is ubiquitous. The Center for Industrial Ecology at the Yale School of the Environment has created an extensive online bibliography of research on EPR. This talk will describe the development, structure, and functionality of the bibliography and plans for its further evolution.

Practical Sustainability: Making Environmental Goals Work in the Real World

Lainika Johnson*

Eco in the City, United States

Abstract

Across agencies and organizations, sustainability goals are abundant—but measurable progress often falls short. Practical sustainability examines the widening gap between environmental policy and the realities of implementation, exploring what it takes to turn ambitious mandates into achievable daily actions. Drawing from field experience implementing California's SB 1383 organic waste mandates, sustainability leader Lainika E. Johnson shares insights from the front lines of compliance, education, and behavioral change. Her work with TrashLogic and Eco in the City demonstrates how data, infrastructure, and human behavior must align for environmental goals to translate into real-world impact. While policies set the vision, compliance

often falters at the point of execution—where frontline staff, property managers, and community partners must carry out programs without clear guidance or adequate tools. This presentation explores that friction point, offering a transparent look at what's working, what isn't, and how organizations can better connect policy design with operational realities. Rather than presenting theory, practical sustainability presents perspective—how leaders can use field data, community engagement, and cross-sector collaboration to build accountability into sustainability without overcomplicating it. By bridging the gap between legislative ambition and daily practice, this session underscores a crucial truth: sustainability only succeeds when it leaves the page and lives in the process.

Featured Presentations

Importance–performance Assessment of Adaptive Recycling and Community Participation in Marine Plastic Management in Island Cities: Evidence from Batam, Indonesia

Ari Rahman[1,2], I. Wayan Koko Suryawan[1-3*], Mega Mutiara Sari[1,2], Nova Ulhasanah[1,2], Evi Siti Sofiyah[1,2], Sapta Suhardono[4] and Chun-Hung Lee[2,3,5]

[1]Department of Environmental Engineering, Faculty of Infrastructure Planning, Pertamina University, Jakarta, Indonesia

[2]Center for Environmental Solution, Pertamina University, Jakarta, Indonesia

[3]Center for Interdisciplinary Research on Ecology and Sustainability, College of Environmental Studies and Oceanography, National Dong Hwa University, Hualien, Taiwan

[4]Environmental Sciences Study Program, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret, Surakarta, Indonesia

[5]Department of Natural Resources and Environmental Studies, College of Environmental Studies and Oceanography, National Dong Hwa University, Hualien, Taiwan

Abstract

Marine plastic pollution poses a critical challenge for island cities, where land–sea interactions, limited infrastructure, and rapid urban–industrial growth intensifies environmental pressures. This study examines the performance and perceived importance of adaptive marine plastic recycling systems and community participation in Batam, Indonesia, using an importance–performance analysis framework integrated with an adaptive management perspective. The analysis focuses on key adaptive capacity dimensions, including assets, flexibility, organization, learning, and agency, to evaluate how local systems respond to dominant waste types, particularly single-use plastics originating from land- based sources. Household surveys and community-based assessments were conducted to capture perceptions of recycling effectiveness, institutional support, and public engagement across coastal and island communities. The findings reveal substantial importance–performance gaps, especially in upstream waste reduction, community learning, and institutional coordination. While recycling initiatives and community-driven clean-up efforts demonstrate relatively strong perceived importance, their performance remains constrained by limited infrastructure, fragmented governance, and uneven public participation. Indicators related to agency and organizational coordination show the most critical gaps, indicating challenges in sustaining long-term adaptive recycling practices. The results highlight the need for integrated, adaptive marine plastic management that links community participation with institutional capacity and policy coherence. Strengthening learning processes, improving system flexibility, and empowering local actors are essential to enhancing recycling performance and reducing marine plastic leakage in island cities. This study provides empirical insights for policymakers and practitioners seeking to advance circular economy and adaptive environmental governance in coastal and island contexts.

A Landscape-based Exploration of Air Pollution Sources and Patterns in Muzaffarnagar

Priyadarshini Dasgupta[1*], Debarshi Roy[2], Pratik Dutta[3] and Reetu Tevatia[4]

[1]*Southeastern Louisiana University, United States*

[2]*Alcorn State University, United States*

[3]*State University of New York, United States*

[4]*Amrapali University, United States*

Abstract

Muzaffarnagar, a district in the state of Uttar Pradesh, India, is experiencing rapid industrialization, intensive agricultural practices, and inadequate waste management. These have contributed to the contamination of natural resources and increased health risks for local residents. Industrial waste from paper and sugar mills, along with untreated municipal sewage, is often discharged directly into the river. The contamination of the Kali River has also affected groundwater in nearby villages. Polluted river water mixed with agricultural runoff containing excessive amounts of fertilizers and pesticides has seeped into groundwater sources. Studies have also found high levels of heavy metals such as chromium, copper, and lead in the water, exceeding permissible safety limits. Excessive use of chemical fertilizers and pesticides has harmed soil fertility by reducing essential nutrients and soil microorganisms. Industrial emissions of pollutants like sulfur dioxide and nitrogen oxides contribute to poor air quality and can lead to acid rain, which damages vegetation, degrades soil quality, and affects freshwater bodies. A joint monitoring report on the industrial clusters in Muzaffarnagar from December 27, 2023 to January 17, 2024, highlighted specific issues, including an estimated 46.7 tons of plastic waste disposed of in an unregulated manner. Around 23.8 metric tons of effluent treatment plant sludge were being improperly managed. Open dumping and the burning of waste, including plastics, contribute to water contamination and deteriorate air quality. Overall, this study focuses on identifying industrial waste in Muzaffarnagar and examining its relationship with declining soil and air quality. Using statistical correlation methods, the research highlights how industrial emissions, agricultural practices, and improper waste management contribute to environmental deterioration and the region's pollution index.

Adaptive Planning Attitudes and Service Performance Gaps in Supporting Geopark Gorontalo: An Importance–performance Analysis Approach

Ari Rahman[1,2*], I Wayan Koko Suryawan[1-3], Nova Ulhasanah[1,2], Mega Mutiara Sari[1,2], Evi Siti Sofiyah[1,2] and Chun-Hung Lee[2-4]

[1]*Department of Environmental Engineering, Faculty of Infrastructure Planning, Pertamina University, Jakarta, Indonesia*

[2]*Center for Environmental Solution, Pertamina University, Jakarta, Indonesia*

[3]*Center for Interdisciplinary Research on Ecology and Sustainability, College of Environmental Studies and Oceanography, National Dong Hwa University, Hualien, Taiwan*

[4]*Department of Natural Resources and Environmental Studies, College of Environmental Studies and Oceanography, National Dong Hwa University, Hualien, Taiwan*

Abstract

The development of the Geopark Gorontalo as a prospective National Geopark in Gorontalo Province, including Kota Gorontalo, requires strong community engagement and adaptive behavioral responses to support sustainable geotourism and conservation efforts. This study aims to analyze the relationship between adaptive behavior, planning attitude, and public valuation of urban service performance in supporting city-led geopark initiatives. Using an importance–performance analysis (IPA) framework, the research evaluates citizens' perceptions of key service attributes related to environmental management, urban infrastructure, cultural preservation, and community participation as critical drivers in preparing the region for National Geopark recognition. Data was collected through structured questionnaires administered to households in Gorontalo City and analyzed to identify priority areas where service importance and actual performance gaps exist. The findings reveal that adaptive planning attitudes significantly influence community willingness to support geopark-related initiatives, while several service dimensions remain underperforming despite being perceived as highly important. These gaps indicate the need for targeted policy interventions focusing on participatory planning, environmental awareness programs, and improved urban service delivery to strengthen local readiness for geopark governance. The study contributes to the growing literature on behavioral adaptation and urban service valuation by integrating adaptive behavior theory with IPA-based evaluation, providing practical insights for local governments in aligning city services with sustainable geopark development strategies. The results highlight the importance of embedding citizen-centered planning and adaptive governance approaches in achieving long-term geo conservation and

regional sustainability goals in Indonesia.

A New Power is in Your Hands: Proven Biopolymer Coagulants Reliably Outperform Alternatives

Jenn Wood[1*], Ashley Nief[2] and Alex Gaynor[3]

Tidal Vision, United States

Abstract

Advancements in biopolymer liquid-solid separation technology offer modern water treatment professionals a new level of performance. These tools are uniquely formulated using safer chemicals produced with zero waste. Experiencing wide adoption in North America, these new liquid coagulants are ready to fit directly into existing treatment systems and upgrade total system efficiency. They are based on a naturally occurring biopolymer whose active ingredient is considered a basic substance, included on the environmental protection agency safer chemical ingredients list. Unlike other biopolymer-based solutions, these coagulants feature high molecular weight and a high positive charge density. This allows for superior performance and improved economics, all while using less chemistry. These tools set new standards for water treatment in a wide range of industrial and municipal applications. Non-toxic coagulants enhance the efficiency of both aerobic and anaerobic digestors, enable the use of sludge as a valuable co-product, and increase the health of microbiological ecosystems. Plus, they're non-corrosive, safer for handlers, and biodegradable. Manufactured from biological byproducts, with zero waste, and degradability at the end of their use, this technology shows how a circular economy can be used to generate more efficient and economical water treatment solutions. Only with solutions that outcompete in performance, cost, and footprint can be effectively lower the process emissions of critical world industries. Join us for a presentation that includes powerful case studies and a guide for how to reap the benefits of biopolymer chemistry in your operations.

Critical Extended Producer Responsibility Developments Shaping the U.S. Landscape: What You Need to Know

Jason Bergquist[*]

RecycleMe, Brunswick, United States

Abstract

The rollout of extended producer responsibility (EPR) regulations has now officially begun; in the spring, "obligated" producers in Oregon (OR) will be reporting, and paying fees on the full year of sales data for 2024. Next in line, in the summer, "obligated" producers in Colorado (CO) will be reporting and paying fees on the first six months of sales date for 2025. What are the obstacles that face brands? We will dive into the definitional structures (a "producer" in OR may not necessarily be a "producer" in CO), and how those definitions could impact both downstream and upstream suppliers. Further, all three of the leading Western States (OR, CO and California (CA)) have different material categories (for example, OR and CA have exempt deposit return system exemptions; CO does not) of various lengths, and therefore material differences in fee structures. We will unpack the barriers created by harmonization gaps, but also how producers can avail themselves of the areas that do align. The presentation list of discussion points is as follows:

- Present brief case studies that led to the current situation;
- Discuss the basic tenets of EPR;
- Present the current status of EPR in the US – adopter states and proposed states;
- Exploring significant challenges due to the complex political landscape in the US;
- Addressing the obstacles faced by plastic and packaging producers;
- Harmonization barriers and the impact of fragmentation within the EPR framework;
- Sharing best practices for EPR implementation to maximize environmental benefits.

Experimental Evaluation of Multi-stage, Multi-pass (Batch) Electrodialysis Desalination Brackish Water at Pilot Plant Scale

Jonathan Bessette*, Shane Pratt, Ben Judge, Andria Jones and Amos Winter

Massachusetts Institute of Technology, United States

Abstract

There is growing demand for high-recovery water treatment and reuse technologies for applications including industrial wastewater recycling, produced water treatment, and brackish groundwater desalination. Many of these applications require partial desalination to enable reuse rather than full demineralization, creating opportunities for membrane processes optimized for energy efficiency and throughput. Multi-stage, multi-pass (batch) electrodialysis offers a promising pathway by enabling spatial and temporal voltage control, potentially reducing capital costs while maintaining favorable energy performance. However, these architectures have not been experimentally validated at pilot scale under realistic operational constraints. Here, we present the construction and evaluation of a flexible, multi-stage, multi-pass electrodialysis platform using commercially available stacks. A comprehensive automated experimental campaign was conducted across varied feed salinities, recovery ratios, hydraulic conditions, and current densities. Over 200 batch experiments were performed at approximately 75% recovery and 25 ± 2 °C, targeting partial desalination from 6000 - 12000 μS/cm feedwaters to reuse-relevant product salinities of approximately 1000 μS/cm. Results from initial one- and two-stack configurations demonstrate Pareto-optimal system specific energy consumption (SEC) ranging from 2 to >14 kWh/m^3 with corresponding time- averaged production rates of 1 to 8.5 m^3/h. Optimal operating points consistently occurred under constant-current control at higher current densities, while constant-voltage operation did not appear on the Pareto frontier. Auxiliary and hydraulic losses were found to contribute up to one-third of total SEC, highlighting critical system-level inefficiencies often overlooked in laboratory-scale studies. The minimum as-built levelized cost of water was \$1.89/m^3, with modeled pathways indicating potential reductions to \$0.42/m^3 through improved efficiency, extended system lifetime, and reduced capital cost. These results establish experimentally validated performance envelopes for batch electrodialysis systems and provide practical design guidance for water reuse and industrial treatment applications.

Environmental Assessment of Recycling Technologies for New-generation Photovoltaic Modules

Aistis Rapolas Zubas[1,2*], Jolita Kruopiene[1], Gintaras Denafas[1] and Alessandra Bonoli[2]

[1]*Kaunas University of Technology, Lithuania*

[2]*University of Bologna, Italy*

Abstract

The rapid deployment of photovoltaic (PV) systems is expected to result in substantial volumes of end-of-life modules in the coming decades. Among emerging designs, glass–glass PV modules encapsulated with polyolefin elastomer layer represent a growing market segment. Although these modules offer improved durability and performance, their structural and material configuration requires adapted recycling strategies to ensure efficient resource recovery and environmental sustainability. This study evaluates recycling pathways for new-generation PV modules from an environmental perspective. Several treatment scenarios, including mechanical, thermal, and chemical processes, were analyzed to investigate the potential for material recovery and associated environmental implications. The assessment focuses on the recovery of key materials, including glass, silicon, and valuable metals. In addition to material recovery efficiency, the process related inputs were considered. A life cycle assessment approach was applied to evaluate the environmental performance of the proposed recycling scenarios. The assessment considers both direct impacts associated with operational processes, such as energy use and chemical inputs, and indirect impacts related to upstream production of processing materials. Potential benefits related to materials recovery are also included in the study. By integrating these contributions within defined system boundaries, the analysis enables a comprehensive comparison of the alternative treatment pathways. The research explores how variations in treatment configuration and material quality influence overall environmental performance.

Hydrogen and Fuel Cells — A Bridge to a Sustainable Energy Future

Yanhai Du*

School of Engineering, Kent State University, United States

Abstract

Hydrogen and fuel cell technologies are emerging as critical enablers for transitioning from fossil fuel–dominated energy systems toward a sustainable and low-carbon future. Currently, over 70% of global greenhouse gas emissions are energy-related, with the majority of energy production still reliant on fossil fuels. This presentation examines hydrogen as a clean energy carrier and fuel cells as high-efficiency electrochemical conversion devices that can bridge this gap. The talk highlights recent advances in solid oxide fuel cells (SOFCs) and solid oxide electrolysis cells for efficient energy conversion and hydrogen production. Emphasis is placed on micro-tubular SOFC design, advanced ceramic materials, and additive manufacturing techniques, including freeze casting and 3-dimension printing, which enable improved performance, durability, and scalability. In parallel, hydrogen production pathways and CO_2 capture technologies are discussed as integrated components of sustainable energy systems. Demonstrated applications ranging from portable power systems to unmanned aerial systems and stationary power generation illustrate the versatility and real-world impact of these technologies. Hybrid systems integrating fuel cells with batteries and capacitors are also presented as solutions for enhanced performance and operational flexibility. Overall, this work underscores the role of hydrogen and fuel cells as a practical and scalable bridge toward carbon neutrality, while identifying remaining technical and deployment challenges in materials, manufacturing, and system integration.

Changes in Ambient Temperature and Cadmium and Zinc Pools in a Contaminated Tailing Amended with Biochar

Luís Reynaldo Ferracciú Alleoni*, Mariana Pezzatte Pollo, Matheus Bortolanza Soares and Guilherme Bovi Ambrosano

Luiz de Queiroz College of Agriculture, University of São Paulo, Brazil

Abstract

The capacity of biochar's to immobilize contaminants is well known, but it is important to evaluate whether this capacity is maintained under climate change conditions which can alter the sorption capacity of biochar for metals like zinc (Zn) and cadmium (Cd). We investigated the impact of sugarcane (*Saccharum officinarum* L.) straw biochar pyrolyzed at 350 °C (B350) and 750 °C (B750) on chemical properties of a tailing contaminated with Zn and Cd at 20 and 30 °C. Chemical characterizations of the tailing and biochar, sequential chemical extraction, and desorption studies were carried out. The sequential extraction separated the following fractions: exchangeable (F1), linked to organic matter (F2), associated with iron, aluminium, and manganese oxyhydroxides (F3), and residual (F4). As temperature increased, the concentration of elements in F2 of the control sample (without biochar) decreased, while F1 increased. Biochar addition mitigated the thermal decomposition of organic matter and boosted the percentage of metals bound to this fraction. B750 was more effective in retaining Zn in F2, while B350 better preserved organic matter and prevented Zn desorption at higher temperatures. In biochar-amended samples, Cd availability decreased, with F2 levels being higher in B350-amended samples as compared to B750. Zn and Cd were primarily present as free ions, indicating a potential for increasing soil pollution. Both metals desorbed the entire soluble fraction within the first 5 min, but the amount released in the biochar-amended samples was lower. We concluded that biochar was effective in reducing metal desorption and enhancing metal remediation strategies under climate change conditions.

Day 3: Featured Presentations

Challenges in Solid Waste Management: Strategies that have Driven Success

Lynal Albert* and Oluwabusolami Erinle

Department of Mechanical, Environmental and Civil Engineering, Tarleton State University, Texas, United States

Abstract

Solid waste has persistently remained a global challenge for decades. The solid waste problem is exacerbated by population growth, industrialization and evolving consumption patterns thereby resulting in significant environmental and public health impacts. This study presents a comparative analysis of solid waste management strategies adopted by cities in India and the United States, focusing on waste collection, segregation, processing, and disposal. The paper also reviews practices such as

recycling, reuse, and repurposing. The analysis demonstrates that improved waste management can be achieved through strong regulatory frameworks, infrastructure development, and active community participation. In the United States, the resource conservation and recovery act establishes the regulatory framework for the safe management of solid and hazardous waste, including landfill regulation and the promotion of recycling and waste minimization. In India, the solid waste management rules (2016) mandate source segregation, decentralized processing, and implementation by local authorities, while recognizing the role of the informal sector. These successful case studies demonstrate that while solid waste management remains an ongoing challenge, improvement is achievable through sustained policy enforcement, institutional coordination, and public engagement.

Regress, Reverse, Recycle: Contextual Stochastic Optimization in Waste Policy and Logistics Network Design

Austin Saragih[1*], Milena Janjevic[1], Yossi Sheffi[1] and Jan C. Fransoo[2]

[1]*Massachusetts Institute of Technology, Cambridge, United States*

[2]*Tilburg University, Netherlands*

Abstract

Effective policies and reverse logistics networks for municipal solid waste (MSW) recycling are crucial for advancing the circular economy. Current approaches to MSW recycling often disrupt the process of reversing logistics from endogenous recycling policies and separate waste collection routing from network design, failing to capture critical interdependencies. We address these limitations by incorporating endogenous recycling policy estimation and collection routing into reverse logistics network design. Our methodology uses post double selection with rigorous lasso to regress recycling rates against municipal policies and characteristics, then optimizes the reverse logistics network using empirical residuals-based sample average approximation. This approach enables the transformation of endogenous policies into exogenous ones for optimization. Through a comprehensive case study of Massachusetts' recycling network, we provide data-driven, actionable policy options to improve recycling rates and profitability. This methodology extends beyond MSW applications to broader supply chain network design and stochastic programming problems.

Association Between Compost Temperature and Structural Failure of Compostable Bioplastic Bags Under Simulated Community Composting Conditions

Max Yang[1*], Katelyn Li[2] and Linda Shi[3]

[1]*Canyon Crest Academy, California, United States*

[2]*La Jolla Country Day, California, United States*

[3]*University of California, California, United States*

Abstract

Background: Compostable bioplastic bags are increasingly used in municipal organic waste programs. Although observational studies suggest that these bags decompose under elevated composting temperatures, the quantitative relationship between compost temperature and the timing of bag structural failure has not been formally evaluated. Understanding this relationship is important for assessing their performance in community composting systems.

Objective: To quantify the association between compost temperature (F) and time to first structural failure of compostable bioplastic bags under simulated community composting conditions.

Methods: A repeated-measures composting experiment was conducted over 60 days under simulated community composting conditions. Compost buckets containing compostable bioplastic bags filled with food scraps were monitored regularly. Compost temperature, moisture, and pH were measured repeatedly using a soil meter. Structural failure was defined as the first observed day of bag breakage by visual inspection. Time to failure was treated as the primary outcome, with intact bags right censored at day 60. Kaplan–Meier survival curves were used to describe time to initial bag breakage. Cox proportional hazards models with time-varying temperature were applied to evaluate the association between compost temperature and bag failure, adjusting for moisture and pH.

Results: Compost temperature increased rapidly during the early composting phase, peaking around the second week and remaining elevated thereafter. Bag breakage was first observed after approximately three weeks. Higher sustained compost temperatures were associated with shorter time to initial bag breakage. Statistical modeling showed that higher compost temperatures were independently associated with increased hazard of bag structural failure.

Conclusion: Higher composting temperatures were associated with earlier structural failure of compostable bioplastic bags, supporting their functional degradation as intended under community composting conditions.

Recent Development of Innovative Zinc-based Catalytic Strategies for Recycling Plastics: A Sustainable Solution to the Global Plastic Pollution Crisis

Bismark N. Tei[1*] and Evans O Asare[2]

[1]*Department of Chemistry and Biochemistry, Duquesne University, United States*

[2]*Department of Chemistry, School of Sciences and Humanities, Nazarbayev University, Astana, Kazakhstan*

Abstract

The global plastic pollution crisis represents one of the most critical environmental threats of the 21st century, with approximately 99% of plastic production dependent on finite fossil fuel reserves. Chemical recycling of polymeric plastics to their constituent monomers has emerged as a superior strategy over traditional mechanical methods, which suffer from inherent downcycling. Recent advancements have identified specific organometallic compounds, particularly Zn(II), Mg(II), and Sn(II) halides and acetates, as highly effective agents for accelerating depolymerization under mild conditions. This review highlights recent advances in zinc-based catalytic systems demonstrating superior efficiency in depolymerizing common polyesters and polycarbonates. Homoleptic Zn(II)-complexes synthesized with tridentate {NNO} ligands achieved complete depolymerization of bottle-grade polyethylene terephthalate within one hour at 180 °C, with isolated bis(2-hydroxyethyl) terephthalate monomer yields reaching 58% at optimal catalyst loading. Comparative kinetic studies of polycaprolactone depolymerization revealed that zinc catalysts achieved 89% monomer yield in just four hours at 100 °C, dramatically outperforming longer reaction times at lower temperatures. Analysis of relative catalytic activity against various polymer functional groups confirms that Zn(II) offers a balanced profile across primary hydroxyls, secondary hydroxyls, and carbonate linkages, making it ideal for mixed-plastic waste streams. Consequently, zinc-based catalysis represents a promising and scalable avenue for chemical recycling, enabling recovery of high-quality monomers to mitigate plastic pollution and reduce associated healthcare and environmental burdens.

Virtual: Keynote Presentations

Micro/Nano-sized Plastics in Biosolids-an Emerging Threat to the Environment and Public Health

Sung Hee Joo[*]

Program Director and Professor of Environment Engineering, Metropolitan State University of Denver, Colorado, United States

Abstract

Plastics in the environment potentially threaten the environment and public health, but increasing their detection has been challenging. Waste sludge generated by wastewater treatment plants undergoes pretreatment before biosolids are disposed of via land application, landfilling, or incineration. However, biosolids require further treatment because of emerging contaminants, including microplastics (MPs) and per- and polyfluoroalkyl substances. MPs in biosolids cause potential risks, but few studies have explored their risk assessment. In this study, the conceptualized framework for environmental risk assessment (ERA) of MPs in biosolids is examined in each stage of ERA, identifying potential risks and the extent to which biosolid-borne MPs cause harm based on risk characterization. The aims are twofold, namely, (a) to evaluate a conceptualized framework of ERA of biosolid-borne MPs and (b) to identify the effects of biosolid-borne MPs on human health through the food chain. ERA is implemented through several processes, including (a) hazard identification, (b) exposure assessment, (c) toxicity assessment, and (d) risk characterization. The study highlights factors to be considered in exposure analysis based on the concentration level of biosolid-borne MPs. Such factors are shown to depend on various conditions, including the properties, fate, and transformation of MPs. The effects of uptake through ingestion of food contaminated with MPs from biosolids on human health revealed that comprehensive evaluation of information is a precedent for the ERA framework, particularly concerning quantitative data and information related to potential diseases after the exposure and information related to the hazard (MPs) itself, route of exposure, level of exposure, and food matrix.

Water and Waste Related Energy Production and Extraction

Catherine N. Mulligan*

Concordia University, Canada

Abstract

The challenges of sustainable development include a water supply for healthy people, efficient use of water and energy resources, and protection of the ecosystem and environment. All must be resilient under climate change. The nexus between water and energy is a highly important element. The water sector exerts a heavy energy footprint (4% of global electricity consumption). Therefore, to offset this, there is a strong need to research energy production and recover from water and waste. Some methods are production of biogas from waste and energy production from wastewater treatment such as pressure reduced osmosis which will be the focus of this presentation. Up to 50% of the energy required for wastewater can be produced by biogas. Production of energy and waste management, improvement of the potential for water reuse, protection of the environment, reducing carbon emissions and enabling the improvement of their environmental practices are all objectives. These research orientations will contribute and foster an integrated approach for understanding the water- waste-energy nexus and enabling the design of carbon neutral or negative water treatment facilities.

Prospective Evaluation of Nanomagnetic Composites for Water Remediation

Paulo C De Morais[1,2*]

[1]*Catholic University of Brasilia, Genomic Sciences and Biotechnology, Brasilia, Brazil*

[2]*University of Brasilia, Institute of Physics, Brasilia, Brazil*

Abstract

The growing concern over environmental contamination – particularly pollution of water bodies – has driven the development of innovative technologies aimed at mitigating these impacts. Among these, nanotechnology holds significant promises for advancing water remediation strategies. This presentation explores the application of nanomagnetic composites for removal of petroleum following accidental spills in marine and freshwater environments. Specifically, it highlights the successful incorporation of cubic ferrite-based magnetic nanoparticles into expanded and hydrophobized vermiculite template. The aforementioned magnetic nanocomposite demonstrated the ability to remove nearly 100% of petroleum in bench-scale experiments. This talk will include details of the fabrication and characterization of magnetic nanocomposite material. Additionally, images of the performance of the proposed technology will be presented in order to demonstrate the effectiveness of the petroleum removal process.

Featured Presentations

Recycling of End-of-life Poly-crystalline Silicon Solar Panels for Separating Materials and Recovering Silicon Solar Cells

Deepti Vishwakarma* and Nikhil Dhawan

Indian Institute of Technology, Roorkee, India

Abstract

Conventional recycling of end-of-life first-generation silicon solar panels involves direct combustion, resulting in blackish tempered glass, poor separation of solar cells and the emission of hazardous fluorinated gases from the back sheet. These effects raise environmental concerns and limit clean material recovery. To overcome this, the present work introduced a new environment-friendly recycling method, based on preliminary mechanical treatment for separating tempered glass, copper-tin connecting wire and back-sheet. The remaining encapsulated solar cell portion is followed by an ideal process of pyrolysis at 500, 1 h in an argon atmosphere to recover clean silicon (Si) solar cells (SC) and viscous oil without generating fluorine gases. The experimental results demonstrated complete separation of clean glass, connecting wire, back-sheet and Si solar cells. The X-ray fluorescence and microwave plasma–atomic emission spectroscopy testing showed the recovered Si solar cell contains weight % of 88.6%, 9.2% and 0.6% of Si, aluminium and silver, respectively. Additionally, the field-emission scanning electron microscopy energy-dispersive x-ray spectroscopy analysis of recovered Si solar cells showed the presence of spherical morphology of aluminium-back contact at the rear side and silver finger paste on the front side. The thermal stability kinetics of ethylene-vinyl acetate, studied by thermogravimetric analysis, resulted in the complete removal of ethylene-vinyl acetate at 500.

The outcomes of this study revealed that by using this concept of recycling, the clean glass, connecting wire, back-sheet, and Si SC with silver finger and aluminium back-contact can be recovered easily.

Assessment of Ecological and Human Health Risks from Microplastics and Heavy Metals in the Sundarbans Mangrove Estuarine System, Bangladesh

Mir Mohammad Ali[1*], Md Kamal Hossain[2] and Ashiq Anam Sajal[1]

[1]*Department of Aquaculture, Faculty of Fisheries and Marine Science, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh*

[2]*Bangladesh Council of Scientific and Industrial Research Laboratories, Dhaka, Bangladesh*

Abstract

Weathering of sediment-associated microplastics (MPs) enhances their surface reactivity and metal-binding capacity, potentially amplifying combined ecological risks in aquatic systems. This study investigated the distribution and concentrations of MPs and heavy metals in water, sediment, and fish from Pashur River, Bangladesh, highlighting potential health risks. Results revealed significant variations in MPs and heavy metal concentrations across the sampled matrices. MPs were quantified at 14 to 32 particles/L (water), 31 to 61 particles/kg (sediment), and 6 to 9 particles /kg (fish gastrointestinal tract). Metal concentrations were reported as chromium > cadmium (Cd) in fish samples. Geo-accumulation index (I geo) indicated predominantly unpolluted to moderately polluted sediments (Class 1), with Cd reaching moderate contamination (Class 2), while pollution load index (> 1) confirmed anthropogenic metal enrichment. The evaluation of target hazard quotients (THQs) for both adults and children indicated that neither group would experience non-carcinogenic effects, as the THQ values were below the threshold limit of 1. Furthermore, the cumulative carcinogenic risks remained within acceptable ranges, suggesting negligible carcinogenic effects on consumers. However, it's important to note that children were more susceptible to both non- carcinogenic and carcinogenic effects compared to adults. Overall, the findings demonstrate moderate anthropogenic pressure and highlight the need for sustained pollution control to prevent long-term ecological and public health consequences in the Pashur River system.

Functionalized Silica Spheres: A High-efficiency Platform for Precision Radiopharmaceutical Production and Sustainable Waste Minimization

Mohamed Abdelaty Habila[1*], Ahmad Saud Abdullah Alobaysi[1,2], Ibrahim Aljammaz[2] and Zeid AL Othman[1]

[1]*Department of Chemistry, College of Science, King Saud University, Riyadh, Saudi Arabia*

[2]*Department of Cyclotron and Radiopharmaceuticals, Research Center of King Faisal Specialist Hospital, Riyadh, Saudi Arabia*

Abstract

The global demand for high-purity medical isotopes and sustainable water treatment solutions has oriented researchers toward engineered nanostructured adsorbents. This study presents the development and performance of functionalized silica nanoparticles, synthesized via a modified Stöber sol-gel process using ethylenediaminetetraacetic acid as a selective chelating agent. The resulting "magic silica spheres" possess a uniform aspherical morphology with a precision-engineered size range of 361 nm to 580 nm. The developed functionalized silica spheres exhibited effective medical application efficiency, in nuclear medicine, where the isolation of lead-201 (Pb-201) is a critical prerequisite for the production of thallium-201, the gold standard for myocardial perfusion imaging. This technology achieves an 86% separation efficiency for radioactive Pb-201, enabling "mono-isotopic" preparation that eliminates radioactive impurities and enhances clinical diagnostic clarity. Beyond performance, the innovation directly supports United Nations sustainable development goals 3, 6, 9, and 12 by reducing dependence on aging nuclear reactors, minimizing radioactive waste, and meeting World Health Organization/Environmental Protection Agency safety standards for drinking water. The platform's self-regeneration capability and industrial scalability position it as a lucrative and sustainable solution for the multi-billion-dollar markets of nuclear medicine and industrial wastewater treatment.

Optimized Growth and Manipulation of Light-matter Interaction in Stabilized Halide Perovskite Nanowire Array

Lena Yadgarov*

Ariel University, Israel

Abstract

Halide perovskite nanowires (HP-NWs) exhibit fascinating optical properties, making them attractive for advanced technologies. However, instability and lack of an effective synthetic protocol limit their commercialization. To address this, we use nanoporous anodized aluminum oxide (AAO) metamaterial as templates for the growth of perovskite (CsPbBr3) NW arrays. AAO functions as both a growth template and a stabilizing medium. The NW array exhibits strong light-trapping ability, and the pore geometric features (pore radius-R and distance between pores-d) have the potential to enhance the light-matter interactions (LMI). We demonstrate the impact of R and d on LMI within the AAO/CsPbBr3 system using theoretical finite difference time domain simulations. Optimal LMI was observed with R = d = 25 nm and R = d = 50 nm. We report ligand-free synthesis of CsPbBr3 NW arrays via spin-coating, drop-casting, and inverse temperature crystallization (ITC). The spin-coating and drop-casting yielded poor pore filling, while the modified ITC method yielded nearly complete (>90%) pore filling with significant NW lengths. Our findings highlight the potential of AAO templates for protecting CsPbBr3 and addressing synthetic challenges in HPs and other semiconductor NW arrays. This study provides valuable references for LMI in HPs and advances HPs and NW array-based optical devices and renewable energy applications.

Revitalizing Petroleum Waste for Green Applications

Cuiying Jian*

York University, Canada

The oil industry is among the largest sectors globally. Moreover, it is considered to have the most significant impact on the economy, spanning transportation, energy conversion, and manufacturing systems. Asphalt, a common product derived from crude oil, is utilized in numerous applications, including road paving and building construction. Furthermore, organic materials, particularly hydrocarbons, serve as the fundamental basis for crude oil formation when subjected to high temperature and pressure during processing. Nevertheless, the oil industry remains closely linked to environmental and social impacts. One of the most notable causes is oil waste that flows into bodies of water and is absorbed by the surrounding soil. This is an issue because it disrupts the environmental food chain. Additionally, toxic chemicals from oil can contaminate the atmosphere, endangering living standards and posing health risks. It has been reported that the toxicity of crude oil, which contains gasoline, toluene, and other light aromatic compounds, can cause kidney disease and cancer. The final concern is the impact on aquatic life, as they are the most vulnerable part of the ecosystem regarding oil waste problems. Studies have shown that oil pollution decreases the fertility of fish and forces them to migrate to other habitats. The goal of this research is to utilize these waste materials to develop properties similar to those of graphene, rather than storing them in a specific location. Since this approach can be accessible to many people, it offers an opportunity to discover new properties within asphalt. Numerous studies have demonstrated the production of laser-induced graphene (LIG) in carbonaceous materials, including wood, cardboard, and polyimide films. This evidence suggests that asphalt may also facilitate LIG formation, owing to its predominantly carbonaceous elemental composition. In this talk, highlights of LIG from asphalt will be discussed along with its potential applications. This development introduces novel, user-friendly prospects for material synthesis that enhance efficiency in manufacturing processes.

Upcycling Waste Polyethylene Terephthalate into Sorel-type Cement Composites

Edith Luévano-Hipólito[1,2*], Leticia M. Torres-Martínez[1,2] and Daniel Sánchez-Martínez[1]

[1]Universidad Autónoma de Nuevo León, México

[2]CIMAV, México

Abstract

The development of alternative cementitious binders has gained increasing attention to reduce the environmental footprint of conventional building materials. Among them, sorel-type zinc oxychloride cement (ZOC) represents a promising alternative due to its low fast setting and low cost of production. In parallel, the accumulation of polyethylene terephthalate (PET) waste from water bottles represents a major environmental concern, which requires the urgent implementation of strategies to upcycling it. Considering this opportunity, this work proposes the integration of recycled PET (r-PET) fibers into ZOC pastes to enhance material performance while contributing to plastic waste valorization. Different r-PET contents (0.5 - 4

wt.%) were tested in the pastes to evaluate its effect on the microstructure, thermal behavior, pore structure, and resistance to accelerated weathering. The results indicated that the incorporation of low r-PET content led to noticeable changes in the pore size distribution and water-related thermal events. The accelerated weathering exposition of the samples revealed a reduced cracking compared to the reference paste, suggesting an improvement in resistance to environmental exposure. Thus, these results highlight the potential of combining waste PET upcycling with sorel-type alternative cement as a promising route toward more sustainable construction materials.

WasteXAI: An Artificial Intelligence-driven Internet of Things Architecture for Intelligent Waste Operations and Circular Urban Systems

Shamir Hyman*

Waste Exploration Technologies Inc., California, US

Abstract

The global waste management sector remains dominated by static schedules and manual audits, resulting in inefficiencies, excess hauling, and preventable emissions. To address this, we present WasteXAI, an artificial intelligence-driven, sensor-integrated architecture designed to transform waste operations into a continuous, data-informed system. At the core of WasteXAI is a distributed internet of things (IoT) sensing network that captures real-time container fill-level data using ultrasonic and environmental telemetry. These edge devices communicate via LTE-M/NB-IoT to the WasteXAI CoreTM, a cloud-based analytics engine that applies adaptive learning models to detect anomalies, predict collection needs, and quantify contamination risk. The system leverages temporal pattern recognition and geospatial correlation to dynamically optimize pickup schedules and improve asset utilization. A modular data schema enables integration with municipal and private fleet application programming interfaces, supporting route optimization and performance benchmarking across heterogeneous environments. Initial pilot results show reductions of 20 - 40% in unnecessary collection trips and marked improvements in diversion rate accuracy. Future development of the WasteXAI link SensorTM will embed lightweight artificial intelligence inference directly on-device, enabling autonomous detection of contamination events and localized material classification without continuous cloud dependency By establishing a unified telemetry and analytics layer for waste streams, WasteXAI demonstrates a scalable model for circular infrastructure intelligence—turning waste data into an actionable resource for sustainability, emissions reduction, and urban systems resilience.

Poster Presentations

Strengthening Urban Resilience Through Sustainable Use of Recycled Construction Materials

Maria João Falcão Silva*, Filipa Salvado, Filipe Ribeiro, António Correia, Nuno Marques de Almeida, Ana Silva, Maria Paula Mendes, Seyed Rezvani, Cláudia Pinto, Mónica Amaral Ferreira, Liliana Oliveira and Miguel Inácio

National Laboratory for Civil Engineering (LNEC), Lisbon, Portugal

Abstract

Rapid urbanization and increasing construction activities have intensified the consumption of natural resources and the generation of construction and demolition waste, posing significant environmental and socio-economic challenges to cities worldwide. In this context, urban resilience has emerged as a critical framework for enabling cities to adapt to environmental pressures, climate change impacts, and resource scarcity. This paper explores how the sustainable use of recycled construction materials can contribute to strengthening urban resilience. The study examines the role of recycled materials in reducing environmental impacts, enhancing resource efficiency, and promoting circular economy principles within urban construction systems. By minimizing landfill disposal and decreasing reliance on virgin materials, these practices reduce greenhouse gas emissions, energy consumption, and material extraction pressures. Furthermore, the integration of recycled construction materials supports economic resilience by lowering construction costs, fostering local recycling industries, and creating green employment opportunities. From a resilience perspective, the use of recycled materials also contributes to adaptive capacity by encouraging flexible design strategies, decentralized material supply chains, and innovation in sustainable construction technologies.

The Spatial Planning Imperative for Mitigating Tuberculosis Prevalence in Bandung's Highly Populated Districts

Beta Paramita[1,2*], Baojie He[3] and Andreas Matzarakis[4]

[1]*Magister Architecture Study Program, Indonesia University of Education, Bandung, Indonesia*

[2]*Center of Excellence for Low Carbon Building Material and Energy, Indonesia University of Education, Bandung, Indonesia*

[3]*School of Architecture and Urban Planning, Chongqing University, Chongqing, China*

[4]*Chair of Environmental Meteorology, Faculty of Environment and Natural Resources, University of Freiburg, Freiburg, Germany*

Abstract

Tuberculosis (TB) remains an endemic issue in global south, with Indonesia being no exception holds the world's second-highest number of TB cases. Within this national context, West Java emerges as a primary epicenter, contributing approximately 22% of the country's total TB burden. This research positions urban spatial planning not merely as a technical exercise, but as a strategic public health instrument designed to identify and alleviate the growth of TB (+) cases in dense metropolitan environments. By employing ordinary least squares regression integrated with geographic information systems, the study meticulously analyzes the spatial relationship between the built environment and health outcomes. It investigates how variables such as building density, population concentration, and environmental quality correlate with TB incidence and associated mortality. A key finding of the research is that high population density serves as a significant predictor for increased TB prevalence, highlighting the risks inherent in overcrowded urban pockets. Furthermore, the study delves into urban morphology, specifically examining the sky view factor and the presence of urban canyons. These elements are found to dictate the duration of solar exposure and the quality of natural ventilation within neighborhoods. The data suggests that strategic spatial interventions, optimizing sunlight penetration and airflow can directly aid in reducing TB fatalities. Ultimately, these results underscore an urgent imperative for policymakers: spatial planning must evolve beyond identifying hotspots. It must actively mandate design standards that minimize overcrowding and maximize environmental health, transforming the city of Bandung into a more resilient, breathable urban ecosystem.

What Drives Purchase Intention? A Configurational Perspective Using Fuzzy-set Qualitative Comparative Analysis and Machine Learning

Hao Zheng[1*] and Menghan Li[2]

[1]*Eastern Institute for Advanced Study, Eastern Institute of Technology, Ningbo, China*

[2]*University of Nottingham Ningbo China, Ningbo, China*

Abstract

This study investigates how consumers' purchase intentions are shaped by different configurations of perceived product sustainability, perceived product trustworthiness, brand attitude, and perceived corporate social responsibility sincerity in the context of the Sweetie Store. To capture the complexity of consumer decision-making, the study adopts a two-stage analytical design that combines fuzzy-set qualitative comparative analysis (fsQCA) with machine learning. First, fsQCA is used to identify multiple causal configurations associated with high purchase intention, recognizing that consumer responses may arise from different but equally effective pathways. The findings reveal that purchase intention is not driven by any single factor alone; rather, it emerges from distinct combinations of sustainability perception, trustworthiness, brand attitude, and corporate social responsibility related perceptions. In particular, the research indicates that product trustworthiness and brand-related evaluations play important roles across several configurations. Second, machine learning is applied to complement the configurational results by assessing the relative importance of the antecedent conditions in predicting purchase intention. By integrating fsQCA with machine learning, this study provides both configurational and predictive insights into consumer behavior. The research contributes to the marketing and sustainability literature by showing that purchase intention is multidimensional and causally complex, while also offering practical implications for marketers seeking to design more effective branding and sustainability strategies.

Structural Drivers of Pharmaceutical Waste in South Korea: A Socio-technical Analysis of Infrastructure and Disposal Practices

Een Park[1*], Kangmin Lee[1], Madelyn Karam[1] and Hojun Lee[2]

[1]*Cushing Academy, School Street, Ashburnham, United States*

[2]*Department of Psychiatry, School of Medicine, Keimyung University, Daegu, South Korea*

Abstract

Background: Rising pharmaceutical consumption has transformed unused medication into a significant fiscal and environmental challenge as South Korea transitions to a super-aged society. Comprehensive research synthesizing nationwide quantitative data on the structural and behavioral drivers of this issue remains lacking. Therefore, this study aimed to evaluate pharmaceutical waste as a socio-technical issue, quantified its economic burden, and identified systemic barriers to effective management.

Methods: We integrated National Health Insurance claims data (2018 - 2023) with a nationwide behavioral survey (n = 237) and spatial analysis of infrastructure to examine the intersection of pharmaceutical expenditure, disposal accessibility, and public practice.

Results: Pharmaceutical expenditure rose by 33.6% over five years, resulting in an estimated fiscal leakage of 632.3 billion KRW ($468.4 million). Spatial analysis identified a structural mismatch: while the elderly (aged ≥65 years) account for 45.7% of consumption, collection infrastructure is concentrated in urban centers, creating barriers in rural regions. Furthermore, a profound awareness-action gap exists; despite high environmental risk recognition (82.3%) and willingness to participate (94.1%), actual utilization of return systems remains low at 21.1% due to logistical frictions rather than public resistance.

Conclusion: This study identified pharmaceutical waste as a structural by-product of the imbalance between upstream prescription and downstream recovery. Mitigating this in efficiency requires a dual-track strategy: optimizing prescription patterns at the source and integrating the recovery infrastructure into lower logistical barriers.

Assessing the Effects of Microplastics on Black Soldier Fly Driven Organic Waste Conversion Efficiency

Shazina Saraf*

The University of Texas at Arlington, Texas, United States

Abstract

Microplastic contamination in organic waste streams presents emerging challenges for sustainable waste treatment systems. Black soldier fly (BSF) larvae (*Hermetia illucens*) have been identified as an effective biological solution for organic waste conversion; however, their interaction with microplastics requires evaluation to ensure safe and scalable implementation. This study investigates the effects of different microplastic types, including polyethylene (PE), polypropylene, and polystyrene, at concentrations ranging from 0.1% to 5% (w/w) under controlled treatment conditions over a 14-day period. Key performance indicators, including larval survival, biomass development, waste reduction efficiency, and feed conversion ratio (FCR), were used to assess system performance. Results show that BSF larvae preferentially ingest smaller microplastic particles (<100 µm), with approximately 70 - 90% excreted within a short duration, indicating limited bioaccumulation. Surface modification and fragmentation of particles were observed, suggesting partial breakdown, although overall polymer degradation remained minimal. Waste reduction efficiency remained within typical ranges at lower contamination levels but declined with increasing microplastic concentration, accompanied by increased FCR and reduced larval growth. Higher contamination, moderate reductions in survival and treatment efficiency were observed. These findings suggest that BSF-based systems can tolerate low levels of microplastic contamination with minimal performance loss; however, higher concentrations may adversely affect system efficiency. Integration of pre-treatment and monitoring strategies is essential for large-scale and industrial implementation.

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