Coalesce Research Group

APPROVED PROVIDER #782310

Joint Event

2nd International Conference on

CLEANER PRODUCTION AND CIRCULAR ECONOMY

&

ENERGY ENGINEERING AND RESOURCE EFFICIENCY

September 23-25, 2024 | Prague, Czech Republic

Coalesce Research Group
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Greenville, SC 29607, USA

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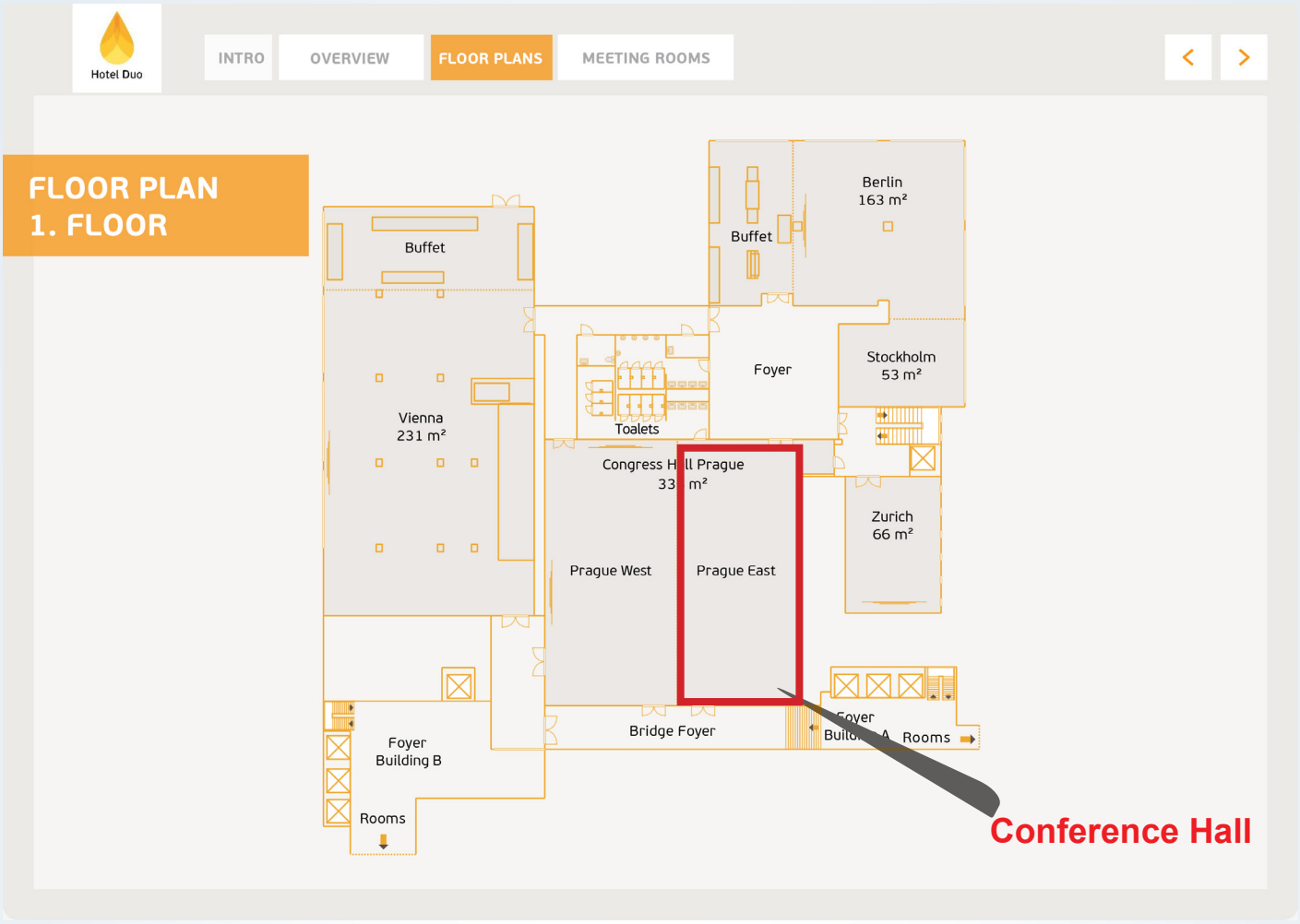
Floor Plan



Wi-Fi Details:

Username: Coalesce Conference
Password: Prague2024

Scientific Program

Scientific Program

Monday
September 23, 2024

2nd International Conference on

Cleaner Production and Circular Economy
&
Energy Engineering and Resource Efficiency

Day 1 - September 23, 2024	
Meeting Hall: Prague East	
08:00 - 08:45	Registrations
08:45 - 09:00	Opening Ceremony and Introduction
Keynote Presentations	
09:00 - 09:40	Stormwater Modeling: Recent Progress and Challenges **Erik R Christensen, University of Wisconsin-Milwaukee, USA**
09:40 - 10:20	Cleaner Production and Circular Economy: Paradigm Shifts and New Directions **K Sandy Kyaw, Cardiff Metropolitan University, UK**
Networking & Refreshments 10:20 - 10:40 @ Bridge	
Oral Presentations	
Session Chair	**K Sandy Kyaw,** Cardiff Metropolitan University, UK
Sessions:	Circular Economy | Circular Bio-economy | Life Cycle Assessment | De-carbonization/ Low- Carbon Economy and Net Zero | Environmental Sustainability and Climate Change | Resource Efficiency and Value Chain | Renewable Energy
10:40 - 11:05	How Small Projects Shed Light on the Big Picture: Rural Biogas Projects Vs Global Environmental Degradation A Common Denominator **Jón Gudmundsson, Agricultural University of Iceland, Iceland**
11:05 - 11:30	Development of a Methodological Framework for Circular Economy Business Model Valorization **Natalija Cudecka-Purina, BA School of Business and Finance, Latvia**
11:30 - 11:55	Towards a Circular Economy for Bikes: AI-based Damage Detection for Repair Planning **Tobias Geger, Institute for Software and Systems Engineering, University of Technology Clausthal, Germany**
11:55 - 12:20	The Circular Economy – Comparative Study of Different Countries on the Spectrum - Germany, Netherlands, and France, on One Side, and Romania and Poland, on the Side **TUDOROIU, Simina Claudia and TUDOROIU, Roxana Elena, University of Petrosani, Romania**
12:20 - 12:45	Enabling a Circular Economy of Medicines with a Smart Packaging Environmental Sensor **James Gerrans, University of Reading, UK**
Group Photo: 12:45 - 13:00	
Lunch 13:00 - 14:00 @ Berlin	
14:00 - 14:25	Circularity Assessment by Hierarchy of Disassembly: An Application of Circularity Indicators as a Design Tool for Architecture **Francesco Incelli, Iuav University of Venice, Italy**

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14:25 - 14:50	Can it be Determined? On how to Rate Refurbishment Expenditure of Power Tool Batteries with the Help of Artificial Intelligence
	Robert Werner, Institute for Software and Systems Engineering, University of Technology Clausthal, Germany
14:50 - 15:15	Cogeneration Unit with a Pulse Detonation Engine
	Jirí Rusín, Technical University of Ostrava, Czech Republic
15:15 - 15:40	Identification of R. Erythropolis Bioadsorption Process and Cesium Accumulation Location
	Woong Kim, Kyungpook National University, South Korea
15:40 - 16:05	Testing Experience with GIT as a More Sustainable Solution
	Necmettin Mert Kocanali, Best Transformer Balıkesir, Türkiye
Networking & Refreshments 16:05 - 16:25 @ Bridge	
16:25 - 16:50	Does the Circular Economy Provide Solutions to the Challenges of Public Transport Electrification? Insights from the CE4CE Project
	Marcin Wolek, University of Gdansk, Poland
Poster Presentations @ 16:50 - 18:00	
Poster Judge	**James Gerrans, University of Reading, UK**
POSTER 01	The Northern Netherlands: Transformation of a Gas-Producing Region into a Forerunner in the Biobased Circular Transition
	Johanna Angela Thomann, Hanze University of Applied Science, The Netherlands
POSTER 02	Methane Production from the Pyrolysis-Methanation of Waste Polyethylene Terephthalate Plastic
	Maram Alotaibi, University of Leeds, UK
POSTER 03	Pyrolysis of Waste Plastics and Tires for Liquid Fuels and Chemicals
	Noof Alzahrani, University of Leeds, UK
POSTER 04	Application of Ligninolytic Enzyme Producing Bacteria for Enhanced Bioconversion of Lanzhou Lily Biomass into Bioethanol
	Kamran Malik, Lanzhou University, China
POSTER 05	Grapes Pomace and Potatoes Residues Potential of Bioethanol Production: Pre-Treatment Approach for Maximizing Bioethanol
	Shah Mudassar, Lanzhou University, China
POSTER 06	Facing up to the Non-Circularity of Plastics: Policies for Plastics that Address Human Health and Environmental Safety Concern
	Shambulova Malika, HafenCity University Hamburg, Germany
Day 1 Concludes followed by Certificate Felicitation	

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Tuesday
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Day 2 - September 24, 2024	
Meeting Hall: Prague East	
Keynote Presentations	
09:00 - 09:40	Global Population: From Super-Malthus Behavior to Doomsday Criticality **Aleksandra Drozd-Rzoska, Institute of High Pressure Physics Polish Academy of Sciences, Poland** **Agata Angelika Sojecka, University of Economics in Katowice, Poland**
09:40 - 10:20	Sustainable Options for the End-Of-Life of Clean Energy Technologies **Anna Mazzi, University of Padova, Italy**
Networking & Refreshments 10:20 - 10:40 @ Bridge	
Oral Presentations	
Session Chair	**Jón Gudmundsson, Agricultural University of Iceland, Iceland**
Sessions:	Cleaner Energy Systems | Circular Economy | Sustainable Development and Sustainable Technology | Cleaner Production Economics | Cleaner Logistics and Supply Chain | Renewable Energy | Advanced Energy Systems | Cleaner and Responsible Consumption
10:40 - 11:05	Solar Harvesting via Multiple Transparent Photothermal Panels for Building Heating Utilities **Donglu Shi, University of Cincinnati, USA**
11:05 - 11:30	Circular Economy in the Construction Sector. An Explorative Study about the Recycling of Single-Use Masks based on a Customer Survey and Business Expert Interviews **Daniela Ludin and Erika Mueller, Department of Economics, Heilbronn University, Germany**
11:30 - 11:55	Circular Economy and Entrepreneurship in Europe: An Analysis of the Impact of Cultural Factors and Regulatory Framework **Francisco J Sáez-Martínez and Angela Gonzalez-Moreno, University of Castilla-La Mancha, Spain**
11:55 - 12:20	Sustainability Awareness among Customers in the Service Sector. An Explorative Study Based on a Survey at a German Hair Salon **Daniela Ludin and Erika Mueller, Department of Economics, Heilbronn University, Germany**
12:20 - 12:45	Improving Areas with a Circular Economy Approach for Plastic from the Target Environment. A Case Study **Marius Köder, Aalen University of Applied Science, Germany**
12:45 - 13:10	The Cycle of Zero Fossil Methane **Suaad S Al-Zakwani, University of Birmingham, UK**
Lunch 13:10 - 14:00 @ Berlin	

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14:00 - 14:25	Enhancing the Use of Reclaimed Building Materials: Supply Chain Actors' Attitudes Toward the Potential of a Mobile Application
	Aleksandra Dorota Kret-Grzeskowiak, Wrocław University of Science and Technology, Poland
14:25 - 14:50	Biodiesel Production Processes with Yeasts from a Sustainable Approach
	Alejandra Sánchez Solís, Universidad Iberoamericana, Mexico
14:50 - 15:15	Harnessing Energy from Descending Greywater in Tall Buildings
	Gideon Oron, Ben-Gurion University of the Negev, Israel
15:15 - 15:40	Reverse Logistics of Post-Consumer Glass Bottle in Brazil: A Case Study from the Perspective of the Street Collectors and the End Consumer
	Alaercio Nicoletti Junior, Production Engineering Department, Mackenzie Presbyterian University, Brazil
Networking & Refreshments 15:40 - 16:00 @ Bridge	
16:00 - 16:25	Development of Viable Hop Planting in Brazil - A Case Study
	Alaercio Nicoletti Junior, Production Engineering Department, Mackenzie Presbyterian University, Brazil
16:25 - 16:50	The Challenge of Reverse Logistics for Post-Consumer Glass Packaging in Brazil
	Alaercio Nicoletti Junior, Production Engineering Department, Mackenzie Presbyterian University, Brazil
16:50 - 17:15	The Use of Fine Pellet Grains and Sponge Iron Sludge to Produce Oxide Briquettes Based on Circular Economy
	Reza Bahaadini, Reza Rouholamini and Samad Abbaslou, Golgohar Iron and Steel Development Company, Iran
17:15 - 17:40	Optimizing DO Concentration in Conventional Activated Sludge Process to Alleviate Energy Consumption: Application of Particle Swarm Optimization algorithm
	Mpho Muloiwa, Tshwane University of technology, South Africa
Day 2 Concludes followed by Certificate Felicitation	

Scientific Program

Wednesday
September 24, 2024

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Day 3 - September 25, 2024	
Oral Presentations	
Session Chair	**Erik R Christensen, University of Wisconsin-Milwaukee, USA**
Sessions:	Cleaner Production and Advanced Manufacturing | Circular Economy | Green Technologies and Green Development | Resource Efficiency and Value Chain | Environmental Sustainability and Climate Change | Renewable Energy
09:00 - 09:25	Machine Learning as A Modeling Tool for Energy Consumption Planning Entity According to Product Characteristics for the Die-Casting Industry: Case Study
	Mariel Alfaro-Ponce and Cristopher A Muñoz-Ibañez, Institute of Advanced Materials for Sustainable Manufacturing, Tecnologico de Monterrey, Mexico
09:25 - 09:50	Development of a Green Process to Recover Gold, Silver, and Copper from Electronic Waste in Ecuador
	Alejandra Galarza, Extractive Metallurgy Department, Escuela Politécnica Nacional, Ecuador
09:50 - 10:15	Rejected Stream from Recycling of Multi-Layered Packaging Waste: Characterization, Opportunities for Circularity and Environmental Impacts Review
	Carolina Bedoya Muñoz, Universidad Nacional de Colombia, Colombia
Networking & Refreshments 10:15 - 10:35 @ Bridge	
10:35 - 11:00	Systems Based Assessment of Livelihood Vulnerability and Adaptation Strategies to Climate Change: Rajanpur District Pakistan
	Muhammad Afzal, University of Southern Queensland, Australia
11:00 - 11:25	An Experiment Investigating the Potential of Utilizing a Phase Change Material to Enhance the Electrical Efficiency of a Solar Panel
	Mohamed Bouzelmad, Ibn Zohr University, Morocco
11:25 - 11:50	Carbon Pricing in Germany's Road Transport and Housing Sector: Options for Reimbursing Carbon Revenues
	Manuel Frondel, RWI Leibniz-Institut für Wirtschaftsforschung, Germany
E-Poster	
E-Poster	Tackling Climate Change Through Multi-Stakeholder Partnerships. Promoting SDG 17 to Combat Climate
	Elena Bulmer, Antonio de Nebrija University, Spain
Day 3 Concludes followed by Certificate Felicitation and Vote of Thanks	

Virtual Program

2nd International Conference on

Cleaner Production and Circular Economy
&
Energy Engineering and Resource Efficiency

Day 1 - September 23, 2024	
Virtual Presentations - British Summer Time (BST)	
11:00 - 11:30	The Possibilities of Bacterial Cellulose within Established Markets: The Scalability of the Process and the Versatility of the Material
	Patrizia Bolzan, Politecnico di Milano, Italy
11:30 - 12:00	Does Family Care Promote Clean Cooking Energy Choices for Older Persons? – Analysis In Light of Home-Based Care in Rural China
	Wei Huang, Sichuan Agricultural University, China
12:00 - 12:30	Hosting Capacity of Distribution Grid
	Alen Tatalovic, HEP ODS d.o.o. Elektroprimorje Rijeka, Croatia
12:30 - 13:00	Aspects of V2G Implementation in the Distribution System
	Mateo Kirincic, University of Rijeka, Croatia
13:00 - 13:30	Study of the Process of Structural Wood Reuse in a Deconstruction/ Reconstruction Operation
	Odran Lemaitre, Laboratoire d'Etude et de Recherhce sur le Matériau Bois, Université de Lorraine, France
13:30 - 14:00	Environmental Sustainability and Intelligence as well as General Green Technologies
	Jinsong Wu, University of Chile, Chile
14:00 - 14:30	SRF Pyrolysis: Recovery Potential and its Role in the Circular Economy
	Jarudej Asingsamanunt, Imperial College London, UK
14:30 - 15:00	A Step Closer to Sustainability with In-Mold Electronics
	Stephan S Harkema, TNO at Holst Centre, Netherlands
15:00 - 15:30	Research and Development on Space Solar Power in Korea
	Joon-Min Choi, HanSeo Univeristy, South Korea
15:30 - 16:00	Optimizing the Reverse Supply Chain for Deconstructed Modular Building Components
	Hosna Ghorab, Concordia University, Concordia Institute for Information Systems Engineering, Canada
16:00 - 16:30	Understanding Dairy Livestock Farmers' Intention to Adopt Sociocultural Dynamics for Food Security using the Theory of Planned Behaviour
	Paresh Kumar Sarma, Bangladesh Agricultural University, Bangladesh

Day-1
Keynote Presentations

STORMWATER MODELING: RECENT PROGRESS AND CHALLENGES

Erik R Christensen

University of Wisconsin-Milwaukee, USA

Abstract

Background: Urban, and agricultural runoff from stormwater is often released without treatment to receiving waters although increased attention to ecological and human adverse effects of pollutants such as metals, e.g., zinc and copper, organic compounds for example PCBs and PFAS, and microbial pollutants has prompted further legislation and treatment efforts.

Objective: To review stormwater models, including GIS and combined sewer-based models.

Methods: Continuous models that have gained widespread use include SWMM, Winslamm, HSPF, as well as physically based, and empirical models. They differ in land application and whether several drainage areas can be considered simultaneously. Geographical Information Systems (GIS) is useful for accurate delineation of drainage areas and determination of runoff coefficients. Combined sewer areas can be considered by application of CMB and PMF models.

Results: From CMB modeling of combined sewer overflow (CSO) events from 2000 to 2006 in the Milwaukee, WI, area there was at least 26% of the flow from stormwater with up to 8% from groundwater. Metals and TSS are predominant pollutants in CSO. Sanitary sewage contributes ≥ 28% of BOD5, NH3 and TP. GIS determined drainage areas of 18 sites in Milwaukee, WI, produce consistent runoff coefficients between 0.123 for a mostly residential area to 0.697 for a freeway related land.

Conclusion: CMB modeling is useful for CSO modeling. Drainage area and runoff coefficient determination benefit from GIS.

Biography

Erik R Christensen's research activities relate to the fate and transport of pollutants in the aquatic environment, including quantifying sources and degradation of organic compounds. He has also contributed to models of the effect of pollutants on aquatic organisms. Christensen has received significant funding for his research from the U.S. National Science Foundation as well as from other federal and state agencies. Christensen convened the first IWA specialist conference on sediment contamination and remediation in Milwaukee. He is a fellow of the American Society of Civil Engineers and a UWM Distinguished Professor Emeritus. Research interests are aquatic pollutants, stormwater, models, membranes and ecotoxicity.

CLEANER PRODUCTION AND CIRCULAR ECONOMY: PARADIGM SHIFTS AND NEW DIRECTIONS

K Sandy Kyaw

Cardiff Metropolitan University, UK

Abstract

Whilst cleaner production and circular economy are integral to many of the latest Sustainable Development Goals set forward by the United Nations, new developments pertaining to circular economy-oriented innovation, sustainable development and building resilient futures point to the complexity and interdisciplinarity of various fields. This keynote speech examines the intricacies of relevant phenomena or potential paradigm shifts and new directions in the light of topical themes such as economic viability models, circular economy designs, open innovations, social and behavioural dimensions, and policy and regulatory frameworks.

Biography

K Sandy Kyaw is the Field Group Chair for Finance and Investment, and an Associate Professor in Applied International Economics and Development at Cardiff School of Management in Cardiff Metropolitan University. She holds a PhD in Economics from the University of Strathclyde, is a Fellow of the Higher Education Academy, and serves as the Managing Editor of International Journal of Management, Economics and Social Sciences. Sandy has published in leading international journals and her research interests include development economics, financial economics, international finance, applied econometrics, and business and management. Her research has received funding from various funders, including the Leverhulme Trust, European Social Fund, Wales Innovation Network, Research Wales, and Hodge Foundation.

Day-1
Oral Presentations

HOW SMALL PROJECTS SHED LIGHT ON THE BIG PICTURE: RURAL BIOGAS PROJECTS VS GLOBAL ENVIRONMENTAL DEGRADATION A COMMON DENOMINATOR

Jón Guðmundsson
Agricultural University of Iceland, Iceland

Abstract

Background: Planetary boundaries have been surpassed one by one in recent years. More and more people is forced below socially acceptable conditions regarding nutrition, housing, income, health and human rights. Climate changes fast approaching tipping point of no return. Rate of species extinction reaching one not seen in millions of years. Natural terrestrial ecosystems decreased to half of its area in early 20th century. Material consumption increased parallel with GDP, by 60% in 2000- 2017, reaching 100 bn tonnes a year in 2020. Amount of plastics in the ocean tripled in 20 years (2000-2019). Serious human induced drought urgently call on proactive actions in water management, landscape restoration and regenerative agricultural practices. The imperative demand on economic growth is main underlying course of these planetary threats.

Exploration and design: Local solution toward more sustainable communities, combining renewable energy and nutrient circulation can contribute. Biogas production for rural areas based on decentralized fermentation and centralised upgrading, was designed and its potential and challenges explored.

Results: The design has potential to meet considerable proportion local fossil fuel energy demand, improve nutrient cycling, and play part in solving organic waste issue of municipalities. Added social value could be included depending on cooperative design and ownership. The design requires new infrastructure and compete with other renewable energy sources on heat and electricity. Focusing on return of capital invested the design is not number one choose.

Conclusion: The dominance of narrow financial interest (investment capital return) in decisions on how we construct our system is the common dominator of planetary threats we are facing and an obstacle to many of the changes needed.

Biography

Jón Guðmundsson has worked for long time with greenhouse gasses measurements from various ecosystems and as expert in land use related GHG inventory (LULUCF). His interests in human ecosystem relations goes far back, and is the motivation for participating in many projects with wide range of subjects. Projects including ecosystem GHG fluxes and sequestration, biochemical cycles, soil hydrology, land use inventories and carbon stocks, biogas production on farm and national scale, and climate change effects on ecosystem. System approach and interweaving social and ecological aspects have always been important to him.

DEVELOPMENT OF A METHODOLOGICAL FRAMEWORK FOR CIRCULAR ECONOMY BUSINESS MODEL VALORIZATION

Natalija Cudecka-Purina and Dzintra Atstaja

BA School of Business and Finance, Latvia

Abstract

Background: For the last twenty years the necessity of implementation of circular economy business models and transition from business as usual to sustainability has been widely discussed and emphasized by researchers and also policy planners. The European Union has developed an ambitious policy framework to secure a shift to climate neutral continent. In order to successfully achieve the goals, a significant role is devoted to SMEs and the local and regional economies. One gap that has been identified by the Authors is in the intersectoral and cross-sectoral cooperation potential among SMEs of different industries, that has a huge potential for resource optimization.

Objective: To develop a framework for the methodology of the most suitable circular business model application, based on a range of input criteria of SMEs.

Methods: Research methods include qualitative data collection for a first-stage descriptive research, covering literature review and case studies on circular economy business model application. The data analysis will also engage a multilevel-model approach as well as systems dynamics.

Results: This research initiates a process for creation of a methodology that would allow SMEs to explore the benefits of circular economy business models and to maximize the valorization of the resources used by an SME, thus eliminating any potential waste generation, and leading to financial sustainability by cost optimization. The approach developed by the authors will allow SMEs to establish new connections in their value chain, to reconsider the latter, by applying latest ESG principles and to secure sustainable development of the entity in the long run.

Conclusion: Current economic growth alongside worldwide population growth requires urgent actions to be taken in order to continue development within the planetary boundaries. In order to do so, the national economies as well as SMEs need to revise their vision on waste and resource management and to gain knowledge or benefit from best practices on how to keep the resources in the economic cycle for the longest possible period. But beyond this there is a huge potential to foster circularity, if the development of an SME is not being assessed on a stand alone basis, but in combination with such factors as: geographic location, neighboring entities and their set of input/output resources, resource mapping and beneficial sectoral or cross-sectoral linkage possibilities (i.e. potential for industrial symbiosis.

Biography

Natalija Cudecka-Purina, ORCID ID 0000-0002-5736-7730 Assoc. Prof., Phd in Business Administration with a focus on Circular Economy and Sustainability for waste landfills. Natālija has over 15 years' experience in Sustainability, being involved in development of Latvian waste management system – implementation of infrastructural projects on dumpsite closure and recultivation, construction of sanitary landfills and waste sorting infrastructure. Followed by almost 10 years' experience in public sector in policy planning and strategy development. In the role of Associate Professor, Natalija has developed a range of study courses and continues scientific research in the field of sustainability, waste management, circular economy (LIFE, Erasmus +, Horizon, COST actions, etc.). Research interests are circular economy, industrial symbiosis, resource efficiency, waste management.

TOWARDS A CIRCULAR ECONOMY FOR BIKES: AI-BASED DAMAGE DETECTION FOR REPAIR PLANNING

Tobias Geger, Dominique Fabio Briechle, Marit Briechle-Mathiszig, Nelly Nyeck and Robert Werner

Institute for Software and Systems Engineering, University of Technology Clausthal, Germany

Abstract

Background: The production of new bicycles is an energy and resource intensive process. In order to produce, for example a new CFK-frame, up to 1500 liters of water and 400 MJ for energy are necessary. To save resources, the Circular Economy is a counter approach, where products will be reused and repaired. However, in the case of repairing bicycles the knowledge gap regarding missing or defective components can be quite large, which hinders effective reuse/repair of the bicycles, which is benefitted by the delay caused by the supply chain of parts.

Objective: Conception of an AI to identify damaged/missing components on bicycles for repair and supply chain planning

Methods: Data was generated out of 115 different bicycles to display a wide array of possible types and damages. A product breakdown structure was defined to enable the annotation of the bicycles based on the different influencing parameters. The state of the bicycles as well as the assessment of the condition types is currently conducted together with bicycle technicians to ensure the validity of the recorded condition of the components.

Results: A total of 115 bicycles were recorded and a preassessment of the condition of the bicycles was conducted. In the process, 690 images were taken in total from different angles of vision. The preliminary results were submitted as a short paper which is currently pending. The next steps will contain the data annotation as well as the training of the model until summer 2024, including the presentation of the results.

Conclusion: The preliminary results already show the applicability of the product breakdown structure in order to annotate the images in correlation to the condition of the parts. The utilization for the training of the aspired model has yet to be seen. However, current approaches found in literature show promising attempts.

Biography

Tobias Geger is a PhD candidate at the Institute of Software and Systems Engineering (ISSE) at the University of Clausthal (TUC). He started his PhD research in 2023 and began his research after he completed his master's in computer sciences with focus on robotics and artificial intelligence. In his PhD he starts exploring human-robot interactions in the context of Circular Economy. As part of the academic staff of the ISSE he is assisting in different formats of academic teaching. Tobias Geger's research combines theoretical and practical frameworks to enhance industrial efficiency and sustainability. His work aims to transform interactions between humans and robots, promoting sustainability through smarter resource use in industrial settings. Research interests are circular economy, human-robot interaction and artificial intelligence.

THE CIRCULAR ECONOMY – COMPARATIVE STUDY OF DIFFERENT COUNTRIES ON THE SPECTRUM - GERMANY, NETHERLANDS, AND FRANCE, ON ONE SIDE, AND ROMANIA AND POLAND, ON THE SIDE

TUDOROIU, Simina Claudia and TUDOROIU, Roxana Elena
University of Petrosani, Romania

Abstract

In this paper we will introduce concepts related to circular economy, such as those depicted by Paul Ekins, the butterfly model introduced by Ellen Mac Arthur, the 9 R's introduced by European Union in 2017, to denote the strategies for a circular economy, the indicators of a circular economy proposed by Teresa Domenench (material use – consumption, recycling; energy use – consumption, renewable energy; natural – air quality, water consumption; well-being – health, social cohesion), the indicators of a circular economy proposed by Peterborough (amount of renewable electricity available to each household, CO_2 emissions per capita, % household waste recycled, % circular jobs, etc). North America and Europe, as well as Japan are the first promoters of this kind of economy throughout the globe.

Inside Europe, the differences situate themselves between western Europe, more advanced on the implementation of the roadmap for a circular economy, while the Eastern Europe is making the effort for designing its roadmap and little by little going towards the implementation of it.

We will take a close look at three major western European countries – Germany, Netherlands and France, and consider them as role models into the future of circular economy. We will present how far they are on this path, and what they still need to achieve.

On the other hand, we will take a close look at eastern and central European strategy plans for a circular economy and bioeconomy. We will consider for our research especially Romania and Poland. We will see that while they are working on some programs such as recycling pets, they

are lacking initiative for other programs, like recycling municipal wastes, reinserting back into economy raw materials and the production of renewable biological resources for the conversion into food by innovative and efficient technologies.

ENABLING A CIRCULAR ECONOMY OF MEDICINES WITH A SMART PACKAGING ENVIRONMENTAL SENSOR

James Gerrans and R Simon Sherratt

University of Reading, UK

Abstract

Background: Medicine waste is a global issue that is predicted to double by 2050. In 2010, the NHS spent GBP 300 million on medicines that ultimately went unused while medicine waste products have been found in the ground, river and even some drinking water in every continent around the earth.

Medicine Reuse is a field in its infancy, and currently is too expensive but implementing additional safety measures could enable medicine reuse on a national scale.

Objective: To evaluate the effectiveness of a Smart Packaging System in aiding medicine reuse by validating the storage conditions of medicines while in patient care so that a higher quality of medicines may be re-dispensed.

Methods: A credit card sized smart sensor was designed to read environmental conditions and communicate with a companion pharmacy system over NFC. This system is configurable for its assigned medicine's needs on dispensation and relays it's collected data on return.

The system was assessed according to its functionality (lifespan, and accuracy of readings/data transmission) and feasibility (projected economic impact, largescale environmental impact, and likelihood of largescale adoption).

Results: The results are not yet collected but are expected to be as follows:

The system will function adequately, having a lifespan of 6-12 months and reading/relaying environmental conditions accurately. The system will be low cost when factoring in an economy of scale and will save money by streamlining medicine assessment.

The system may struggle to be environmentally feasible but will be reused multiple times throughout its lifespan and could be further redesigned to be more recyclable. Overall, it is likely that the system will be adopted as it will allow for a more streamlined and safer medicine returns process.

Conclusion: A practical system will be presented to reduce medication wastage and enable a circular economy of medicines.

Biography

James Gerrans is a PhD candidate in Biomedical Engineering at the University of Reading. His work focuses on the reduction of medicine waste through the reuse of previously owned medicines. He is encouraging the introduction of a circular economy of medicines through the use of a smart packaging sensor to validate the storage conditions of medicines while in patient care. James is currently working with the ReMINDs team, a multidisciplinary group of academics at the University of Reading aiming to enable and normalise large-scale medicine reuse. James' interest in engineering comes from a desire to fix problems and a love of science fiction. In his spare time, James enjoys being in nature while whitewater kayaking and painting. Research interests are medicine reuse and embedded systems.

CIRCULARITY ASSESSMENT BY HIERARCHY OF DISASSEMBLY: AN APPLICATION OF CIRCULARITY INDICATORS AS A DESIGN TOOL FOR ARCHITECTURE

Francesco Incelli

Iuav University of Venice, Italy

Abstract

Background: The integration of circular economy (CE) principles in architectural design and construction highlights the role of architectural technology in enabling circular metabolisms within the built environment. However, the fragmentation of CE knowledge and the diversity of circularity assessment methods pose significant challenges during the concept design phase, hindering the widespread adoption of circular design in the construction sector.

Objective: This study aims to evaluate the potentials and limitations of CE protocols in architectural design, considering the influence of circular economy principles on building projects. Emphasis is placed on integrating circularity indicators (CI) early in the design process to support effective Design for Disassembly (DfD) strategies. Additionally, the study seeks to enhance understanding of circularity evaluation protocols, utilizing them as tools throughout the design and post-project phases.

Methods: Employing innovative methodologies, the research implements CI protocols, including Level(s) and Material Circularity Indicator, on pre-existing projects known for their significant reversibility. This approach enables meaningful comparisons of design alternatives using specific circularity metrics. Case studies encompass a diverse range of works, with a focus on those characterized by high structural reversibility and short life cycles.

Results: The findings highlight the variability of circularity indicators, demonstrating fluctuations of 10% to 30% based on disassembly hierarchy, from raw materials at the microscale to functional units at the macroscale. This emphasizes how connectivity strategies and technological solutions adopted at the concept stage exert impacts comparable to material choices.

Conclusion: In summary, this study emphasizes the critical importance of a comprehensive and integrated approach to circularity in architectural design. Early and strategic planning is highlighted to develop circularity-focused design solutions, particularly regarding specific technological aspects of building materials. Furthermore, the study provides fresh perspectives and tools to address challenges in transitioning towards a circular economy and architecture.

Biography

Francesco Incelli is a Chartered Civil Engineer and Lecturer with extensive experience in the design and construction industry. His expertise spans various aspects of civil engineering, including structural design, project management, and sustainable construction practices. Francesco has actively contributed to research and education in the field, emphasizing innovative approaches to enhance building resilience, minimize environmental impact, and promote circular economy principles. His commitment to advancing sustainable design aligns with the evolving needs of the academic and construction sector. Research interests are circular economy, design for disassembly and reversible façade design.

CAN IT BE DETERMINED? ON HOW TO RATE REFURBISHMENT EXPENDITURE OF POWER TOOL BATTERIES WITH THE HELP OF ARTIFICIAL INTELLIGENCE

Robert Werner, Dominique Fabio Briechle, Tobias Geger, Marit Briechle-Mathiszig and Nelly Nyeck

Institute for Software and Systems Engineering, University of Technology Clausthal, Germany

Abstract

Background: The average European produces over 10 kg of electronic waste per year, resulting in a high consumption of resources and energy. A lot of electronic products which are deposed show however just minor damage or malfunctions and could be repaired easily. The bottlenecks here are mostly the infrastructure regarding potential repair, refurbishment and remanufacturing (3Rs) operations as well as the lack of damage information the potential repairer has regarding a product. To pave the way to a broader application of 3R services for products, we investigate the possibility of a repair expenditure assessment system to predict the specific damage of a power tool battery.

Objective: Investigate the capabilities of artificial intelligence to assess refurbishment expenditure.

Methods: In the context of the project, we applied a data acquisition system in order to record the images of the power tool batteries. This process is conducted via a partially automated toolchain, which processes the incoming batteries. In order to investigate the accuracy of the refurbishment process expenditure demonstrator, different methods for small sample data set classification tasks are applied and evaluated.

Results: We have recorded 30 defective batteries so far and collected information regarding the failure type and usage. Additionally, we investigated the electronics of each battery in order to build up a detailed data structure for the incoming products. Therefore, a data acquisition system was designed, which findings were already submitted as a short paper (Status pending). It is planned to train the model until summer 2024 with an extended data set and present the results in a presentation.

Conclusion: The project showed that we have two dominant failure types, which result in different expenditures regarding the time/cost to reinstate the functioning condition. However, although we have found promising attempts in scientific sources, the outcome has yet to be determined.

Biography

Dominique Fabio Briechle has a background in resource engineering and started his PhD research in 2022 at the Institute of Software and Systems Engineering (ISSE) at the University of Technology Clausthal (TUC). His research topics include Circular Economy based Systems as well as tool design to enable the 3Rs (repair, refurbish and remanufacture). As part of the academic staff of the ISSE he is assisting in different formats of academic teaching. He is a further part of the team working in the living-lab "Digitized Circular Economy" of the Center for Digital Technologies of TUC. Research interests are circular economy, automatization tools and processes.

COGENERATION UNIT WITH A PULSE DETONATION ENGINE

Jiří Rusín, Tomáš Výtisk and Ferdinand Madry

VSB - Technical University of Ostrava, Czech Republic

Abstract

Background: Effective use of the chemical energy of biogas by transforming it into mechanical, thermal and electrical energy is an extremely actual topic in the use of renewable energy sources with minimal impact on the quality of the environment. The cogeneration unit is designed for the efficient production of electricity, using the technology of a pulse detonation engine burning mixture of biogas and hydrogen. Part of the heat from engine cooling is further used for the production of low- potential steam in the steam RC cycle and part is available for heating of fermentation tanks, or possibly for pre-treatment or drying of biomass.

Objective: A structurally simple, investment- and operationally undemanding unit for the efficient use of biogas energy with the possibility of installation in the biogas stations technology.

Methods: Balance calculations and functional diagrams were used for the production of a lab-scale functional sample of the unit. Sets of tests with diagnostic measurement of thermal technical parameters during operation of the unit led to its optimal structural design.

Results: Depending on the composition of the input biogas, its treatment and enrichment with hydrogen in the range of 20-30% by volume is performed. When igniting such enriched biogas, it is possible to obtain the required velocity of the output flue gas (105-115 m/s) at a high temperature (530-590 °C), and the enthalpy and kinetic energy thus obtained can be further transformed for the production of electric power in the range of 8-10 kW with simultaneous gain of 4-8 kW of heat.

Conclusion: The system of transformation of hydrogen-enriched biogas chemical energy into electrical and thermal energy is a unique due to the type of equipment used, especially the pulse detonation engine, and their connection with the aim of minimizing losses.

Biography

Jiří Rusín has his expertise in anaerobic digestion, aerobic composting and newly also in biohydrogen production by dark fermentation process. He also led projects dealing with applied research and experimental development in the field of anaerobic bioreactors and biogas to biomethane upgrading processes.

IDENTIFICATION OF R. ERYTHROPOLIS BIOADSORPTION PROCESS AND CESIUM ACCUMULATION LOCATION

Woong Kim, June Lee and Jeon-Chang-Hyun

Kyungpook National University, Republic of Korea

Abstract

Ecosystem pollution caused by methane and plastic waste emissions is a global challenge. Polyhydroxyalkanoates (PHA) are polyesters naturally produced by microorganisms, with poly-3-hydroxybutyrate (PHB) being a major type. Although PHB is widely known as a biodegradable polymer substitute capable of replacing conventional petroleum-derived polymers, it has not had a significant impact in the industry for a long time due to its high production cost. Therefore, the aim of this study is to install a gas-solid reactor to continuously produce PHB from Methylosinus trichosporium, a methanotroph capable of producing PHB. The maximum PHB content on a dry weight basis was 23.5%, the maximum PHA productivity was 0.56 g/L/day, and the maximum purity was 82.2%. To investigate how the growth of PHA-producing microorganisms varies depending on the concentrations of different nitrogen sources when methane is used as the carbon source, response surface analysis was conducted. The results showed that at a methane concentration of 0.8 mmol, the highest microbial growth was observed when NH_4^+ was at 1 mM and NO_3^- was at 0.7 mM. Additionally, FT-IR and DSC analyses revealed that the type of PHA produced varied when the strain of microorganism changed. We confirmed continuous biological PHB production and anticipate large-scale production of PHB through future scale-up efforts. Keywords: PHA; Methylosinus trichosporium; methane; PHB; response surface analysis.

TESTING EXPERIENCE WITH GIT AS A MORE SUSTAINABLE SOLUTION

Necmettin Mert Kocanali[1], Irem Hazar[1], Ramazan Altay[1], Mahmut Aksoy[1], Mahmut Antika[2] and Okan Ozgonenel[3]

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Abstract

Transformers are one of the most expensive and critical components in electrical power systems. A failure in a transformer causes economic losses and injuries. Therefore, it is essential to ensure that transformers operate safely throughout their working life. Mineral oil has been used for more than 100 years as coolant and insulating liquid for transformers. Mineral oil has excellent electrical insulating properties, but has also been the most popular transformer insulation, which has many problems such as high flammability, significant cleaning issues, and is very difficult to dissolve in nature. However, in recent decades, the reduction of mineral oil reserves and sustainability goals with renewable energy become core issues world-wide.

The adverse ecological effects of mineral oil, the lack of mineral oil reserves, leakage risks and the disposal of waste oil prompted researchers to focus on biodegradable and renewable insulating materials. For this reason, electricity companies around the world must constantly look for ways to provide safer and more efficient electricity while reducing the negative impact on the environment. In this context, the development of gas-insulated transformers (GIT) has begun. Especially the demand for gas insulated transformers is increasing rapidly in Japan, Hong Kong, and China. More than 10,000 units and up to 275kV-300MVA class of gas- insulated transformers are currently operating in the field. GIT are transformers used in high voltage power systems. GITs were developed as an alternative to conventional oil-insulated transformers. They utilize a gas insulating medium (usually sulphur hexafluoride gas - SF_6). Within the scope of gas insulated transformers, various gases with different properties are used. These gases are SF_6, R410A, CF3I, C3F6I, c–C4F8 etc... Among these gases, the R410A has the best atmospheric lifetime. Atmospheric lifetime is 3200 years for SF_6 and 16 years for R410A. Two other main advantages that also motivate the growing interest in R410A are non- flammable and don't need to firefighting required. R410A gas transformers provide more operating safety than mineral oil. In this addition to this, compared to mineral oil insulated transformers, gas insulated transformers are much lighter and provide flexibility in radiator design. Some of the main features of GITs are shown below.

- Insulation: Gas insulation provides insulation by preventing the elements inside GITs from coming into contact with highly stressed components. This means a more compact design and higher power density.
- Safety: Gas insulation of GITs reduces the risk of fire because the gases used in GITs are generally non-flammable or have low flammable properties. This ensures a safe working environment.
- Environmental impact: The gases used in GITs generally do not cause harmful emissions to the environment than SF_6 gas and mineral oils. Therefore, they are considered a more environmentally sustainable option.
- Reduced maintenance: Total substation size is half with GIT since not necessary to use fire wall and leakage oil channels.

- High reliability: GITs provide higher reliability because they have fewer moving parts and a sealed design. Reduced risk of damage from external factors.

In this paper, FEM analysis, production, and test results of 50 kVA R410A gas insulated transformer are presented. Mechanical strength for 4 bars, electrostatic for insulation system, thermal for hot-spot, winding and gas temperature rises analysis have been carried out. Finally, the prototype is passed all routine electrical and heat run tests [**Figure 1**].

Figure 1: 50kVA, R410A gas insulated transformer in service.

DOES THE CIRCULAR ECONOMY PROVIDE SOLUTIONS TO THE CHALLENGES OF PUBLIC TRANSPORT ELECTRIFICATION? INSIGHTS FROM THE CE4CE PROJECT

Marcin Wołek, Aleksander Jagiełło and Agnieszka Szmelter-Jarosz
University of Gdańsk, Poland

Abstract

Background: The circular economy at an urban level, specifically the challenges associated with electrifying road-based public transportation, remains poorly researched and described in the literature, mainly due to the limited number of electric buses that have completed their full life cycle.

Objective: The study aims to prepare an inventory of challenges and problems for cities, especially public transport operators, and match the circular economy solutions to solve them. The CE4CE project (Interreg Central Europe Programme), focused on greening public transport, aims to reduce the ecological footprint of public transport through a higher circularity.

Methods: We used the case study method and in-depth interviews with the company's representatives. Then, we discussed the results with the focus group of other partners within the CE4CE project.

Results: The principles of the circular economy, including the 10R principles, applicable apply to infrastructure (built environment), vehicles, and their crucial components, which are batteries and materials that wear out during service provision (e.g., tyres). In our study, various stakeholders of public transport in cities (PT providers, NGOs, researchers, consulting companies) identified the possibilities of implementing 10R and filling technological and methodological gaps or gaps resulting from lack of experience in a given field (e.g. lack of experience in using end-of-life batteries, for example as energy micro-storages). The collected results are presented graphically as circularity compass for public transport. This format allows for easy and efficient utilisation by most various stakeholders of the public transport market.

Conclusion: We presented the possibilities of implementing a circular economy in the selected enterprise and, more broadly, in public transport by proposing the assumptions of the electromobility strategy and circular economy strategy for Polish cities and, more broadly, cities in Central Europe.

Biography

Marcin Wołek has his expertise in public transport management. For over 25 years, he has been developing public transport strategies, including Sustainable Urban Mobility Plans in Polish and Ukrainian cities, cooperating with different public and private transport stakeholders and within transnational projects. He is experienced in public transport operations research, especially in electrified public transport. Interests are public transport, sustainable urban mobility and urban circular economy.

Day-1
Poster Presentations

THE NORTHERN NETHERLANDS: TRANSFORMATION OF A GAS-PRODUCING REGION INTO A FORERUNNER IN THE BIOBASED CIRCULAR TRANSITION

Johanna Angela Thomann, André Heeres and Errit Bekkering

Hanze University of Applied Science, The Netherlands

Abstract

Background: The world faces fundamental transitions in production of energy and goods, to be realized through the adoption of renewable energy and a biobased circular transition. The article explores how an European North Sea region that has been traditionally highly reliant on natural gas navigates its shift to a biobased circular economy and its ambition to excel in the field.

Objective: To communicate the economic developments of the Northern Netherlands with focus on the chemical sector by exploring how they were initiated and showing the opportunities that this region has to offer today.

Methods: The article is a commentary published in the Journal of Business Chemistry. Information was gathered through literature study and interviews. SWOT analyses were conducted and an overview of new proposition for high-value chemicals from end-of-life plastics, biomass, the energy sector and regionally available chemicals is given.

Results: Relevant ingredients for these transitions are available in the region, namely, green energy, renewable feedstock, infrastructure and knowledge. Its coastal location and agricultural background provides access to off-shore wind energy and biomass. Proximity to excellent knowledge centers and upscaling facilities is also decisive. Existing gas infrastructure provides an advantage for building-up a hydrogen economy as recognized by the status European Hydrogen Valley. While the chemical sector with its two complementary clusters in basic chemicals and polymers plays a crucial role, close intersectoral collaboration is needed in the form of sourcing more sustainably from the agricultural, energy and waste sectors.

Conclusion: Availability of green energy and feedstock, infrastructure and knowledge, as well as intersectoral collaboration have accelerated the biobased circular transition in the Northern Netherlands. There is economic potential arising from the creative combination of available feedstocks in an innovative ecosystem providing necessary framework conditions. The region now caters a fruitful environment for sustainably-minded (bio)chemical businesses.

Biography

Johanna Angela Thomann is a PhD candidate at the Research Center Biobased Economy in Groningen, The Netherlands, where she is mostly busy with finding environmentally benign alternatives for common chemically modified starch products by combining regional feedstocks. Besides, she has always been interested in working at the interface of science and economics and is passionate about finding ways to make the chemical industry more sustainable. She has done internships at oil refineries, biomass-processing industries and climate-tech start-ups. During her studies in Germany and the Netherlands, she worked in the field of organic chemistry and photochemistry in the groups of Prof. dr. Anna McConnell and Nobel laureate Prof. dr. Ben Feringa. Research interests include circular biobased transition, sustainable business practices, green chemistry and starch modifications.

METHANE PRODUCTION FROM THE PYROLYSIS-METHANATION OF WASTE POLYETHYLENE TEREPHTHALATE PLASTIC

Maram Alotaibi, Mohamad Nahil and Paul T Williams

University of Leeds, UK

Abstract

Background: The rapid increase in the amount of waste polyethylene terephthalate (PET) has caused significant environmental contamination. As a result, the environmental implications of these wastes are raising issues about suitable management systems for PET. The pyrolysis process is a promising method of waste processing because it contributes to the reduction of this waste and has the potential to produce useful gas and liquid fuels.

Objective: This study aims to investigate the generation of methane from PET waste plastic through the enhancement of CO, and CO_2 in the product gas from pyrolysis followed by methanation of the evolved CO and CO_2 in a three-stage fixed bed methanation reactor.

Methods: A three stage (i) pyrolysis (ii) catalytic cracking (iii) methanation experimental reactor system was used for methane production from PET. The pyrolysis of PET was carried out at a temperature of 500°C for the first stage pyrolysis, followed by catalytic cracking at different temperatures for the second stage, 550, 650, 750 and 850°C, then catalytic hydrogenation at a 360°C for the third stage methanation of the evolved CO and CO_2 gases. Different catalysts were used in the second stage to crack the pyrolysis liquid products with the aim to increase the yield of CO and CO_2 from the pyrolysis of the PET, also different metal- based alumina catalysts were used in the third stage to maximize methane production.

Results: The experimental findings of PET pyrolysis indicated a liquid yield of around 60%, a gas yield ranging from 21% to 23%. The two-stage (i) pyrolysis (ii) catalytic cracking of PET results indicate that the amount of gas yield and CO and CO_2 concentration increases with increased temperature. For example, the gas yield was increased to 64.6% with CO and CO_2 concentrations of 15.19 mmol/g and 3.25 mmol/g respectively. Incorporating a third stage reactor operated at 360°C with a 10% Ni/Al_2O_3 as a catalyst produced the highest yield of methane from the three stages (i) pyrolysis (ii) catalytic cracking (iii) methanation of PET.

Conclusion and Future Work: The findings of this study provide evidence to support the assertion that pyrolysis is a very effective method for managing and converting waste materials, such as PET. Furthermore, the utilization of a catalyst in a second stage fixed-bed reactor under the specified operating conditions resulted in a significant increase in the production of gas products, which aligns with one of the primary goals of this research. Using a Ni-alumina catalyst gave good results for methane production in a third stage fixed-bed reactor, leading to maximized methane production from PET.

Future work will involve the use of the three-stage (i) pyrolysis (ii) catalytic cracking (iii) catalytic hydrogenation reactor system to investigate the optimal operating parameters to produce the maximum yield of methane.

Biography

Maram Alotaibi is a PhD student who began her studies in 2023. Her work focuses on Methane production from pyrolysis processing of plastic waste in particular polyethylene terephthalate plastic (PET). She has developed a novel three- stage [i] pyrolysis [ii] catalytic cracking [iii] methanation reactor for the project to produce methane from PET. Maram is sponsored by Royal Embassy of Saudi Arabia – Cultural Bureau in London. Research interest is methane production.

PYROLYSIS OF WASTE PLASTICS AND TIRES FOR LIQUID FUELS AND CHEMICALS

Noof Alzahrani, Mohamad A Nahil and Paul T Williams

University of Leeds, UK

Abstract

Background: More than 27 million tonnes of waste plastic and more than 3 million tonnes of waste tires are produced in Europe each year. There are increasing concerns around the treatment and disposal of waste plastics and waste tires in the environment. Thermal processing of such wastes by pyrolysis is a viable alternative to existing waste management options. Pyrolysis of waste plastics and tires produces a gas, oil and solid char that can be used as fuels and chemicals.

The main plastics found in municipal solid waste are polyethylene, polypropylene, polystyrene and polyethylene terephthalate. Co-pyrolysis of waste plastics with tires has the potential to produce a suite of volatile products that can be upgraded to low molecular weight product oil and a range of high value chemicals. Here we report on the co-pyrolysis of different waste plastics (polyethylene, polypropylene, polystyrene, and polyethylene terephthalate) with waste tires to determine their influence on the production of low molecular weight premium grade fuel oils and aromatic chemicals.

Objective: The aim of the work focuses on the changes in products yield, particularly the oil composition, and investigates the synergistic interaction between tires and plastics during the co-pyrolysis to maximize the production of the high value chemicals and premium grade fuel oils.

Methods: The pyrolysis experimental work used a fixed bed reactor and analysis of the product oils and gases used a range of analytical techniques. Gases were analyzed using a suite of gas chromatographs for hydrocarbons and permanent gases. Product oils were analyzed using GC and confirmation of identified compounds used gas chromatography/mass spectrometry (GC/MS).

Results: Pyrolysis of polyethylene produced a wax/oil product consisting of a set of triplet's aliphatic hydrocarbons (alkadiene, 1-alkene, and alkane, from C1- C30). Polypropylene also produced a wax/oil product composed of aliphatic compounds from C6-C25 with the cyclic structures were primarily produced. Polystyrene pyrolysis produces an oil product consisting of high concentrations of styrene and other aromatic compounds including benzene, toluene, ethylbenzene, xylene, and alkylated benzenes. Pyrolysis of polyethylene terephthalate produces an oil containing mainly benzoic acid. Pyrolysis of tires produces a high oil yield, and the main compounds found in the oil are benzene, toluene, ethylbenzene, xylenes, styrene, indene, limonene, and 2-5 ring polycyclic aromatic hydrocarbons. Co-pyrolysis of the mixtures of different plastics and tires showed that the addition of tires had a significant effect on the composition of the product oils and gases. Synergistic interaction of the plastics and tires during the pyrolysis process was demonstrated.

Conclusion: This work highlighted the oil composition, particularly the valuable chemicals that were produced from the co-pyrolysis of waste tire/plastic. The results showed the liquid oil produced from the pyrolysis of tires and polystyrene was mostly composed of aromatic compounds. The liquid oil formed from the pyrolysis of polyethylene was mostly waxes, whereas polypropylene produced more alicyclic compounds. Polyethylene terephthalate pyrolysis oil consists of compounds, such as xylene, styrene, and other oxygenated compounds, with a high concentration of benzoic acid. Oil obtained from

the pyrolysis of the mixtures (tyre and plastic, 50:50%) revealed a considerable increase in single ring aromatic compounds.

Biography

Noof Alzahrani, a PhD researcher student in my third year in the School of Chemical and Process Engineering at the University of Leeds. My research project involves the production of high value, premium grade liquid fuels and high value chemicals from the processing of waste materials such as waste plastics and waste tires. My work is of significant scientific and engineering impact involving sustainable and resource recycling of waste materials to produce high value products. Attendance at this conference will raise my profile and research. In addition, I will greatly benefit from the experience of research and social interaction with other researchers from around the world. Research interest is recycling (pyrolysis) of waste polymers to produce high value chemicals.

APPLICATION OF LIGNINOLYTIC ENZYME PRODUCING BACTERIA FOR ENHANCED BIOCONVERSION OF LANZHOU LILY BIOMASS INTO BIOETHANOL

Kamran Malik, Taixiang Chen and Chunjie Li

Lanzhou University, China

Abstract

Background: Appropriate bioprocessing of lignocellulosic materials into ethanol could address the world's insatiable appetite for energy while mitigating greenhouse gases. Bioethanol is an ideal gasoline extender and is widely used in many countries in blended form with gasoline at specific ratios to improve fuel characteristics and engine performance. Finding a suitable microbial agent for the efficient conversion of lignocellulose is still an active field of study.

Objective: To enhance the bioethanol production with effective lignin degradation and utilization of pentose and hexose sugars in an economical way.

Methods: Lanzhou lily (*Lilium davidii* var. unicolor) biomass was the substrate. Microbial strains were isolated, identified, determined for their lignin degradation capability, and used as pretreatment agents for the lignin degradation.Various modern spectroscopic analyses, ligninolytic activity, sugar estimation, enzymatic hydrolysis, and liquefaction and fermentation process were conducted. The final data was statistically validated with post-hoc Tukey test, R software and SPSS Statistics 26.

Results: The proximate and ultimate analyses of raw biomass showed that it comprised of total solids 96.54%, volatile solids 92.82%, carbon 48.22%, and sulphur 0.28%. After the application of bacterial pretreatments, the lignin content was considerably reduced to 6.78%, and the cellulose share increased to 57.31%. The LiP and MnP like activity was highest in alkaline lignin culture source with an amount of 0.67 ± 0.1 U/mL and 1.03 ± 0.08 U/mL, respectively. The optimum sugar utilization efficiency was reached at 93.46%, with the highest bioethanol production of 0.51 g/g and 85.78% bioethanol yield after the anaerobic fermentation.

Conclusion: In this study, successful delignification of the *Lanzhou lily* biomass was achieved by bacterial pretreatments and maximum bioethanol was produced. The integration of bacterial pretreatments and C5 and C6 sugar utilizing microbial strains could enhance the commercial bioethanol production. However, to meet global energy demand further studies to develop sustainable and cost-effective approaches are still required.

Biography

Kamran Malik is a dedicated scientist in the field of microbiology and renewable energy. Driven by a desire to make a meaningful impact in the realm of sustainable energy, Dr. Malik earned a Ph. D degree in Microbiology with a focus on bioethanol production from agricultural biomass sources. His doctoral research was groundbreaking, exploring innovative methods to harness the potential of microorganisms in converting biomass into bioethanol, a renewable and environmentally friendly alternative to traditional fossil fuels. Building upon his doctoral work, Dr. Malik embarked on a postdoctoral research position at Lanzhou University, China, where he is currently serves as a key member of the renewable energy research team. In this role, he focuses on expanding his expertise in renewable energy technologies, with a particular emphasis on advancing the understanding of microbial processes for bioenergy production. Research interests are renewable energy sources and technologies.

GRAPES POMACE AND POTATOES RESIDUES POTENTIAL OF BIOETHANOL PRODUCTION: PRE-TREATMENT APPROACH FOR MAXIMIZING BIOETHANOL

Shah Mudassar, Irfan Muhammad and Shah Faisal

University Gansu, China

Abstract

Background: The escalating global energy demand and the urgent need for sustainable waste management solutions have directed significant attention toward bioenergy production from agricultural residues. This study highlights the technological advancements in bioenergy conversion, such as anaerobic digestion, fermentation, and transesterification, which have enhanced efficiency and scalability.

Objective: This study explores the feasibility and efficiency of generating bioenergy from grape pomace and potato waste, two abundantly available agro-industrial byproducts. Utilizing anaerobic digestion and fermentation processes, we investigated the potential of these substrates to produce bioethanol and biogas.

Methods: The research involved a comprehensive analysis of the biochemical properties of grape pomace and potato waste, including their carbohydrate, protein, and lignin content. Through a series of laboratory experiments, we optimized the conditions for maximum yield, assessing factors such as pH, temperature, and microbial consortia.

Results: The results demonstrated that grape pomace, rich in fermentable sugars, is a viable substrate for bioethanol production, yielding up to 0.45 g/g of dry weight. Conversely, potato waste, characterized by its high starch content, proved efficient for biogas production, achieving a methane yield of 0.38 m^3/kg of volatile solids.

Conclusion: In conclusion, grape pomace and potato waste hold significant potential as feedstocks for bioenergy production. This research underscores the importance of developing efficient conversion technologies and optimizing process parameters to harness the full energy potential of agricultural residues, thereby supporting environmental sustainability and energy security.

Biography

Shah Mudassar has his expertise in biogas and bioethanol production through agriculture wastes. His research focus is enhancement of biogas and bioethanol production through synergism of different wastes along with the introduction of nanoparticles. The integration of these processes into existing agro-industrial frameworks presents a promising pathway for sustainable energy production, contributing to waste reduction and renewable energy goals. Research interest is Bioenergy.

FACING UP TO THE NON-CIRCULARITY OF PLASTICS: POLICIES FOR PLASTICS THAT ADDRESS HUMAN HEALTH AND ENVIRONMENTAL SAFETY CONCERNS

Shambulova Malika and Irene Peters

HafenCity University Hamburg, Germany

Abstract

Background: "Circular Economy" has become the dominant policy narrative for the management of materials in our society. It promises a closed-loop system in which materials are perpetually recycled, minimizing waste generation and the exploitation of finite resources. Reality is otherwise, esp. for the most ubiquitous man-made material around: Petrochemical-based polymers, i.e. plastics. While there is great potential to increase the recycling rates for many material classes, including their re-design, there are limits to the recycling of the polymer products that are in use currently and for decades to come.

Mechanical recycling may not be the best end-of-life management option, because of human health and environmental safety concerns arising from intentionally and non-intentionally added substances and the generation of microplastics.

Objective: The paper

- presents insights and emerging research on the resource efficiency limitations, human health and environmental safety concerns of the recycling of polymer products as they are in use today and will be produced for years to come.
- offers an overview of the legal frameworks and policy landscapes addressing plastics waste
- identifies policy gaps for the life-cycle management of plastic products with prioritization of the largest human and environmental safety and resource efficiency concerns.
- suggests further research addressing the practical limitations of plastic waste recycling.

Methods: Review of scientific literature

Biography

Shambulova Malika holds a bachelor's degree in Energy and Environmental Engineering the University of Applied Sciences, and a master's degree in resource efficiency in Planning from HafenCity University Hamburg, where she is a Research Associate in the Technical Urban Infrastructure Systems Group. She is teaching in courses oriented towards Urban Material Cycles, Sustainability, Data Science and AI. Her research interest lies in the management of plastic products over their lifecycle, industrial symbiosis and industrial ecology, planetary boundaries and microplastics, legacy additives and non-intentionally added substances in polymer production. Research interests are industrial ecology, waste entropy and polymer additives.

Day-2
Keynote Presentations

GLOBAL POPULATION: FROM SUPER-MALTHUS BEHAVIOR TO DOOMSDAY CRITICALITY

Aleksandra Drozd-Rzoska[2] and Agata Angelika Sojecka[1]

[1]*University of Economics in Katowice, Poland*
[2]*Institute of High Pressure Physics Polish Academy of Sciences, Poland*

Abstract

Global population changes from the Holocene onset till 2023 are discussed using a new approach, two Super-Malthus (SM) scaling equations, proposed by the authors (A.A. Sojecka, A. Drozd-Rzoska). The first one (SM-1) is the empowered exponential dependence and SM-2 is the Malthus-type relation with the time-dependent growth rate or relaxation time : The analysis explores a new set of data based on numerically filtered population data from several sources, allowing distortion-sensitive and derivative-based tests.

For SM-1 equation, it revealed the qualitative transformation near the year 1970 (~3 billion population): from the compressed ($\beta > 1$) to the stretched ($\beta < 1$). exponential behavior. Recalling Complex Systems Physics (CSP), it can be related to the 'cumulation' or 'dissipation' of system internal energy and the ability to create spontaneously local structures.

For SM-2 scaling, explicitly linear changes during the Industrial Revolutions epoch, since ~1700 till today, have been evidenced, leading to the critical, 'constrained & frustrated' behavior:

$$P(t) = P_0 \, exp\left[\frac{b}{t_C - t}\right]$$

where critical 'Dooms-year' (year) is the extrapolated year of a hypothetical infinite population singularity.

The above relations suggest a global population of 8.97 billion in 2030, and 11.34 billion in 2050. The link to the famous '*hyperbolic*' or '*Doomsday*' equation by von Foerster et al. is notable. Finally, considerations of the per capita relative growth rate and available resources (system capability), also in frames of the extended Verhulst model, led to a hypothetical universal checkpoint pattern for population scaling equations.

Developed protocols can be implemented in arbitrary population studies.

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SUSTAINABLE OPTIONS FOR THE END-OF-LIFE OF CLEAN ENERGY TECHNOLOGIES

Anna Mazzi
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Abstract

Clean energy technologies are essential in energy transition. The total energy consumption in 2050 would be less than today because of improvements in efficiency; at the same time, most of the energy would come from renewable sources, especially solar and wind power. When "sustainable solutions" in Renewable Energy Systems (RESs) have to be considered, the focus could not only relate to the net-zero greenhouse gas emissions: main impacts associated to RESs are resources use, ecosystem damage and human health. To obtain comprehensive impact assessment results it's important to adopt multicriteria and multiscenario analyses. Life Cycle Assessment (LCA) is undoubtedly considered robust tool to know the environmental sustainability of technologies and systems. As recommended by scientists, "cradle-to-grave" perspective is essential to consistently quantify the environmental impacts associated to different RESs, including overall processes, from the raw material extraction to the end-of-life. Five main stages have to be considered for carrying out the LCA of RESs: construction; operation; maintenance; decommissioning; and final disposal with recycling options. Several recent scientific papers reinforce the relevance of LCA in analyzing of environmental benefits associated to clean energy technologies, especially as recycling options and final disposal. In parallel with an exponential attention to the environmental problems associated with waste management for the end of life of RESs, the risk assessment on health and safety of workers in collection and recycling of these technologies has to be considered.

Day-2
Oral Presentations

SOLAR HARVESTING VIA MULTIPLE TRANSPARENT PHOTOTHERMAL PANELS FOR BUILDING HEATING UTILITIES

Donglu Shi, Anudeep Katepalli, John Krupczak, Yuxin Wang, Jou Lin, Anton Harfmann and Mathias Bonmarin

University of Cincinnati, USA

Abstract

Background: The Photothermal Solar Tunnel Radiator (PSTR) emerges as a groundbreaking development in the realm of energy-neutral building heating utilities. This pioneering technology harnesses the potential of multiple transparent photothermal glass panels (TPGP) to redefine the efficiency and sustainability of solar energy capture. A notable demonstration of this innovation is the "Photothermal Solar Box" (PSB), a lab-scale model exclusively heated with TPGP under natural sunlight.

Objective: The primary objective of the PSTR project is to introduce a transformative approach to energy-neutral building heating utilities. By focusing on the utilization of transparent glass substrates with photothermal coatings, the aim is to directly capture solar energy for efficient heating. The Fe_3O_4@ $Cu_{2-x}S$ coated glass substrates, known for their high transparency, play a pivotal role in enhancing solar harvesting and photothermal energy generation within the PSB.

Method: Through rigorous experimentation and implementation, the PSTR system was designed and developed to maximize solar energy capture. The setup involved the integration of multiple TPGP panels within the PSB, each coated with Fe_3O_4@$Cu_{2-x}S$ for optimal efficiency. The system's performance was evaluated with 8 photothermal panels operating in parallel, measuring the thermal energy output under various conditions.

Results: Impressively, the PSTR system exhibited remarkable thermal energy output, reaching up to 9.1 x 105 joules during experimentation. Even under colder conditions (ambient temperature: -10°C), with accelerated heat loss, the interior temperatures of the PSB with partial thermal insulation achieve a commendable 35°C, showcasing effective photothermal heating in cold weather. This underscores the system's effectiveness in photothermal heating, particularly in adverse weather scenarios.

Conclusions: The findings from the PSTR project highlight its resilience and efficiency in harnessing solar energy under diverse conditions, including partial cloudy weather. This innovative system not only provides a practical alternative to traditional solar heating methods but also aligns with broader sustainability goals. The PSTR stands as a transformative solution, paving the way for energy-neutral building heating utilities by leveraging the power of transparent photothermal glass panels. In conclusion, this initiative represents a significant step towards a cleaner, greener future, offering scalable and sustainable solutions for efficient building heating.

Biography

Donglu Shi, a professor of Materials Science and Engineering at the University of Cincinnati's College of Engineering, leads pioneering research funded by the National Science Foundation. His work introduces a groundbreaking 3D approach to solar light harvesting, surpassing the constraints of conventional 2D photovoltaic devices. Dr. Shi's impactful research spans diverse fields, including solar-activated energy generation, photothermal-photovoltaic smart building skins, and solar desalination. With over 300 peer-reviewed journal publications, including in prestigious journals like Nature and Advanced Materials, he is also the Editor-in-Chief of Nano LIFE and serves on the Editorial Board of Journal of Energy and Power Technology. Dr. Shi has authored 13 edited books covering topics such as superconductivity and nano-medicine. Recognized for his contributions, he has received numerous awards, including the George Rieveschl Jr. Award for Distinguished Scientific Research, the Sarah Grant Barber Outstanding Faculty Advisor Award, and is a Fellow of ASM International. Research interests are energy materials and spectral selective 3D solar harvesting.

CIRCULAR ECONOMY IN THE CONSTRUCTION SECTOR. AN EXPLORATIVE STUDY ABOUT THE RECYCLING OF SINGLE-USE MASKS BASED ON A CUSTOMER SURVEY AND BUSINESS EXPERT INTERVIEWS

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Abstract

Background: With the Covid-19 pandemic, there came a substantial growth in mask usage and therefore mask waste, as many countries introduced obligatory mask wearing in public spaces. Although many institutions have created waste management systems to overcome the overflow of waste created, these were all more in line with "firefighting" strategies than long terms solutions. The systems imposed cause a great amount of negative environmental impact and must be re-examined. As most mask material is non-recyclable, one must find ways to otherwise sustainable use them.

Objective: The objective of this paper is to evaluate the position of consumers and construction companies regarding innovative and sustainable construction materials, as well as to find out about their behavior and knowledge in single-use mask waste. A popular idea is the use in construction materials like concrete. This way used masks will be recovered and alternatively reused. For this to happen, there must be a large interest. Construction companies will only act upon these ideas if there is enough commercial interest, and that can only happen if the public is aware of the option. The objective of the study is to see the market size on a small scale.

Methods: First literature research was chosen to create a basis of understanding as well as identifying research gaps for the formation of this study. To ensure the quality of the literature review, the respective journals were verified through listings of the German "VHB-JOURQUAL 3". Then in 2023 an explorative online survey of customers was conducted; the sample consists of 118 people. In addition to consumers, three constructions companies were also examined via explorative business expert interviews. The data obtained was analyzed with the help of descriptive statistics using. Open answers were clustered and categorized.

Results: The explorative survey showed that there is not only a clear interest in sustainable building materials, but also a lot of customers who are concerned about the mask waste. The explorative expert interviews with the construction companies showed that they were open to the use of new and sustainable materials, specifically when customers estimate it.

Conclusion: The data shows a clear market for sustainable construction materials, as well as a willingness of construction companies to provide these. Practical implications recommend introducing a company-wide circular economy system in the construction sector.

Biography

Daniela Ludin - In September 2015, Prof. Dr. Daniela Ludin has been offered a professorship in general business administration at Heilbronn University; from March 2009 to August 2015, she held a professorship for law, environmental and forestry policy at the Rottenburg University. Since September 2023, she has held a research professorship for Sustainability - Digitization – Innovation. She has been a sustainability officer at Heilbronn University and chairperson of the Council for Sustainable Development (RNE) since April 2019. As part of her functions at Heilbronn University, she organized the symposiums "Sustainable Procurement" (2017) and "Sustainable Consumption" (2019). One result of the symposia are the editorial works "Sustainable Procurement" and "Sustainable Consumption", which were published by Springer in 2019 and 2021. Research interests are sustainability, digitization and innovation.

CIRCULAR ECONOMY AND ENTREPRENEURSHIP IN EUROPE: AN ANALYSIS OF THE IMPACT OF CULTURAL FACTORS AND REGULATORY FRAMEWORK

Francisco J Sáez-Martínez, Ángela González-Moreno, Cristina Díaz-García and Ángela Triguero

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Abstract

Background: The circular economy (CE) is regarded as one of the solutions to the current environmental crisis, as it involves substituting the current predominant linear production model for an alternative cyclical model. In academia, the number of studies on the CE has grown exponentially and several reviews of the literature have been published, with an incipient literature about the factors that enable firms to achieve an effective transition towards a circular and sustainable economy. Cultural, regulatory and technological issues are considered the main stumbling blocks that companies face when transitioning to the CE, and hence there is a need for a more in-depth integrated analysis of these arguments in SMEs.

Objective: To understand the factors that drive SMEs to develop CE activities, to delve deeper in the role of cultural factors, entrepreneurship, and regulatory framework in promoting CE in SMEs.

Methods: We used the following databases: Environmental Policy Stringency Index, Hofstede's Cultural Values; Global Entrepreneurship Monitor; and the Flash Eurobarometer 441, a survey covering 10,618 SMEs from Europe. Four different models, including interaction terms, are tested through a binomial logistic regression.

Results: We found a positive relationship between feminism and individualism with CE. The later can be explained by individualism being positively associated with entrepreneurship, as has been evidenced in previous studies. We also found a negative relationship between regulatory stringency and the CE. This could be justified by the fact that in countries where respect for the environment is more deeply rooted and companies voluntarily adopt measures in this regard, the role of the regulator is less important.

Conclusion: In settings where entrepreneurship is more forceful, a regulatory framework to drive a transition to the CE is less necessary, or less effective, than in environments where the entrepreneurship rate is weaker.

Biography

Francisco J Sáez-Martínez is Full Professor of Management at the Faculty of Economics of the University of Castilla-La Mancha (UCLM) where he is currently Vice-chancellor for Economy and Planning. He holds the Chair of Circular Economy sponsored by the Regional Government and his research interest is focused on eco-innovation and the circular economy, publishing numerous works in specialized journals such as Journal of Cleaner Production, Technological Forecasting and Social Change, Sustainable Development and Business Strategy and the Environment, among others. He has been a visiting researcher at the Krannert Graduate School of Management of Purdue University (USA), the Dublin City University Business School (Ireland) and a visiting professor at the Universidad del Pacífico (Peru), Universidad Andina Simón Bolívar (Bolivia) and Universidad Autónoma Gabriel René Moreno (Bolivia). Research interests are Circular Economy and Entrepreneurship.

SUSTAINABILITY AWARENESS AMONG CUSTOMERS IN THE SERVICE SECTOR. AN EXPLORATIVE STUDY BASED ON A SURVEY AT A GERMAN HAIR SALON

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Abstract

Background: In the last few years, the general awareness of sustainability has increased. For consumers the topic of environmental awareness and sustainability is mostly related to aspects of private life, e.g. shopping preferences. These include the ingredients, the production and the packaging of consumer goods, water and electricity consumption as well as travel and mobility. However, sustainability can also play a role in the service sector.

Objective: The aim of this study is to analyse how customers evaluate sustainability in relation to services. It catches up with sustainability awareness among customers of a German hair salon.

Methods: Through a systematic literature review the awareness of sustainability of customers in the service sector, especially in SMEs as hair salons is analysed. Based on this literature review and in order to gain new insights into the significance of sustainability when visiting a hair salon, a quantitative highly structured explorative survey of customers of a German hair salon, that is known for its sustainability orientation, was conducted. 38 customers participated in the survey. Descriptive statistical procedures are used for data analysis and interpretation.

Results: The empirical study shows that the majority of customers at this particular hair salon are already strongly sensitized to the issue of sustainability. The survey provides insights into the fact that the assessment of the topic varies among customers in the areas of purchasing and use of services. In purchasing, it is clearly important for more people to pay attention to sustainability. However, the survey participants seem to be comparatively less sensitized to sustainability in services or the hairdresser's visit.

Conclusion: The results of the study are intended to contribute to a better understanding of the awareness of sustainability in the service sector and to derive practical recommendations for the service sector; especially for SMEs as hair salons. From practical implications a lack of knowledge about sustainability aspects or insecurities in communication and/or marketing skills might have an effect on sustainability communication and sustainable practices in the hairdressing sector. Providing and supporting relevant skills might be an essential task for salon owners, trade unions and education institutions. This indicates a need to integrate sustainability aspects in the training of apprentice hairdressers.

Biography

Daniela Ludin - In September 2015, Prof. Dr. Daniela Ludin has been offered a professorship in general business administration at Heilbronn University; from March 2009 to August 2015, she held a professorship for law, environmental and forestry policy at the Rottenburg University. Since September 2023, she has held a research professorship for Sustainability - Digitization – Innovation. She has been a sustainability officer at Heilbronn University and chairperson of the Council for Sustainable Development (RNE) since April 2019. As part of her functions at Heilbronn University, she organized the symposiums "Sustainable Procurement" (2017) and "Sustainable Consumption" (2019). One result of the symposia are the editorial works "Sustainable Procurement" and "Sustainable Consumption", which were published by Springer in 2019 and 2021. Research interests are sustainability, digitization and innovation.

IMPROVING AREAS WITH A CIRCULAR ECONOMY APPROACH FOR PLASTIC FROM THE TARGET ENVIRONMENT. A CASE STUDY

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Abstract

Background: Environmentally friendly upgrading of urban areas can enhance human living in cities all around the world. Circular economy is a game-changer in almost all economies. Looking into plastics and the broad usage of different kinds of plastics in daily living, especially this resource provides a high potential to implement resource-saving approaches like circular economy, cleaner production, sustainable materials and recycling.

Objective: Taking the public part of the port of Valencia in Spain as an example, this work discusses the added value of the re-usage of bottle caps and fishing nets found in this area to create plastic slaps as a raw material to build up products for public usage in the port of Valencian. The overall objective of the work is to create a modern and convenient product designed from recycled plastics in the marina area of Valencia.

Methods: Creating something new from the old requires taking into account various parameters. Value chain, production, energy consumption, logistics and availability of materials are contrasted by the social and environmental added value, sustainable designs, safety and benefits in cleaner waste systems. The versatility of parameters and influencing factors in circular economy yields multiple solutions. A survey, dialogues with the local administration and discussions with the production company as well as prototyping products in the workshop are part of the approach.

Results: Three final products were developed enhancing the urban surroundings of the showcase area. These products were evaluated considering the identified key indicators for suitable and sustainable products as outcome of the circular economy approach.

Conclusion: Suitable products for a target environment hinge on a variety of different aspects identified in this study. A universally applicable approach depends on the marginal conditions of the target area where circular economy takes place. An example of the port of Valencia is provided with this work.

Biography

Marius Köder is interested in improving wellbeing and develops technologies and approaches to minimise human impact on the environment. Marius Köder studied his bachelor's in electrical engineering and did his Master´s Degree in Advanced Systems Design in the Faculty of Electrical Engineering and Computer Science. He is doing his PhD in the Institute for High Integrity Mechatronic Systems (ZMS) at Aalen University of Applied Science. His research activities are centered around his interest in reliable systems, Carbon Capture, Utilization and Storage (CCUS) and maritime technologies. Research interests are Renewable Energy, Reliability, CCUS.

THE CYCLE OF ZERO FOSSIL METHANE

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University of Birmingham, UK

Abstract

Background: Biomass-based fuels offer compelling advantages as sustainable alternatives to conventional fuels. Naturally formed through photosynthesis from atmospheric CO2 and water, biomass is carbon-neutral, renewable, and abundant, providing a cost-effective, non-fluctuating energy source available day and night. This study simulates a zero-fossil methane cycle, leveraging biomass as a primary feedstock for green fuel production. The cycle aims to contribute to energy system decarbonisation by producing fuel with zero fossil carbon content.

Objective: The primary goal of this study is to supply synthetic natural gas, a versatile fuel suitable for stationary applications and transport, without any fossil carbon conversion involved.

Methods: Aspen Plus V11 has been utilised as a simulation tool that enables a detailed analysis of the entire biomass processing chain. The processing sequence involves gasification, methanation, and anaerobic digestion coupled with a Power-to-Gas (PtG) chain incorporating solid oxide electrolysis (SOE) and fuel cell (SOFC) technologies.

Results: Processing 15 MWth of biomass through gasification produces syngas with a 7 MJ/kg calorific value and a carbon conversion efficiency of 85%. The syngas produced is further processed into SNG via methanation. Another 15 MWth of lignocellulosic biomass is anaerobically digested and upgraded into 97% biomethane. The production rate of biogas is 396.3 Lbiogas/kgbiomass. The estimated AD process conversion efficiency from volatile solids feedstock into valuable biogas is 76.25%. The results were consistent with the experimental results.

Conclusion: The cycle of zero fossil methane comprehensive approach, integrating various technologies, not only enhances the efficiency of synthetic natural gas production from biomass but also ensures its sustainability.

Biography

Suaad S Al-Zakwani is a dedicated PhD student at the University of Birmingham-Birmingham Energy Institute. She is engaged in advancing knowledge and solutions in the energy field. Her academic journey began with her master's studies at the University of Waterloo, Canada, where she specialised in the Allocation of Ontario's Surplus Electricity to Different Power-to-Gas Applications. This experience gave her a strong foundation in understanding energy systems and their practical applications.

As a doctoral candidate at the University of Birmingham, Suaad is not just committed to her research, but driven by a passion for sustainability. Her aim is to develop innovative approaches to energy challenges, leveraging interdisciplinary perspectives and cutting-edge research methodologies to address complex energy issues. Research interests are alternative fuels, biomass gasification, methanation, solid oxide fuel cell, solid oxide electrolysis, power-to-gas, anaerobic digestion, syngas and biomethane.

ENHANCING THE USE OF RECLAIMED BUILDING MATERIALS: SUPPLY CHAIN ACTORS' ATTITUDES TOWARD THE POTENTIAL OF A MOBILE APPLICATION

Aleksandra Dorota Kręt-Grześkowiak
Wrocław University of Science and Technology, Poland

Abstract

Background: Given the urgent need to reduce environmental impact, particularly due to the construction sector's significant contribution of up to 37%, ongoing intensive research focuses on the circular economy concept and its implementation. While increased use of reclaimed building materials could lead to a rapid transition to a closed loop-built environment, the only emerging market for reclaimed materials in Poland requires an information system synchronizing demand and supply streams, such as digital reuse platforms.

Objective: To explore supply chain stakeholders' attitudes and expectations towards a potential mobile app supporting the use of reclaimed building materials.

Methods: A survey was prepared based on a literature review and interviews with prefabricated houses manufacturers operating in Poland. The literature review focused on both the circular economy in the construction sector and theories on implementing new strategies. Six survey versions were prepared with sections tailored to capture key stakeholder groups' feedback: investors, architects and structural engineers, manufacturers, (sub)contractors, as well as recycling and waste collection facilities. Around 120 surveys were distributed among relevant market actors in Poland and responses are currently being collected.

Results: Preliminary analysis of the already submitted survey responses indicates that more than half of the respondents find a mobile application supporting the use of secondary building materials to be useful. Key features identified include precise information on the quantity, size, and quality of available materials, as well as their origin and history. Additionally, respondents suggested including a cost comparison between new materials and available recycled materials.

Conclusion: Interim survey results indicate an interest in a dedicated mobile application designed as a digital platform to facilitate the use of reclaimed building materials. To facilitate the uptake of reclaimed materials in construction materials' market context the supply chain actors provided concrete suggestions regarding features of the planned application deemed most important.

Biography

Aleksandra Dorota Kręt-Grześkowiak explores the circular economy within the construction sector, with a strong focus on its implementation. Her practical experience as an architect in Germany, Switzerland and Poland has provided her with comprehensive knowledge of the design process and practices in the sector. She is a PhD candidate at the Faculty of Architecture at Wroclaw University of Science and Technology, Poland. Her research in collaboration with Prof. Magdalena Baborska-Narożny has revealed the conditional overlap between circular economy principles and the design for disassembly, highlighting the importance of context for environmental benefits, which extend beyond the technical model. She gained experience in the Life Cycle Assessment methodology at the Department of Green Technology, University of Southern Denmark, working with Prof. Morten Birkved. Her further studies on circular strategies, particularly reuse, are based on both environmental Life Cycle Assessment and social qualitative and quantitative research.

BIODIESEL PRODUCTION PROCESSES WITH YEASTS FROM A SUSTAINABLE APPROACH

Alejandra Sánchez Solís
Universidad Iberoamericana, Mexico

Abstract

In recent years, renewable sources of energy have been sought due to the environmental impacts associated with fossil fuels, such as greenhouse gas emissions into the atmosphere. A promising alternative is biodiesel, particularly when obtained using yeast, as they offer certain advantages over other microorganisms due to their resilience to grow in various conditions, short reproduction times, lower susceptibility to bacterial infections because they thrive at lower pH levels and have the ability to utilize a wide variety of substrates. Furthermore, biodiesel produced with yeast is composed of methyl ester fatty acids (FAME), providing it with good quality and performance in internal combustion engines, resulting in reduced greenhouse gas emissions compared to conventional diesel. The production of biodiesel using yeast involves six general stages, which offer various methodological alternatives with different degrees of sustainability. The objective of this review is to assess the sustainability degree of various methodologies employed in each of the stages of yeast-based biodiesel production through environmental and economic sustainable indicators.

HARNESSING ENERGY FROM DESCENDING GREYWATER IN TALL BUILDINGS

Gideon Oron

Ben-Gurion University of the Negev, Israel

Abstract

The rate of worldwide energy consumption is continuously growing. The majority of these processes occur in cities due to farmers migration. These community centers threaten the availability main energy sources such as coal, fossil fuel, and natural gas along with environmental pollution. Hydroelectricity, utilizing natural water flow for energy creation, is a relatively simple and low-maintenance way to produce electricity. In residential high-rise buildings, substantial amounts of greywater flow downstream directly into the wastewater system and can be applied for potential energy generation.

A simulation model was developed for electricity generation in high-rise buildings. The system consists of an operating tank that stores the greywater obtained from the upper floors. The collection/operating tank is high enough installed turbines. The turbine is used to convert the water potential energy into dynamic electricity. The study examined the economical profitability of using this layout for assessing the energy generated. A management model was defined with some key variables towards its' optimal operation. The technical and economic feasibility study were used to compare the alternatives, including using the Return of Investment (ROI) parameter. The return period for buildings with 50 floors and above is less than 12 years. Implementing the model extensively in new buildings could save a substantial amounts of air pollution and energy waste thereby reducing our adverse impact of climate changes on the global environment.

REVERSE LOGISTICS OF POST-CONSUMER GLASS BOTTLE IN BRAZIL: A CASE STUDY FROM THE PERSPECTIVE OF THE STREET COLLECTORS AND THE END CONSUMER

Alaercio Nicoletti Junior and Isamara Babosa de Oliveira

Production Engineering Department, Mackenzie Presbyterian University, Brazil

Abstract

Background: The environmental and social impacts associated with the management of urban solid waste in Brazil confront its current efficiency, given the discrepancy between the amount collected and the mass of waste recovered, especially in the case of glass. Studies prove the existence of numerous benefits in relation to glass, such as its efficiency as a container with an infinite life cycle. However, this tends to have a lower participation in selective collection, resulting in inappropriate disposal that harms the environment and recycling.

Objective: map the difficulties in correct disposal and collection for reverse logistics of glass bottles for drinks based on the perception of a crucial part of its supply chain, the collectors and consumers. The study also aims to identify viable alternatives to increase the collection of glass packaging for subsequent recycling.

Methods: A multi-case study was carried out involving two glass collectors' cooperatives in the city of São Paulo and a non-governmental organization that works on behalf of the collectors.

Results: The study confirmed the importance of regulations to encourage the return of packaging, in addition to the need for joint action between the State, manufacturers, consumers and collectors to improve the reverse logistics of glass packaging. The difficulties lie in the fact that glass offers low remuneration to collectors, given that its cost per kg is around 30 times lower than that of aluminum, for example, in addition to the risk of injuries during handling.

Conclusion: There are still many difficulties to be overcome in the collection and recycling of glass beverage packaging in Brazil, as less than 4% of this waste is actually collected. However, improving the reverse logistics of this material proves viable when government, companies and society work together with a focus on its reuse in the bottle manufacturing industry itself.

Biography

Alaercio Nicoletti Junior has a PhD in Production Engineering and has expertise and more than 25 years of experience in the management of Sustainability/ESG, Continuous Improvement and Open Innovation. He is head of Sustainability and Open Innovation at Grupo Petrópolis, the largest brewery in Brazil with 100% national capital and works as a PhD professor in Production Engineering at Mackenzie Presbyterian University. He coordinates actions and projects such as the First Amazon Mission with University and companies in November 2022, with the aim of mapping the "pirarucu" management chain and understanding the post-reverse logistics of consumer packaging. He develops together with CNI (National Confederation of Industries) / SENAI (National Industrial Learning Service) and with tax incentives and financial support from entities such as EMBRAPII (Brazilian Company for Industrial Research and Innovation) the national call for the Glass Circularity project. This initiative aims to ensure the reverse logistics of post-consumer glass packaging. Research interests are sustainability / ESG and innovation.

DEVELOPMENT OF VIABLE HOP PLANTING IN BRAZIL - A CASE STUDY

Alaercio Nicoletti Junior and Isamara Babosa de Oliveira

Production Engineering Department, Mackenzie Presbyterian University, Brazil

Abstract

Background: Actually, Brazil is the 3rd largest beer producing country in the world and hops, one of its inputs, come mainly from the United States or Germany, which adds transport costs to the product, in addition to the CO_2 emissions generated. In 2021, Brazil imported 8,200 tons of hops, with an estimated cost of US$82 million.

Objective: Study and understand hop cultivation with the aim of developing seedlings for economically viable hop production in Brazil.

Methods: This article involves the case study of a Brazilian beverage manufacturing company that developed, in partnership with a government institute and university, the development of viable seedlings for planting in Brazil.

Results: The study involved 6 phases of development, the first being for research and development of viable seedlings; the second contemplated the three-harvest cycle with the seedlings; Subsequently, phases 3 to 5 were expansions of the program based on previous experiences and the sixth aimed to increase productivity per plant, aiming at the financial viability of planting.

Conclusion: The study allowed the development of viable seedlings, showing that Brazil can be a major global producer of hops, debunking the theory that the climate in the country would not be favorable to obtaining satisfactory results. The project is in phase 5, the planting area has been expanded on a scale, totaling 5.85 hectares in 2023, and the biggest challenge now is to obtain an average productivity of 2 kg per plant, to make this activity economically viable. Although progress is evident, which encourages continued research, there is still a need for development to increase productivity per plant.

Biography

Alaercio Nicoletti Junior has a PhD in Production Engineering and has expertise and more than 25 years of experience in the management of Sustainability/ESG, Continuous Improvement and Open Innovation. He is head of Sustainability and Open Innovation at Grupo Petrópolis, the largest brewery in Brazil with 100% national capital and works as a PhD professor in Production Engineering at Mackenzie Presbyterian University. He coordinates actions and projects such as the First Amazon Mission with University and companies in November 2022, with the aim of mapping the "pirarucu" management chain and understanding the post-reverse logistics of consumer packaging. He develops together with CNI (National Confederation of Industries) / SENAI (National Industrial Learning Service) and with tax incentives and financial support from entities such as EMBRAPII (Brazilian Company for Industrial Research and Innovation) the national call for the Glass Circularity project. This initiative aims to ensure the reverse logistics of post-consumer glass packaging. Research interests are sustainability / ESG and innovation.

THE CHALLENGE OF REVERSE LOGISTICS FOR POST-CONSUMER GLASS PACKAGING IN BRAZIL

Alaercio Nicoletti Junior, André Luis Helleno and Maria Célia de Oliveira

Production Engineering Department, Mackenzie Presbyterian University, Brazil

Abstract

Background: The inefficiency of the selective collection of post-consumer glass packaging in Brazil, given that around 1.3 million tons of glass bottles are manufactured per year and recycling accounts for 47% of this mass. When considering only post-consumer waste from non-returnable packaging, this number drops to less than 4%. Government pressure for regulation has increased the percentage of packaging mass to be guaranteed in reverse logistics year after year, with the prospect of reaching 40% in 2032, which causes a lack of materials for this compensation in States of the Federation.

Objective: To understand the challenges of increasing reverse logistics for post-consumer glass packaging and propose improvements.

Methods: A multi-case study was carried out involving beverage manufacturers, distributors, points of sale and end consumers. Reverse logistics data was collected, and interviews were carried out with actors in the manufacturing and consumption ecosystem.

Results: The study so far has highlighted the challenges and opportunities for increasing selective collection with public awareness, pilot actions at points of sale and the adoption of actions with collectors, which allows the project to continue.

Conclusion: Glass Reverse Logistics is an important challenge for industries in the beverage market, as well as for society, and its solution involves the interaction of those involved, from the bottle producer to the final consumer, in the correct disposal of the packaging after its use.

Biography

Alaercio Nicoletti Junior has a PhD in Production Engineering and has expertise and more than 25 years of experience in the management of Sustainability/ESG, Continuous Improvement and Open Innovation. He is head of Sustainability and Open Innovation at Grupo Petrópolis, the largest brewery in Brazil with 100% national capital and works as a PhD professor in Production Engineering at Mackenzie Presbyterian University. He coordinates actions and projects such as the First Amazon Mission with University and companies in November 2022, with the aim of mapping the "pirarucu" management chain and understanding the post-reverse logistics of consumer packaging. He develops together with CNI (National Confederation of Industries) / SENAI (National Industrial Learning Service) and with tax incentives and financial support from entities such as EMBRAPII (Brazilian Company for Industrial Research and Innovation) the national call for the Glass Circularity project. This initiative aims to ensure the reverse logistics of post-consumer glass packaging. Research interests are sustainability / ESG and innovation.

THE USE OF FINE PELLET GRAINS AND SPONGE IRON SLUDGE TO PRODUCE OXIDE BRIQUETTES BASED ON CIRCULAR ECONOMY

Reza Bahaadini, Samad Abbaslou, Mehdi Makiabadi, Hanif Maghzi and Reza Rouholamini

Golgohar Iron and Steel Development Company, Iran

Abstract

By-products such as fine pellet grains and sponge iron sludge are produced in the pelletizing and sponge iron factories. In the iron and steel industry, by-products have created many problems for factories due to occupying a lot of space for storage and the environment due to pollution. In this research, using the circular economy, a new process has been designed to recycle these by-products. The production pilot is designed and constructed to convert by-products into oxide briquettes with good strength and proper regeneration in direct reduction plant. In Golgohar Iron and Steel Development Company, by using pilot plant, sponge iron sludge and fine pellet grains are crushed and mixed together with binders such as sodium silicate glue with different weight percentages, which after mixing enter the briquetting machine and oxide briquettes are produced. Oxide briquettes are in different geometric shapes such as spherical, cylindrical and elliptical with different geometric dimensions as 20 mm until 50 mm. The compressive strength of briquettes has an acceptable with an average of 600 Kgf/briquette and in terms of chemical properties (Fe=65%, S=0.01%). After the production of oxide briquettes from by-products, they are charged in the Midrex direct reduction furnace. After about 400 minutes, the oxide briquettes are taken out of the furnace and the sample of sponge iron briquette has been tested in the laboratory to measure, Femetal, Fetotal and Metallization Degree (MD). Also, the strength of these types of briquettes is acceptable after regeneration, CCS=400 Kgf/briquette. The composition of 70% fine pellet grains, 25% sponge iron sludge and 5% sodium silicate glue is the best sample with high strength and suitable regeneration parameters (Fem=79.10%, Fet =84% and MD=94.2).

Biography

Reza Bahaadini has his expertise in evaluation and passion in improving the by-products in iron and steel industry based on the circular economy. His academic education is Ph. D in mechanical engineering from shahid Bahonar university of Kerman. His open and contextual evaluation model based on responsive constructivists creates new ways for improving by-products management. He has built this model after years of experience in research, evaluation, teaching and administration both in iron and steel industry and education institutions. The foundation is based on the circular economy (BS 8001, 2017). Research interest is about circular economy.

OPTIMIZING DO CONCENTRATION IN CONVENTIONAL ACTIVATED SLUDGE PROCESS TO ALLEVIATE ENERGY CONSUMPTION: APPLICATION OF PARTICLE SWARM OPTIMIZATION ALGORITHM

Mpho Muloiwa

Tshwane University of Technology, South Africa

Abstract

The conventional activated sludge process (ASP) is the most commonly applied municipal wastewater treatment technology worldwide. The ASP produces optimum removal efficiency of organic and inorganic matter. However large quantities of energy are consumed during this process which is due to the air pump/blower that operates 24 hours non-stop in an attempt to sustain dissolved oxygen (DO) concentration in the ASP. In addition, air blowers/pumps release enormous amounts of CO_2 emissions, contributing significantly towards global warming and, ultimately climate change. The study aimed to optimize DO concentration such that minimal oxygen is utilized in the ASP, which will reduce the operation capacity of air pumps/blowers, resulting in less energy consumption and CO_2 emission release. PSO algorithm was utilized to optimize DO concentration. The results showed a 36.3% difference between the measured (2.43 mg/l) and the optimized (1.54766 mg/l) DO concentration. The reduction in DO concentration reduced energy consumption by 47.156% between the measured (0.0545 kWh/m^3) and optimized (0.0288 kWh/m^3), since less oxygen was utilized. The reduction in energy consumption was achieved by operating the ASP at high wastewater temperature (31°C) which improved the growth of microorganisms (3.8824g/l), at less hydraulic retention time (1.2678 h), low airflow rate (2.0953 l/min), without violating effluent COD concentration (46.4564 mg/l) in the ASP. In conclusion, the ASP should be operated at a DO concentration of 1.54766 mg/l, which will result in less energy consumption and CO_2 emissions, without compromising the survival and growth of microorganisms.

Biography

Mpho Muloiwa, Ph.D., serves as a lecturer within the Department of Civil Engineering at the Tshwane University of Technology, Faculty of Engineering and the Built Environment. He brings extensive industry experience in civil engineering, particularly in landfill site construction, roads, stormwater management, bulk water supply, and wastewater treatment plants. With a strong academic background spanning 9 years, his research focuses on multidisciplinary collaboration and the application of innovative materials for water management. This includes investigating water consumption, demand, supply, wastewater treatment efficiency, and optimizing energy consumption within wastewater treatment systems. Research interests are water consumption, demand, supply, wastewater treatment efficiency, and optimizing energy consumption within wastewater treatment systems.

Day-3
Oral Presentations

MACHINE LEARNING AS A MODELING TOOL FOR ENERGY CONSUMPTION PLANNING ENTITY ACCORDING TO PRODUCT CHARACTERISTICS FOR THE DIE-CASTING INDUSTRY: CASE STUDY

Mariel Alfaro-Ponce and Cristopher A Muñoz-Ibañez

Institute of Advanced Materials for Sustainable Manufacturing, Tecnologico de Monterrey, Mexico

Abstract

Background: Mitigating climate change makes organizations responsible for undertaking actions that allow the reduction of their carbon footprint. In manufacturing, one of the main sources of Carbon comes from the energy employed during production. Therefore, optimizing energy expenditure when manufacturing various products or services is of the utmost importance. In the die-casting industry, these considerations require creating models that optimize energy resources and maintaining long-lasting and current commercial agreements as first-line suppliers to the automotive, aerospace, and electronics industries, among others.

Objective: To apply machine learning models to forecast energy consumption in the die-casting industry.

Methods: This research implements machine learning algorithms for modeling energy consumption in the die-casting industry when companies migrate from energy lines to their own produced energy through solar panels. In this real case study, the consumption of MARROB industries was employed; even though we have information regarding several product characteristics, through a feature selection method, it was established that the weight of the part to be cast was the most important feature and it was employed as input for the model and the energy consumption as an output.

Results: The proposed model combines an MRMR feature selection method with different machine learning methods, achieving an accuracy of 96.5 in forecasting of energy consumption. Of the different models applied, the best performance was delivered by the MRMR combined with a support vector machine.

Conclusion: The model is not just a theoretical concept but a tool that can be immediately integrated into production planning entities, allowing companies to forecast the cost associated with the production of different products and the advantages of investing in alternative ways to produce energy that reflects in the amount of CO_2 that they produce.

Biography

Mariel Alfaro-Ponce is an assistant professor in the Biomedical Engineering Program at Tecnológico de Monterrey Ciudad de Mexico; she received a bachelor's degree in biomedical engineering, a Master of Science in Microelectronic Engineering, and a Ph.D. in Computer Science from the Instituto Politecnico Nacional, Mexico. Her research interests include artificial intelligence, rehabilitation devices, and intelligent bioinstrumentation. She has been a member of the National System of Researchers of Mexico (SNI-Level I). From 2022 until now, is the head of the Manufacturing Processes for Advanced Materials CDMX research unit. Research interests are circular economy and waste to energy.

DEVELOPMENT OF A GREEN PROCESS TO RECOVER GOLD, SILVER, AND COPPER FROM ELECTRONIC WASTE IN ECUADOR

Alejandra Galarza, Katherine Moreno, Fernando Sánchez, Carlos Aragón and Alicia Guevara

Extractive Metallurgy Department, Escuela Politécnica Nacional, Ecuador

Abstract

Background: Annually, generation of electronic waste in Ecuador is estimated at 5.7 kg per capita. In 2019 alone, the total of this waste was 87600 tons (The Global E-waste Monitor, 2020). Locally, the management of e-waste is not specialized, involving just the separation and sorting at early stages followed by the removal of printed circuit boards (PCBs) that are sent abroad for further recycling. Thus, the development of recycling technology adapted to local waste generation is imperative.

Objective: To recover metals of interest like gold, silver, and copper from e-waste generated in Ecuador.

Methods: The process started with the classification of the electronic devices collected during a recycling campaign among university students in Quito-Ecuador. The first option for responsible waste management was focused on the refurbishment of these devices. Refurbished devices were restored by careful inspection and repaired to regain functionality. The rest of the e-waste not recoverable by refurbishment was disassembled and sorted (metals, plastics, PCBs).

The PCBs were characterised and crushed (74 μm). This material was processed by a sequential leaching to first remove copper followed by the recovery of precious metals. Copper was obtained by electrodeposition, whereas the precious metals were recovered by adsorption with activated carbon and subsequent calcination.

Results: It was determined that the collected PCBs were highly heterogeneous with copper, gold, and silver content of 9%, 0.03%, and 0.12% respectively. Metal recoveries from PCBs were 90% (copper), 87% (gold), and 80% (silver).

Conclusion: Recycling of copper, gold, and silver from PCBs was successful. The recirculation and treatment of the leach solutions after metal recovery were also explored showing promising results. Recovery of other precious metals, like palladium, is still under development. Therefore, this recycling initiative presents a cleaner alternative to the poor disposal of electronic waste in Ecuador.

REJECTED STREAM FROM RECYCLING OF MULTI-LAYERED PACKAGING WASTE: CHARACTERIZATION, OPPORTUNITIES FOR CIRCULARITY AND ENVIRONMENTAL IMPACTS REVIEW

Carolina Bedoya Muñoz[1], Janneth Torres Agredo[1] and Jherson Eveiro Díaz Rosero[2]

[1]*Universidad Nacional de Colombia, Colombia*
[2]*Centro Nacional de Asistencia Técnica a la Industria, Colombia*

Abstract

Background: The extensive use of multi-layer packaging (MLP), known as Tetra Pak, and its short life-cycle have led to an increase in waste generation, becoming one of the most abundant wastes on earth. A widely established recycling method for MLP is the recovery of cellulosic fiber through a hydropulper. Predominantly employed by the paper industry facilities to extract cardboard, the hydropulping process generates a rejected stream of plastic, aluminium, and some fiber (PE-AL or PolyAl), which is usually disposed of in landfills. This underscores the need for research into the current management practices and potential recycling methods for this waste.

Objective: To provide a comprehensive understanding of contemporary PE-AL research in composition, approaches to apply circularity, and end-of-life cycle analysis.

Methods: Publications for the review were selected through Scopus and Web of Science. Articles were chosen according to research questions about characterization methods, recycling alternatives, end-of-life environmental impacts, life cycle analysis, and circular economy approaches.

Results: Considerable studies have focused on the characterization and separation methods due to the challenges of separating the layers. However, few studies have analyzed the life cycle of the alternatives. Some identified recycling alternatives include pyrolysis, incineration, and PE-AL delamination. Additional novel approaches, such as bioleaching/enzyme-based recycling of aluminum and polyethylene, the use of PE-AL as a component for energy storage applications, carbon/aluminum composites for arsenic removal from wastewater, and PE-AL as a binder in the construction of sustainable pavement bricks, were also found.

Conclusion: Recycling alternatives are still under development. However, greater attention should be given to life cycle analysis. Furthermore, the generation of industrial and experimental data, particularly from regions outside of Europe, is highlighted to develop more accurate studies.

Biography

Carolina Bedoya Muñoz is an environmental engineer pursuing her master's degree in environmental engineering as a member of the Materials and Environment Research Group, directed by Dr. Janneth Torres Agredo. Carolina possesses expertise in waste management and demonstrates a profound passion for implementing sustainable strategies such as zero waste and industrial symbiosis. Her research focuses on evaluating the chemical, mineralogical, and toxicological characterization of industrial wastes to provide a comprehensive diagnosis. The diagnosis serves as a guidance tool for investigating and applying circular economy strategies to the assessed waste streams. Carolina's approach is responsive to all stakeholders and offers a deeper understanding of current trends in sustainable waste management. In this study, specifically in the context of PE-AL waste. Research interest is circular economy.

SYSTEMS BASED ASSESSMENT OF LIVELIHOOD VULNERABILITY AND ADAPTATION STRATEGIES TO CLIMATE CHANGE: RAJANPUR DISTRICT PAKISTAN

Muhammad Afzal, Shahbaz Mushtaq, Thanh Mai, Kathryn Reardon-Smith and Duc-Anh An-Vo

University of Southern Queensland, Australia

Abstract

Background: Climate change has become one of the most challenging environmental issues in the 21st century. Climate change-induced natural disasters, especially floods, are the major factors of livelihood vulnerability, impacting millions of individuals worldwide.

Objective: To evaluate and mitigate the effects of floods requires an in-depth understanding of the relationship between vulnerability and livelihood capital assets.

Methods: Using integrated approach; sustainable livelihood framework and system thinking approach, study developed a conceptual model of generalized livelihood system in District Rajanpur, Pakistan. The model visualizes the livelihood vulnerability system as a whole and identifies the key feedback loops likely to influence the livelihood vulnerability.

Results: The key finding of the study reveals that household income, health and education are the major factors behind the livelihood vulnerability of the rural poor of District Rajanpur.

Conclusion: The study suggests that such conceptual models provide effective communication and understanding tools to stakeholders and decision-makers to anticipate the problem and design appropriate policies. It can also serve as an evaluation technique for rural livelihood policy and identify key systematic interventions. The Pakistani government tried to reduce livelihood vulnerability of the region through different income, health, and education programs but still many changings are required to make these programs more effective especially during the flood times. The government provided only cash to vulnerable and marginalized families through income support programs, but this study suggests that along with the cash government must provide seed storage facilities and access to crop insurance to the farmers. Similarly, the government should establish basic health units in villages and frequent visits of medical mobile vans should be arranged with advanced medical lab facilities during and after the flood.

Biography

Muhammad Afzal has his expertise in climate change adaptation and mitigation strategies and resilience development to climate change and natural disasters to improve rural communities' socio-economic wellbeing. His conceptual and contextual evaluation model based on system thinking creates new pathways for improving adaptive capacity to climate change disasters and reducing vulnerability to disturbance. He has built this model after years of experience in research, evaluation, teaching, and administration both industry and academia. The foundation is based on System Dynamics (SD) which is a theory of problem solving based on the feedback control theory (J.W. Forrester, 1956) this is a computer aided methodology that utilizes strategy and policy design. This approach is responsive to all stakeholders and has a different way of focusing. Research interests are climate change, agriculture and sustainable development.

AN EXPERIMENT INVESTIGATING THE POTENTIAL OF UTILIZING A PHASE CHANGE MATERIAL TO ENHANCE THE ELECTRICAL EFFICIENCY OF A SOLAR PANEL

Mohamed Bouzelmad, Y Belkassmi, A Kotri, M Gounzari and R Oualaid

University Ibn Zohr, Morocco

Abstract

The present study investigates the potential enhancement of photovoltaic (PV) panel performance through the incorporation of a phase change material (PCM) for heat extraction purposes. The primary objective is to assess the impact of PCM integration on the thermal characteristics and energy production of PV modules, employing an experimental methodology. Both PCM-integrated and traditional PV modules were subjected to comparative analysis, focusing on the actual temperature profiles of the solar cells. The PCM layer was applied to the rear surface of the collectors. Experimental findings reveal that, on August 10th, 2023, the daily average temperature of a PV module equipped with PCM was observed to be 9°C lower than that of a standard PV module operating independently. Moreover, the PV module incorporating PCM exhibited a peak energy output of 38.08 W, surpassing the maximum output of 35.36 W recorded for the traditional PV module. Notably, the electrical efficiency of the PV module with PCM reached 15.13%, contrasting with the slightly lower efficiency of 14.97% observed for the conventional PV module. These results underscore the potential of PCM integration in enhancing the thermal management and energy generation capabilities of PV panels. The findings contribute valuable insights to the field of renewable energy technology, particularly in the optimization of PV system performance through innovative approaches such as PCM utilization.

Biography

Mohamed Bouzelmad is a research scholar in the Laboratory of Physics, Energy and Information Processing, Polydisciplinary Faculty of Ouarzazate, University Ibn Zohr, Agadir-Morocco. His research areas are solar energy, heat transfer, engineering, and energy.

CARBON PRICING IN GERMANY'S ROAD TRANSPORT AND HOUSING SECTOR: OPTIONS FOR REIMBURSING CARBON REVENUES

Manuel Frondel[1] and Stefanie Schubert[2]

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[2]*SRH University Heidelberg, Germany*

Abstract

In 2021, Germany launched a national emissions trading system (ETS) in its road transport and housing sectors. This climate policy instrument aims at raising the cost burden of consumers of fossil fuels, the major source of carbon dioxide (CO_2) emissions. A promising approach to secure public acceptance for such a carbon pricing would be to entirely reallocate the resulting "carbon" revenues to consumers. This article discusses three alternatives: a) a per-capita reallocation to private households, b) the reduction of electricity prices by, e.g., decreasing the electricity tax, as well as c) targeted financial aid for vulnerable consumers, such as increasing housing benefits. To estimate both the revenues originating from carbon pricing and the resulting emission savings, we employ a partial equilibrium approach that is based on price elasticity estimates on individual fossil fuel consumption from the empirical literature. Most effective with respect to alleviating the burden of poor households would be increasing housing benefits. While this measure would not require large monetary resources, we argue that the remaining revenues should be preferably employed to reduce Germany's electricity tax, which becomes more and more obsolete given the steadily increasing amount of electricity generated by renewable energy technologies.

TACKLING CLIMATE CHANGE THROUGH MULTI-STAKEHOLDER PARTNERSHIPS. PROMOTING SDG 17 TO COMBAT CLIMATE

Elena Bulmer and Benito Yanez-Araque

Antonio de Nebrija University, Spain

Abstract

Sustainable Development Goal 17 (SDG 17) aims to build global partnerships for development. It makes specific reference to multi-stakeholder collaboration between all sectors of society. While the first sixteen SDGs are dedicated to concrete actions, SDG 17 Partnerships for Development coordinates and facilitates the implementation of the other goals. SDG 17 promotes the "right way" of collaboration between different actors, through the formation of multi-stakeholder partnerships, which are essential to foster sustainable development. Although SDG 17 has it multiple advantage, it also does have its limitations such as the generation of a lessons learned repository to learn how multi-partnerships can become more effective to promote the rest of the SDGs, and that at the moment SDG 17 seems to presently still be more inclined towards the achievement of the economic pillar of sustainability. We analyzed the potential viability of SDG 17 "Partnerships for the goals" (i.e., more specifically Targets 17.16 and 17.17 which relate to multi-stakeholder partnerships) regarding SDG 7 and consequently SDG 13 (relating to climate action). Through the evaluation of two studies located in the southern western part of France, where it is possible to observe how multi-stakeholder partnerships are important in implementing wind farm development projects, and how the latter can bring about different outcomes; in one instance, the project was rejected as was the case in Liglet, however went forward in the communes of Thollet-Coulonges.

Biography

Elena Bulmer is a French-born, half English - half Spanish project manager. She graduated 17 years ago from the University of Sussex in the UK with a BSc (Hon) in Biology which was followed by a Master in Science from Reading University in the UK and a PhD from the Complutense University in Madrid, Spain. She is certified as a Project Management Professional - PMP from the PMI (Paris, France), and is a member PMI´s Madrid chapter. Furthermore, she is also certified Prince2 (both Foundation and Practitioner) from APMG International. She has just completed her second PhD on Sustainability and Project Stakeholder Management from the Rey Juan Carlos University of Madrid.

Virtual Presentations

THE POSSIBILITIES OF BACTERIAL CELLULOSE WITHIN ESTABLISHED MARKETS: THE SCALABILITY OF THE PROCESS AND THE VERSATILITY OF THE MATERIAL

Patrizia Bolzan, Francesca Zeccara and Laura Freixas Conde
Politecnico di Milano, Italy

Abstract

This contribution offers a comprehensive examination of the increasing interest in Growing Materials, with a specific emphasis on exploring novel applications of Bacterial Cellulose within diverse product design domains. Regarded as a functional and sustainable substitute for animal leather in all its applications, this bio-based material is currently predominantly utilized in the fabrication of one-off items. However, despite its promising attributes, the full extent of its scalability remains largely unexplored, resulting in minimal advancements in technical production development.

With this awareness, the experimental research outlined in this contribution seeks to gain a deeper understanding of Bacterial Cellulose behavior to enhance its performance while preserving its inherent regenerative and biodegradable properties. The methodology used is experimental and based on a Material Driven Design approach. The experimental setup has been designed with two main objectives: (1) optimizing growth parameters and minimizing production waste to facilitate environmentally and economically sustainable adoption; (2) expanding the application sectors of this material by investigating its behavior during in situ and ex situ coupling with other naturally derived materials.

The findings obtained through this design-driven experimental approach have been meticulously synthesized and integrated into subsequent testing phases to validate the identified variables comprehensively. The results of this experimental investigation lay the groundwork for the potential initiation of standardized production of Bacterial Cellulose, potentially applicable to semi-industrial production sectors. Furthermore, the concluding section of the contribution offers insightful reflections on the inherent limitations of the research and presents avenues for potential future developments, thus paving the way for further exploration and innovation in this field.

Biography

Patrizia Bolzan, Ph.D. in Design, is a Researcher at the Department of Design of Politecnico di Milano. She investigates the ratio between digital fabrication, with particular attention on additive manufacturing technologies, and Design in practices and processes. She deals with circularity in product system design and technological integration in prototypes. She has participated in several research projects, and she is the coordinator of De-Forma (Design Explorations on Bio fabricated Organic Materials) project, funded by the Department of Design, with the basic research grant. Since 2015 she has been on the permanent staff of Polifactory, interdepartmental makerspace and FabLab). Research interests are digital fabrication and additive manufacturing technologies.

DOES FAMILY CARE PROMOTE CLEAN COOKING ENERGY CHOICES FOR OLDER PERSONS? –ANALYSIS IN LIGHT OF HOME-BASED CARE IN RURAL CHINA

Wei Huang, Shiwu Li, He Yang and Hao Yang

Sichuan Agricultural University, China

Abstract

Background: In the dual context of global aging and the cleaner energy transition, the impact of home-based care for the aged-on cooking energy preferences in rural areas is important.

Objective: To explore the impact of care for the aged-on cooking energy choices among the elderly in rural areas.

Methods: Data was drawn from the China Health and Retirement Longitudinal Study IV (CHARLS 2018). The data was officially released to the public in September 2020. The China Health and Retirement Longitudinal Study is administered and sponsored by Peking University's National Development Research Institute. The study has accumulated in excess of 10,000 instances of microdata of exceptional quality. Data was analyzed using the Probit model and a theoretical framework with Fogg's Behavior Model.

Results: (1) Family care for the aged hurts the utilization of greener cooking energy among the old population in rural areas. Personal care for the aged promotes the utilization of greener cooking energy in contrast. (2) The impact of home-based care for the aged is various among older adults by gender and age. The negative impact of family care for the aged is more pronounced in the male group and the older age group. The beneficial impact of personal care for the aged is also more evident in these two groups. (3) The neighborhood effect significantly enhances the adverse influence of family care. This kind of adverse reinforcement comes from the motivation level element. The feasible ability significantly strengthens the beneficial influence of personal care. The beneficial reinforcement comes from the ability level of cooking energy choice behavior.

Conclusion: To promote the usage of clean energy, it is vital to understand the unique influence of different kinds of care for the aged. Efforts in policy and practice should focus on boosting the motivation and ability to adopt clean energy.

Biography

Wei Huang has his expertise in human behavior decisions and passion in improving the promotion of clean energy. In his paper, he included different kinds of care for the aged as an influencing factor in using clean cooking energy. Through the analysis of motivation and ability factors influencing behavioral choices (Fogg, 2009), he explores the inherent mechanisms. The analysis can bring policy implications for the promotion of clean cooking energy in rural areas of developing countries. In the future, he will continue to conduct research at the intersection of economics and human psychology. He seeks to use the results of his research to increase the use of clean energy and promote carbon peaking and carbon neutrality in China. Research interests are agricultural and forestry economic management, clean energy transition and human behavior decision.

HOSTING CAPACITY OF DISTRIBUTION GRID

Alen Tatalović and Vitomir Komen

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Abstract

Background: The distribution network enables consumers to be powered and thus enables their functioning in everyday life. Renewable energy sources use natural resources to produce electricity that are environmentally friendly for the purpose of protecting the environment and nature. Nowadays, there are renewable energy sources with which more and more consumers are becoming electricity producers, and it is necessary to organize and use them in the right way.

Objective: It is necessary to correctly apply the production of electricity from renewable sources so that there are no negative impacts on the existing distribution network.

Methods: The application of new strategies and methods enables the organization of modern distribution networks, and one of them is the Monte Carlo method. Although this method is widely applied, specifically in electrical engineering, by applying the algorithm, it enables the analysis of different scenarios of distributed production that may appear in distribution networks.

Results: By applying the Monte Carlo algorithm, 1000 different scenarios of adding distributed generation to the network were processed. The calculation was made on the example of a real distribution network consisting of a transformer station with outlets to consumers. The calculation results were processed for two cases when the exchange of electricity was enabled and disabled. In the case of disabled return to the electricity grid, production amounted to 97% of the total consumption of the network, while in the case of enabled return to the grid, production amounted to 156% of the total consumption of the network.

Conclusion: Distribution networks are changing over time and with additional incentives, more and more consumers decide to be small producers of electricity. Distributed electricity production brings significant changes, and it is necessary to optimize them in order to continue the normal functioning of the existing distribution networks.

Biography

Alen Tatalović was born, educated and grew up in the town of Ogulin (Croatia) and enrolled in college in Rijeka (Croatia). After completing my university education at the Technical Faculty of the University of Rijeka, I continued to work professionally in jobs related to electric power engineering at the company HEP ODS d.o.o. Elektroprimorje Rijeka. By working in the profession and participating in projects, I try to enrich my knowledge and experience and share my experiences with other colleagues. Electric power is the oldest and one of the most important branches of electrical engineering, which is developing more and more with new technology, and this is exactly what is the subject of my interest in the future. Research interest is hosting capacity.

ASPECTS OF V2G IMPLEMENTATION IN THE DISTRIBUTION SYSTEM

Mateo Kirinčić and Vitomir Komen

University of Rijeka, Croatia

Abstract

Nowadays we are witnesses of extraordinary challenging and exceptionally dynamic time in the energy sector due to various implementation of new technology, continuously growing presence of distributed energy production from various renewable energy resources, conventional transport and mobility transformation to electrically powered vehicles, decentralization of conventional energy system and continuous update and upgrade of currents energy infrastructure. We can take into consideration V2G system as an example of new technology implementations into the current energy system, where end users can participate as a customer and as a vendor. Therefore, V2G system demands bidirectional flow of energy between the grid and the EV. The ability of EVs to return energy to the grid on call and to participate in ancillary services, altogether contributes to added flexibility, stability and reliability of the grid. It should also be emphasized that V2G system provides not only benefits and financial advantages for the system operator and the network, but also obtains various financial benefits and incentives for end users participating in energy exchange. In this paper we will discuss additional aspects and benefits of V2G implementation such as flexible load, and flexible "generator" option, further involvement of aggregator and provision of ancillary services to system balancing and regulation.

Background: Continuously evolving energy sector is a very demanding stage of significant reorganization and decentralization of the current energy system. Ongoing energy transition and increasing representation of distributed energy resources (DER) represents additional stress for the existing system, and also represents a serous incentive to seek for a helpful solution in new technologies that could be available to help obtain current standards in safety and reliability of electrical grid and electricity supply

Objective: To examine the possibilities of implementing new technologies, such as V2G system, into the energy system, specifically distribution system.

Methods: Data were drawn from the existing literature and experiences and was consolidated in an overlook form with highly stated aspects and benefits of its implementation in energy system, especially distribution system.

Conclusion: New technology implementation, such as V2G system, represents possible and safe respond to exceptionally challenging and rapidly increasing energy demand with simultaneously ensuring grid stability and reliability factor.

Biography

Mateo Kirinčić has a degree in electrical engineering and his domain of interest and research is in energy transition and implementation of new technologies in energy systems. His work also is focused on smart energy communities and aggregation possibilities on local community level. Currently, along with his professional work he is also a PhD student and researcher at Faculty of Engineering in the city of Rijeka. Research interests are energy transition, energy system, grid and smart energy community.

STUDY OF THE PROCESS OF STRUCTURAL WOOD REUSE IN A DECONSTRUCTION/ RECONSTRUCTION OPERATION

Odran Lemaitre, Caroline Simon and Pierre-Jean Méausoone

Laboratoire d'Etude et de Recherhce sur le Matériau Bois, Université de Lorraine, France

Abstract

The building sector in France generates approximately 42 million tons of waste annually, with 49% of this waste originating from demolition, 38% from rehabilitation, and 13% from new construction. Concurrently, the building sector is responsible for 40% of global CO_2 emissions, with half of this figure attributed to the production of construction materials. The reuse of materials from the construction sector appears to be a promising solution to mitigate the environmental impact, particularly considering the recent regulatory measures introduced by the French government.

The objective is to examine the overall approach to structural wood reuse in a deconstruction project, from the removal of the element to its availability.

A real-life experiment of deconstruction and reconstruction of housing buildings was conducted to examine the process of reuse. The process was observed from the initial exhaustive diagnosis of the existing building, through to the identification of the exploitable deposit by the owner, and finally to the availability of the elements. The careful removal and re-characterization of the elements, as well as the re-machining process, were also studied. The objective was to create a new manufactured material that was equivalent to the original.

The number of elements that are likely to be reused is 260 wooden joists, which is in line with the estimate made upstream. The removal of the elements was carried out according to a precise methodology resulting from removal tests. Each element was mechanically characterised according to a destructive method that was established and validated by the technical controller of the operation. All the metal elements were removed from the elements to facilitate their re-machining.

The reuse process will allow the reuse of 180 joists on the construction site and has made it possible to determine precise methodologies leading to a re-characterization of the woods and their re-machining.

Biography

Odran Lemaitre is a wood engineer and a PhD candidate at the Laboratory for Study and Research on Wood Material (LERMAB) and the social landlord VOSGELIS. His expertise lies in the reuse of construction materials, particularly wooden structural elements. His work is based on a project in Remiremont (Vosges, France), which involves the deconstruction of four residential buildings and the construction of two new ones. The reuse approach has been pushed to include the reuse of wooden structural elements was selectively deposited to ensure the continuity of carbon storage according to the concept of "Cascading wood" (D. Sakaguchi 2014). Life cycle analysis is also considered to ensure the environmental efficiency of the project. Research interests are wood reuse and Life Cycle Assessment (LCA).

ENVIRONMENTAL SUSTAINABILITY AND INTELLIGENCE AS WELL AS GENERAL GREEN TECHNOLOGIES

Jinsong Wu
University of Chile, Chile

Abstract

Although the term green has been often used to refer to energy consumption reduction or energy efficiency by many people and literatures, green should refer to environmental sustainability in more general senses. Environmental sustainability issues have been important topics in recent years, which has impacted and will further impact individuals, enterprises, governments, and societies. Environmental sustainability is not simply regarding reducing the amount of waste or using less energy, but relevant to developing processes leading to completely sustainable human society in the future. The long-term consequences of the relevant serious issues have not yet been fully forecasted, but it has been generally accepted in many communities that immediate responses are necessary. From 30 November to 12 December 2015, the 21th United Nations Climate Change Conferences of the Parties (COP 21) was held in Paris, France, as the a historical breakthrough and milestone towards securing the future Earth, a global agreement on the reduction of climate change, the text of which represented a consensus of the representatives of more than 193 countries attending it, which was a profound milestone for global environmental sustainability. Nowadays there is another significant tendency on data driven intelligence. This talk would discuss the history, technical issues, challenges, and new trends of data driven environmental sustainability and Intelligence. Further this talk will extend the view to general green technologies.

Biography

Jinsong Wu received the Ph.D. degree from the Department of Electrical and Computer Engineering, Queen's University, Kingston, Ontario, Canada, in 2006. He is proposer (2021) the Founder (2022) and Founding Editor-in-Chief (2022-present) for the new international journal, Green Technologies and Sustainability (GTS), KeAi. He received the 2020 IEEE Green Communications and Computing Technical Committee (TCGCC) Distinguished Technical Achievement Recognition Award, for his outstanding technical leadership and achievement in green wireless communications and networking. He was the leading editor and a coauthor of the comprehensive book, entitled Green Communications: Theoretical Fundamentals, Algorithms, and Applications (CRC Press, September 2012). He received the 2017, 2019, and 2021 IEEE System Journal Best Paper Awards.

SRF PYROLYSIS: RECOVERY POTENTIAL AND ITS ROLE IN THE CIRCULAR ECONOMY

Jarudej Asingsamanunt, Geoff D Fowler and Sue M Grimes

Imperial College London, UK

Abstract

Background: In the context of a circular economy, the pyrolysis of Solid Recovered Fuel (SRF) emerges as a vital process for converting waste materials into valuable resources, minimising environmental impacts and promoting sustainability. SRF, produced from non-recyclable waste streams, offers a viable feedstock for pyrolysis, a thermochemical process that decomposes feedstock at high temperatures in the absence of oxygen, resulting in products including bio-oil, syngas, and char.

Objective: This study investigates the efficiency and viability of SRF pyrolysis within a circular economy framework. The focus is on assessing the potential of SRF pyrolysis to lower greenhouse gas emissions and produce valuable outputs that can be reintroduced into the economic cycle as alternative raw materials.

Methods: Lab-scale rotary kiln pyrolysis reactors were used to process SRF under controlled conditions. The resulting products were analysed using various analytical techniques to identify their potential applications. A material flow diagram was constructed along with the circular transition indicator (CTI) tool to assess the enhancement of SRF pyrolysis to the circularity.

Results: The results indicate that SRF pyrolysis can effectively convert waste into high-value products. The bio-oil produced shows promise as a substitute for fossil fuels or chemical production, the syngas generated can be used for power generation, the char can be recovered as a carbon material, and inorganic elements (metals) in the char can be extracted through acid demineralization. These applications not only provide economic benefits but also contribute to reducing the environmental footprint associated with waste disposal.

Conclusion: SRF pyrolysis represents a critical component of the circular economy, offering a sustainable solution for waste management and enhanced resource recovery. The integration of SRF pyrolysis into existing waste management systems can enhance resource efficiency and sustainability. Future research should focus on scaling up the technology and improving product quality to maximize overall system efficiency and sustainability.

Biography

Jarudej Asingsamanunt is a dedicated researcher specialising in waste management, especially in pyrolysis process, with a focus on advancing the circular economy through innovative waste management solutions. Currently completing a PhD in Environmental Engineering at Imperial College London, his research explores carbon-efficient value recovery from municipal solid waste using pyrolysis. Jarudej has experience as a research assistant and graduate teaching assistant, contributing to significant advancements in pyrolysis technology. His industrial experience includes roles as an environmental consultant and intern environmental engineer, where he learned the concept of circular economy and waste management. He holds an MSc in Environmental Engineering from Imperial College London and a BEng in Environmental Engineering from Kasetsart University, Thailand, graduating with first-class honors. His work has been recognized at multiple international conferences, and he has several publications in preparation. Jarudej aspires to continue a researcher role, sharing his expertise and passion for sustainable solutions in waste & resource management. Research interests are waste management, pyrolysis and circular economy.

A STEP CLOSER TO SUSTAINABILITY WITH IN-MOLD ELECTRONICS

Stephan s Harkema

TNO at Holst Centre, Netherlands

Abstract

The EU green deal, and the following Climate Law, are intended to safeguard our environment and our raw material feedstock. This requires circularity of materials, energy and data at all stages of the value chain. As an intermediate step in 2030, carbon emissions should be reduced by 55% compared to emissions in 1990. As part of the total legislative package, the eco-design directive targets various electronics and electronic equipment (EEE) in an effort to achieve mandatory energy consumption savings and thus fewer carbon emissions. In the coming years, the eco-design for sustainable products regulations will replace the eco-design directive and will ensure durability, repairability and recyclability for many more energy-related products or product groups.

For highly integrated electronic products, such as In-Mold Electronics, where plastics, metals and semiconductor components are seamlessly combined, the only economically viable end of life scenario today is incineration with metal recovery. With increasing electrification, digitization, broad wireless integration and welfare, the amount of waste from electronics and electronic devices is enormous and is growing fast. From 2012 to 2020, the e-waste in the EU increased by 62% from 7.6 Mtons to 12.4 Mtons. Solutions to recover materials during recycling and to provide repairability are crucial for highly integrated products.

IME introduces functionalities such as lighting, touch controls, antennas and control electronics into mechanical structures. Formerly dead spaces come alive, user experiences are enhanced as well as safety in some applications. Depending on the design, this technology reduces thickness, weight and the number of parts used, simplifying the whole assembly. Moreover, the additive process of printing electronics directly onto thin substrates diminishes the environmental load that comes from using traditional PCBs.

The main focus of the presentation is to examine each of the following required aspects: durability, repairability and recyclability for IME.

About TNO at Holst Centre

With the establishment of Holst Centre in 2006 by imec (Belgium) and TNO (Netherlands), expertise in wireless sensor technologies and flexible electronics was brought under one roof at the High Tech Campus in Eindhoven (The Netherlands). Sharing specific knowledge in an open structure, makes it possible to align research and innovation with societal issues in the areas of health & vitality, energy & climate and mobility & industry 5.0. To help solve those societal challenges, Holst Centre connects the Dutch Brainport region with a global ecosystem of industrial and academic partners. Using the expertise, knowledge and technologies of TNO and imec, technological innovations are developed so that the partner companies can bring them to the market. Holst Centre now has about 200 employees.

RESEARCH AND DEVELOPMENT ON SPACE SOLAR POWER IN KOREA

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Abstract

Space-based solar power (SBSP) is the only renewable energy source capable of overcoming geographical limitations through space technology, enabling 24-hour power generation. Although this concept was established in 1968 and has been researched extensively for over 55 years, it still faces significant technical and economic challenges.

In Korea, the Korea Aerospace Research Institute (KARI) has been leading continuous research in this field since 2017, funded by its own budget. In 2019, Korea announced the conceptual design of the Korean Space Solar Power Satellite (K-SSPS). The K-SSPS has a weight of 10,000 tons and dimensions of 2.2 km by 6.8 km. It utilizes non-concentration photovoltaics and a 3-axis attitude control system. In 2021, Korea proposed a disposal method involving lunar surface impact for the complete removal of all space debris, including SSPSs. Since 2022, KARI has cooperated with the Korea Electrotechnology Research Institute (KERI) on wireless power transmission. Through this collaboration, Korea suggested a small-scale pilot system to validate power transmission capabilities in space using two small satellites. In 2023, Korea proposed a medium-sized satellite system for transmitting power from low Earth orbit to the ground and conducted experiments in wireless power transmission using a deep space antenna as the transmitter, with a rectenna installed on aerostats and a ladder truck. From these experiments, LED lamps were lit at a distance of 1.8 km, and cost-effective methods were verified.

Although Korea started late in the field of SBSP, these research efforts are expected to accelerate the realization of SBSP and provide a technological breakthrough that aligns with international initiatives such as “Carbon Net Zero by 2050” and the “RE100 (Renewable Electricity 100%)” initiative.

Biography

Joon-Min Choi received his Bachelor’s degree in Aeronautical Engineering from Seoul National University in 1981, and his Master’s degree in Aeronautics & Astronautics from the University of Washington in 1985. He earned his Ph.D. in Mechanical Engineering from Texas A&M University in 1993. Afterward, he worked at the Korea Aerospace Research Institute (KARI) for 30 years, primarily focusing on satellite development. He also gained experience as a leader in the directorate of aerospace research output commercialization and in the aerospace policy directorate. In January 2024, he retired from KARI and now serves as an Emeritus Professor at Hanseo University and as the CTO of a startup named NARO-STP. Research interest is space based solar power.

OPTIMIZING THE REVERSE SUPPLY CHAIN FOR DECONSTRUCTED MODULAR BUILDING COMPONENTS

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Abstract

The construction industry is undergoing a transformative shift from a linear economy towards a circular economy approach, emphasizing the reuse of disassembled or deconstructed (Dis/Dec) building components with a primary focus on maximizing their lifespan. Prefabricated and modular construction represents a significant advancement in the realm of disassembly and deconstruction. However, despite these promising developments, a critical challenge is the underdeveloped market demand for reused components.

This study aims to encourage the shift towards a circular economy by optimizing the reverse supply chain for Dis/Dec modular building components. The main objectives are: (1) optimizing the reverse supply chain focusing on minimizing its cost and environmental impact, and (2) optimizing the specific functions of the hubs, such as the quality inspection and refurbishment of steel or concrete components, to facilitate their reuse.

The reverse supply chain model minimizes the cost and environmental impact (i.e. CO_2 emissions) related to the establishment of new hubs, and transportation and operation in hubs and factories, by considering the conditions of Dis/Dec components using Building Information Modeling (BIM) data. Three main types of components are considered: beams, columns and slabs made of steel or concrete. The optimization model will use a Genetic Algorithm (GA) and Geographic Information System (GIS) considering a small number of potential locations for hubs at the regional level in the Province of Quebec, Canada. After finding the optimal locations of the hubs based on the overall quantity and quality of components, the second phase of the optimization model focuses on assigning specific types of components (i.e. steel or concrete components) to specialized hubs. The proposed method promotes the adoption and reuse of modular components and market development for circular construction.

Biography

Hosna Ghorab has a passion for environmental conservation and sustainable resource management, particularly within the realm of circular economy practices across various industries. Her extensive research background includes in-depth exploration of e-waste management strategies, emphasizing the value of device reusability over conventional recycling methods. More recently, her focus has shifted towards the construction sector, with a keen interest in optimizing the deconstruction process. In her innovative approach, she has developed a model centered around the reuse of modular components, designed for effortless disassembly and subsequent repurposing, thus contributing significantly to the advancement of sustainable construction practices. Research interests are circular economy, reverse supply chain, modular construction and reuse.

UNDERSTANDING DAIRY LIVESTOCK FARMERS' INTENTION TO ADOPT SOCIOCULTURAL DYNAMICS FOR FOOD SECURITY USING THE THEORY OF PLANNED BEHAVIOUR

Paresh Kumar Sarma and Samiha Sarwar

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Abstract

Socio-cultural dynamics adoption aims to address various factors contributing to household food security, such as access to resources, social networks, and cultural practices. It is important to incorporate social and cultural factors into strategies and interventions aimed at ensuring the food security of dairy farmers. This study explores how socio-cultural dynamics impact food and nutrition security in dairy farming households. A systematic random sampling technique was used to obtain 400 samples through a predetermined survey questionnaire. The collected data were analyzed using the Theory of Planned Behaviour, and the PLS-SEM model was employed to achieve the objective. The results revealed a positive association between the intention to adopt socio-cultural dynamics and food and nutritional security. Therefore, enhancing intention, expanding community and social networks, and improving perceived behavioural control can positively impact the food security status of dairy farming households. This study underscores the importance of integrating socio-cultural considerations into interventions aimed at improving food and nutrition security in dairy farming communities. It demonstrates that incorporating local socio-cultural practices can enhance food and nutrition security by considering cultural beliefs, social networks, and perceived behavioural control. To effectively address food security in livestock farming households, it is crucial to understand the complex socio-cultural dynamics that shape their practices. Policymakers can tailor interventions to meet the unique needs of these communities by acknowledging and respecting their cultural values and beliefs. This approach will encourage community engagement and incentivize sustainable practices. Key strategies to integrate socio-cultural dynamics and promote food and nutrition security in dairy farming communities include emphasizing cultural sensitivity, building social networks, and collaborating with stakeholders.

Biography

Paresh Kumar Sarma is a Senior Scientific Officer (Special Grade) at the Bangladesh Agricultural University Research System (BAURES) in Mymensingh, Bangladesh. He has a strong background in agricultural economics and development economics and has made significant contributions to the field through his research, teaching, and academic pursuits. Dr. Sarma completed a Bachelor of Science degree in Agricultural Economics and went on to specialize in marketing within agricultural economics through a Master of Science degree. He also pursued a PGD in ICT to enhance his skills in technology and its application in agriculture. Dr. Sarma obtained his doctoral degree from Bangladesh Agricultural University with a specialization in Agribusiness and Marketing, highlighting his expertise in the commercial and economic aspects of agriculture. Additionally, he conducted postdoctoral research in development economics, further expanding his knowledge and research capabilities in economic development and policymaking. Currently, Dr. Sarma serves as a Senior Scientific Officer (Special Grade) at BAURES, where he is actively involved in advanced research projects and academic activities. His responsibilities include contributing to the development of agricultural research methodologies, implementing innovative solutions in agribusiness, and mentoring students and junior researchers. Dr. Sarma's professional achievements at the Bangladesh Agricultural University have played a crucial role in advancing agricultural research and education in Bangladesh. His work continues to support the formulation of effective agricultural policies and practices, benefiting both the academic community and the agricultural sector. Dr. Paresh Kumar Sarma's distinguished career reflects his dedication and expertise in agricultural economics, agribusiness, and development economics, and his contributions are instrumental in shaping the future of agricultural research and development in Bangladesh.

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