VIRTUAL

SUSTAINABLE WASTE MANAGEMENT CONFERENCE

SEPTEMBER 15-17, 2020

Organized by Institute for Sustainability

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TIPS FOR A SUCCESSFUL MEETING

Say **hello** to everyone.
You might make someone's day.

Introduce yourself to people you don't know.
They may be your next good friends.

Stop and **smile**.
You will brighten the room considerably.

Be **understanding**.
Everybody makes mistakes.

Help those with less experience.
We were all novices at some point.

Respect others.
We all have something valuable to contribute.

Value staff and volunteers.
They are here for you.

Be **kind**.
You will never like everybody, but you can be cordial to all.

Enjoy the meeting!
You can have fun while sharing,learning and networking.

Abstracts appear as submitted by their authors. Neither the American Institute of Chemical Engineers (AIChE) and its entities, nor the employers affiliated with the authors or presenting speakers, are responsible for the content of the abstracts.

WELCOME ADDRESS

Welcome!

We would like to personally welcome you to the Virtual 2020 Sustainable Waste Management Conference (SWMC) brought to you by the Institute for Sustainability (IfS), an American Institute of Chemical Engineers (AIChE) technological community.

This conference will offer a timely opportunity for knowledge exchange among professionals all over the world to support the formulation of an efficient sustainable waste management agenda. The session topics provide deeper understandings into this agenda, which include:

- Sustainable Waste Management and Circular Economy
- Process Applications and Circular Economy
- Environmental and Sustainability Assessment
- Technology Development and Application
- Technology and Theory Development

As you know, recently we have been hit with an extraordinary set of hardships, and we would like to express our appreciation for the way the sustainability community has come together in the face of these challenges. Each day, we have been impressed and inspired by the creativity, ingenuity, and care that engineers and scientists have shown as we banded together, while being apart, to keep the essence, authenticity, and spirit of progress alive and well.

The world of sustainability is an exciting area in which to work or study, and the Sustainable Waste Management Conference will continue to meet, even virtually, and bring motivated people together in forums like this, to ensure that waste research remains at the cutting edge.

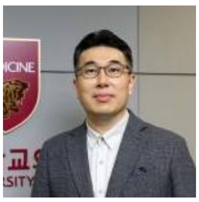
A lot of work has gone into making this conference a success. We extend our thanks to the contributions of the expert Steering Committee and to each and every one of the distinguished speakers and panelists that made this conference possible.

We would also like to thank each of you for attending our conference and bringing your expertise to this gathering. Throughout this conference, we ask you to stay engaged, be proactive, and help shape the future of the world through sustainability initiatives. Our personal respects and thanks go out to all of you. We hope your experience is a pleasant, educational, and inspiring one.

Sincerely,
Conference Chairs of the 2nd SWMC


Siming You
University of Glasgow

Patricia Thornley
Aston University




Yong Sik Ok
Korea University

Ian Watson
University of Glasgow

CONFERENCE ORGANIZERS

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Siming You, University of Glasgow

Ian Watson, University of Glasgow

Yong Sik Ok, Korea University

Patricia Thornley, Aston University

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Meihong Wang, University of Sheffield

Ian Archer, Industrial Biotechnology Innovation Centre

Binoy Sarkar, Lancaster University

Jason Hallett, Imperial College London

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An AIChE Technological Community

TECHNICAL PROGRAM

Technical Program

Day 1	
Tuesday, 9/15	
6:00 - 6:05 AM	Opening and Welcome Patricia Thornley, Aston University
6:05 - 6:55 AM	**Keynote 1 & 2** **Session Chair: Patricia Thornley, Aston University**
6:05 - 6:30 AM	Daniel C.W. Tsang, Hong Kong Polytechnic University
6:30 - 6:55 AM	Andrew Woodend, Defra
6:55 - 7:00 AM	Break
7:00 - 7:25 AM	**Live Q&A for Technical Session 1* & Networking** **Session Chair: Anne Velenturf, University of Leeds**
Watch pre-recorded videos for Technical Session 1 **before** this Live session - available on demand starting September 10, 2020.	
7:25 - 7:30 AM	Break
7:30 - 7:55 AM	**Keynote 3** **Session Chair: Siming You, University of Glasgow**
	Patricia Thornley, Aston University
7:55 - 8:00 AM	Break
8:00 - 8:45 AM	**Panel 1: SWM and circular economy**
	Panel Moderator: Stijn van Ewijk, Yale University
	Anne Velenturf, University of Leeds
	Rupert Myers, Imperial College London
	Sunil Kumar, Technology Development Centre, NEERI Nagpur
	Jeffrey Cross, Tokyo Institute of Technology
***Technical Session 1: Process Applications and Circular Economy**	
Stijn van Ewijk, Yale University. Representation of Waste in Material Flow Analysis: A Review	
Ignasi Palou-Rivera, RAPID. Modular and intensified process technologies for distributed sustainable waste processing	
Asam Ahmed, University of Glasgow. Techno-Economic and Environmental Feasibility of Waste-to-Energy Technologies to Support Net Zero Energy Buildings: A Case Study of Glasgow	
Edward Collins, University of Portsmouth. Amending Lettuce and Tomato Crops with Recycled Shellfish Food Waste to Improve Crop Yield and Antioxidant Activity	
Gary Hilberg, Continuum Energy. Nutrient and Carbon Recovery to Biomaterials	
Roshan Pandey. Agricultural and Food Waste Management	
Tsz Yan Yu, The University of Queensland. Analysing and Understanding the Coupling of Human and Natural Systems for Circular Economy Implementation	

TECHNICAL PROGRAM

Day 2	
Wednesday, 9/16	
6:00 - 6:05 AM	Welcome and Last Day's Takeaways Ian Watson, University of Glasgow
6:05 - 6:55 AM	**Keynote 4&5** **Session Chair: Ian Watson, University of Glasgow**
6:05 - 6:30 AM	Xiangzhou Yuan, Korea University
6:30 - 6:55 AM	Guanyi Chen, Tianjin University
6:55 - 7:00 AM	Break
7:00 - 7:25 AM	**Live Q&A for Technical Session 2** & Networking** **Session Chair: Kumuduni Niroshika Palansooriya, Korea University**
Watch pre-recorded videos for Technical Session 2 **before** this Live session - available on demand starting September 10, 2020.	
7:25 - 7:30 AM	Break
7:30 - 7:55 AM	**Keynote 6** **Session Chair: Kumuduni Niroshika Palansooriya, Korea University**
	Carol Sze Ki Lin, City University of Hong Kong
7:55 - 8:00 AM	Break
8:00 - 8:45 AM	**Panel 2: Environmental sustainability and assessment**
	Moderator: Jeffrey Cross, Tokyo Institute of Technology
	Xiaolei Zhang, University of Strathclyde
	Ambika S, IIT Hyderabad
	Vinod Kumar, Cranfield University
	Daniel S. Alessi, University of Alberta
	Binoy Sarkar, Lancaster University

Technical Session 2: Environmental and Sustainability Assessment
Xiaomeng Hu, City University of Hong Kong. Guiding Environmental Sustainability of Emerging Bioconversion Technology for Sophorolipid Production By Adopting a Dynamic Life Cycle Assessment (dLCA) Approach
Diego M. Juela, Universidad de Cuenca. Alternative Concrete Made with Sugar Cane Bagasse Ash, Recycled Concrete Aggregate, and Powdered Rubber: Compression Tests, Durability and Life Cycle Assessment
Ketan Shah, The University of Texas at Arlington. Solid Waste Management Decision Making for Developing Countries through Life Cycle Assessment Tool
Abraham Castro Garcia, Tokyo Institute of Technology. Feasibility Study on Surplus Wind Energy Potential Use in Hokkaido to Create Liquid Fuels from Kraft Lignin Valorization
Kumuduni Niroshika Palansooriya, Korea University. Novel Chitosan-Biochar Composite Fibers for Removal of Phosphorous from Water
Ken Ushijima, Hokkaido Research Organization / Research Institute for Humanity and Nature. Contribution of Waste-Related Workers in the Informal Sector to Sustainable Waste Management, Case of Bandung City in Indonesia
Short Talk and Poster Session (Available On Demand)
Taira Hidaka, Kyoto University. Regional Resource and Energy Circulation By Anaerobic Digestion of Organic Wastes with Lactic Acid and Photosynthetic Bacteria
Daisuke Inoue, Osaka University. Optimization of Operational Variables for Aerobic Dynamic Discharge Process to Efficiently Enrich Polyhydroxyalkanoate-Accumulating Bacteria in Activated Sludge
Evelyn C. Figueroa-Ribón, Universidad Autónoma de Nuevo León. Hydrochar Production As an Approach to Nixtamalization Waste Management
Junho Park, Portola High School. Investigation on Addition of Neodymium Magnets in Citric Acid Leaching of Spent Lithium-Ion Cells
Niraj Topare, MIT WPU, Pune. Green Adsorbents for Effective Removal of Dyes: A Review

TECHNICAL PROGRAM

Day 3	
Thursday, 9/17	
6:00 - 6:05 AM	Welcome and Last Day's Takeaways Yong Sik Ok, Korea University
6:05 - 6:55 AM	**Keynote 7&8** **Session Chair: Yong Sik Ok, Korea University**
6:05 - 6:30 AM	Jason Hallett, Imperial College London
6:30 - 6:55 AM	Jason Love, University of Edinburgh
6:55 - 7:00 AM	Break
7:00 - 7:25 AM	**Live Q&A for Technical Session 3*** & Networking** **Session Chair: Xiangzhou Yuan, Korea University**
Watch pre-recorded videos for Technical Session 3 **before** this Live session - available on demand starting September 10, 2020.	
7:25 - 7:30 AM	Break
7:30 - 7:55 AM	**Keynote 9** **Session Chair: Xiangzhou Yuan, Korea University**
	TBA
7:55 - 8:00 AM	Break
8:00 - 8:45 AM	**Panel 3: Technology development and application**
	Moderator: Siming You, University of Glasgow
	Changqing Dong, North China Electric Power University
	Shuaifei Zhao, Deakin University
	Ming Xie, University of Bath
	Paula Blanco-Sanchez, Aston University
8:45 - 9:00 AM	**Conclusions and Next Steps** **Siming You, University of Glasgow**

***Technical Session 3: Technology and Theory Development**
Bertha E. Ibarra L., Technical University of Ambato. Methane Landfill Production in Ambato
Jason Iwanesky, The City College of New York. Energy & Integrated-Community Symbiosis Goals for a Next-Generation Water Resource Recovery Facility/Campus
Youhei Nomura, The University of Tokyo, Kochi University. Effect of Nitrate-Nitrogen Concentration on Ulvan Accumulation By Macroalga Ulva Meridionalis
Wakana Oishi, Tohoku University. Hierarchical Bayesian Modeling for Predictive Environmental Microbiology Towards Safe Resource Recovery from Human Excreta
David Onoja Patrick, Universiti Teknologi Petronas, Malaysia. Dissolution Kinetics and Modification of Coal Bottom Ash Treated in Sulphuric Acid Solution
Niraj Topare, MIT WPU, Pune. Ultrasonication an Effective Route for LAB-Scale Catalytic Production of Biodiesel Using Waste Frying Vegetable OIL
Hussein Amusa, University of Benin. The Fabrication and Design of a Waste Sorting Machine
Alan Alberto Ramírez Guevara, Air Liquide, ITESM. Chemical Modification of Halloysite Nanotubes for the Preparation of Nanocomposites on Non Polar Matrix

Guanyi Chen
Tianjin University of Commerce

Guanyi Chen, received his PhD degree in Zhejiang Univeristy in 1998, and then moved to the University of Hong Kong and Delft University of Technology (the Netherlands) for taking the research position there for 5 years. Now he is Chair Professor of Bioenergy and Environment and Distinguished Professor of Tianjin University, Vice-president of Tianjin University of Commerce. He is the former Dean, School of Environmental Science and Engineering, Tianjin University.
His research has been actively focusing on wastes to energy by thermo-chemical conversion, and recently is devoting to the integration of thermo-chemical and biological conversion. He is a member of International Standard Organization (ISO/TC255) responsible for Safety and Environment Issues in the field of biogas. He is the Chairman of the 1st International Symposium on Bioenergy and Environment in 2017, chairman of 6th International Conference on Gasification Technology and Its Application in 2018,, and Chairman of the The 2nd International Symposium on Biomass/Wastes Energy and Environment in 2019.
Prof. Chen has been responsible for a number of large research and development projects at local, national and international level. He participated in number of professional international/domestic conferences as joint chair, plenary speaker, and scientific committee member. He has made the contribution to more than 250 scientific papers (SCI-indexed Journal papers around 150), 30 patents. He is editor in chief of 5 books and guest editor-in-chief for Journal (Science of the Total Environment, Fuel Process Technology, Energy & Fuels).

Jason Hallett
Imperial College

Jason Hallett completed his PhD in Chemical Engineering at the Georgia Institute of Technology in 2002. He took up a Marshall-Sherfield Postdoctoral Fellowship in Sustainable Chemistry in 2006 in the Department of Chemistry at Imperial College. He is now a Senior Lecturer in the Department of Chemical Engineering at Imperial College. His current research interests involve the solvation behaviour of ionic liquids and the use of ionic liquids in biorefining, specifically the production of sustainable chemical feedstocks and lignocellulosic biofuels. He also works on multidisciplinary research projects across several production scales, from laboratory to pilot scale, involving bioprocessing.

Carol Sze Ki Lin City
University of Hong Kong

Dr. Carol Lin is an Associate Professor in the School of Energy and Environment at the City University of Hong Kong. She was a Visiting Assistant Professor at the Bioengineering Program in the Department of Chemical and Biomolecular Engineering at the HKUST from January 2010 to June 2011. Prior to this, she was a postdoctoral researcher in the research group of Professor Wim Soetaert at the Centre of Expertise – Industrial Biotechnology and Biocatalysis (InBio.be) at the Ghent University in Belgium. She worked in a project titled ‘‘Optimalisation and scale up for succinate production using genetically modified Escherichia coli'. It was the last phase of a collaborative project titled the "Metabolic engineering and dynamic modelling of Escherichia coli for the production of chemicals from renewable resources" (MEMORE) project.

Carol graduated in Chemical and Materials Engineering from the University of Auckland, New Zealand with a 1st class honours degree. Her PhD was carried out within the Satake Centre for Grain Process Engineering (SCGPE) in the School of Chemical Engineering and Analytical Science at the University of Manchester, England. In collaboration with the Green Chemistry Centre of Excellence at the University of York, her research focused on novel wheat-based biorefining strategies for the production of succinic acid.

Her recent work on 'Starbucks Biorefinery' strategy for sustainable production of succinic acid has been highlighted by the American Chemical Society (ACS) in the 244th meeting in Philadelphia, USA as well as in numerous high profile media venues such as Time Magazine (US Edition), BBC News, CNN and the South China Morning Post in Hong Kong.

Dr. Lin is also editorial board member of several biotechnology and energy related journals. She has published over 110 papers with several scientific manuscripts in top impact factor journals including Chemical Society Reviews, Energy and Environmental Sciences; editor of 2 books, co-authored 13 book chapters and published 3 patents. She gave around 100 oral presentations including 12 key-note and 5 plenary talk in the following countries: Australia, Belgium, China, Colombia, France, Germany, Greece, Hong Kong, India, Indonesia, Italy, The Netherlands, New Zealand, Portugal, Serbia, Singapore, South Korea, Spain, Switzerland, Taiwan, the UK and USA.

Together with graduate students and colleagues, Dr. Lin has published over 123 research papers and 16 book chapters. She maintains a worldwide professional network through her service as an Associate Editor of the Biochemical Engineering Journal; Special Guest Editor for Green Chemistry, Topics in Current Chemistry, Process Safety and Environmental Protection, Current Opinion in Green and Sustainable Chemistry, Bioresource Technology, Journal of Hazardous Materials. Dr. Carol Lin has served as an Invited Professor in Division of Environmental Science and Biotechnology, College of Life Sciences and Biotechnology, Korea University. She has served as steering committee members of numerous major conferences such as Engineering Sustainable Development 2019 & 2020, organized by the APRU and the Institute for Sustainability of the American Institute of Chemical Engineers (AIChE).

Jason Love
University of Edinburgh

Jason B. Love is Professor of Molecular Inorganic Chemistry at the University of Edinburgh. He is the Edinburgh co-director of the EPSRC CDT for Critical Resource Catalysis (CRITICAT), a centre which delivers postgraduate training and research in all areas of catalysis across St Andrews, Edinburgh, and Heriot-Watt Universities. He is the chair of the RSC Coordination and Organometallic chemistry Discussion Group (CODG) and chair of the upcoming RSC Dalton 2021 conference. He was a visiting professor at the Technical University Munich, Germany (2015) and at Osaka University, Japan (2019-20). He has published 130 peer-reviewed articles (h-index of 38) and has delivered over 30 international and 11 national invited lectures since 2010, including presenting work on 'Mining the Scrapheap' at New Scientist Live (2018). He has diverse interests that span the periodic table, with a focus on catalysis, rare-earth element chemistry, and the recovery and recycling of metals from primary and secondary sources.

Patricia Thornley
Aston University

I work in assessing the environmental, economic and social imapcts of renewable energy technologies, particularly bioenergy systems. I have experience of working in the commercial sector in power generation as well as in academia. I lead the EPSRC SUPERGEN Bioenergy hub (www.supergen-bioenergy.net) and am editor-in-chief of the Elsevier journal Biomass and Bioenergy.

Daniel C.W. Tsang
Hong Kong Polytechnic University

Dr. Daniel CW Tsang is currently an Associate Professor in the Department of Civil and Environmental Engineering at the Hong Kong Polytechnic University and Honorary Associate Professor at the University of Queensland. He was an IMETE Visiting Scholar at Ghent University in Belgium, Visiting Scholar at Stanford University in the US, Senior Lecturer and Lecturer at the University of Canterbury in New Zealand, and Post-doctoral Fellow at Imperial College London in the UK and the Hong Kong University of Science and Technology. Dan's research group strives to develop low-impact solutions to ensure sustainable development and foster new ways in which we utilize biomass waste, contaminated land, and urban water. Dan has published over 350 SCI journal papers with h-index of 47 (Scopus), and currently serves as Associate Editor of Journal of Hazardous Materials, Science of the Total Environment, Critical Reviews in Environmental Science and Technology, as well as Editorial Board Member of Environmental Pollution, Bioresource Technology, Chemosphere, and Advanced Sustainable Systems. Dan has received the Excellence in Review Award at Environmental Science and Technology, Resources, Conservation & Recycling, and Chemosphere. Dan is the Chair and Organizer of multiple international conferences including 5th Asia Pacific Biochar Conference (APBC2020).

Andrew Woodend
Defra

Andrew has worked for the UK government throughout his career, as an analyst, mainly around developing agricultural and, in recent years, environmental policy, particularly waste and resource. In his spare time he loves the outdoor life, particularly exploring the countryside and enjoying the odd countryside pub! He also enjoys (trying to!) play the piano and, with his wife, renovating the older properties they have lived in.

Xiangzhou Yuan
Korea University

Dr. Xiangzhou Yuan is a research professor of Korea University in Seoul, South Korea. His academic background covers clean energy technology, sustainable waste management, and valorization of solid waste into value-added products (i.e., biochar, porous carbon). Dr. Yuan also has an area of expertise in climate change mitigation and wastewater purification. He has registered 4 Korea domestic patents and published about 30 research papers in reputed SCI journals, such Green Chem, Chem Eng J, J Hazard. Mater, Appl Energ. He is also active in servicing as the Outside Director of Sun Brand Industrial Inc. from 2020 and the Key Academic Committee of International Cooperation Research Centre of Carbon Capture in Ultra-low Energy-consumption, Tianjin, China from 2018. He was nominated as the Local organizing committee of 20th International Conference on Heavy Metals in the Environment (ICHMET).

Daniel S. Alessi
University of Alberta

Daniel S. Alessi is an Associate Professor in the Department of Earth and Atmospheric Sciences at the University of Alberta, who specializes in environmental geochemistry and geomicrobiology. Since 2013, his research group has focused on understanding the surface chemistry and reactivity of environmental materials such as iron oxides, bacteria, and biochar, on lithium extraction from oilfield brines, and on improving our knowledge of the water cycle in unconventional oil and gas operations.
Dr. Alessi holds the Encana Chair in Water Resources at the University of Alberta, and was named a 2017-2018 Petro-Canada Young Innovator. He sits on the editorial boards of peer-reviewed journals including Marine and Petroleum Geology, Geobiology, Environmental Geochemistry and Health, Critical Reviews in Environmental Science and Technology and Chemical Geology.

Jeffrey Cross
Tokyo Institute of Technology

Jeffrey S. Cross is a Professor at Tokyo Tech, founder and director of the Online Education Development Office. The office develops MOOC on edX and is part of the Center of Innovative Teaching and Learning located in Tokyo, Japan. Furthermore, he is a faculty member in the department of Transdisciplinary Science and Engineering in the School of Environment and Science as well as in the Energy Science and Engineering Graduate Major. He manages a lab of 15 students doing research on biofuels, waste to fuel conversion, Japanese energy policy and AI in education. Jeffrey previously worked at Fujitsu Labs and Fujitsu Ltd. for 14 years developing ferroelectric memory materials and reliability technology in Atsugi, Japan. He has over 150 published papers and patents combined. Jeffrey received his Ph.D. in Chemical Engineering from Iowa State University in 1992 and has lived/worked in Japan for over 25 years. He speaks Japanese fluently and is learning Khmer. See the website below for more information.

Changqing Dong
North China Electric Power University, China

Prof Changqing Dong received his PhD degree on Municipal solid waste combustion from Southeast University, China in 2003. Then he moved to Tokyo Agri. & Tech. University, Japan to work on the rich husk gasification as Postdoctoral Researcher. Prof Dong joined the North China Electric Power University (NCEPU) in 2004 as Associated Professor and promoted to Full Professor in 2009. He serves as the Deputy Director of the National Key Laboratory for Biomass Power Generation Equipment based in the North China Electric Power University since 2009.
Over the years, Prof Dong has been engaged in the efficient use of waste and energy-saving environmental protection research. He led and completed 1 Project supported by the National Key Technology Research and Development Program of the Ministry of Science and Technology of China, 1 Project supported by the National High Technology Research and Development Program of China (863 Program), 3 National Natural Science Fund projects, 1 Key project of the Ministry of Education, 1 Key project of Beijing Natural Science Foundation, 15 projects at Provincial and

Ministerial levels (incl. the Ministry of Agriculture Integrated Energy Construction Project), etc. He has published 226 papers, 52 authorized invention patents and 4 books, and obtained 9 software copyrights. Prof Dong has been awarded the First Prize of Science and Technology Progress Award of Ministry of Education (2017), First Prize of Progress Award of China Southern Power Grid Company (2013), Second Prize of China Power Science and Technology Progress Award (2013), Second Prize of Natural Science Award of Ministry of Education (2012), etc.

Sunil Kumar
CSIR-National Environmental Engineering Research Institute

Dr. Sunil Kumar is a well-rounded researcher with more than 20 years of experience in leading, supervising and undertaking research in the broader field of Environmental Engineering and Science with focus on Solid and Hazardous Waste Management. He has contributed extensively to these fields and has h-index of 30 and i10-index of 43 (Google scholar); highly impressive for a non-academic researcher from India. His contributions since inception at CSIR-NEERI in 200 include 130 refereed journal publications, 04 books and 25 book chapters, 08 Edited volumes and numerous project reports to various governmental and private, local and International academic /research bodies. The list of his collaborations is long and includes key Indian universities, such as IIT Kharagpur, IIT Delhi and IIT Mumbai and prestigious regional institutes, such as Asian Institute of Technology (AIT) and Kasetsart University in Bangkok, Hong Baptist University as well as universities in US (Columbia, Texas A&M) and Europe (UN University and University of Uppsala). He has contributed immensely to the advancement of environmental engineering/ science fields in India in the region and internationally by acting as editor/ editorial member of numerous journals, Expert committee member for revision of Solid Waste Manual in India, organizing workshops/conferences and delivering invited speeches at both Indian and international venues. Dr. Kumar has achieved much recognition and awarded as Outstanding Scientist in 2011 and 2016 at CSIR-NEERI for his Scientific Excellence in the field of Research & Development in Solid Waste Management. Dr. Kumar was also awarded with the most prestigious award Alexander von Humboldt-Stiftung Jean-Paul-Str.12 D-53173 Bonn, Germany as a Senior Researcher for developing a Global Network and Excellence for more advanced research and technology innovation. He has successfully demonstrated a brick kiln pilot plant at Ramteke, Nagpur, Maharashtra, India and pilot plant at CSIR-NEERI for utilization of distillery sludge as a soil amendment and involved in development of a Cost-effective and Eco-friendly Technology for Resource Recovery from E-waste, producing Bio-HCNG from the agricultural waste (contracted with Korea Government) and process development for production of non-food sugars from mixed variable organic wastes (Indo-UK Newton Bhabha Project).

Vinod Kumar
Cranfield University

Dr Vinod Kumar is a Lecturer in Bioenergy/Biomass Systems at Cranfield University, UK. Dr Kumar has longstanding skills in microbial fermentation (fungal, yeast and bacterial) and extensive experiences in 'state-of-the-art' techniques of bioprocess optimization, bioreactor operations, scale up, molecular biology, metabolic engineering and synthetic biology. Dr Kumar has experience in bioprocess development for metabolites production from renewable sources. His research focuses on designing of microbial chassis as cell factories for overproduction of industrially important compounds using Metabolic Engineering and Synthetic Biology tools. He has carried out research in multidimensional projects aiming at "Development of low cost, energy efficient and sustainable Bioprocesses for production of Biofertilizers, Biopesticides, Biofuels and Biochemicals". His current research focuses on development of second generation biorefinery, connecting industrial and agricultural waste streams to valuable products. He has 30+ publications in peer-reviewed journals with Google Scholar Citations of 1265, h-index of 18 and ResearchGate score of 30.56.

Rupert J. Myers
Imperial College London

Rupert J. Myers is a Lecturer in Sustainable Materials Engineering and leader of the Myers Group at Imperial College London.

He has worked across various engineering/science disciplines and locations, from Australia (Uni. of Melbourne), to the United States (UC Berkeley, Yale, MIT), and to Europe (EMPA, Uni. of Edinburgh, ICL).

Rupert currently champions his mission, to reduce environmental burdens through sustainable engineering, by focussing his research and teaching on materials that are virtually unmatched in importance to society, such as cement and metals, and the services/products that they provide, e.g., shelter/buildings, infrastructure, and cities.

He leads inter(/trans)disciplinary projects in this space, which notably couple industrial ecology and materials engineering/chemistry, in collaboration with various domestic and international academic and non-academic partners.

Rupert is a member of the International Society of Industrial Ecology.

Outstanding prospective PhD students and postdocs that are passionate about sustainability, science/engineering, and materials are encouraged to get in touch by email with their CV attached. Multiple PhD projects are currently available in the Myers Group, on topics such as:

- Modelling use of materials and energy throughout society and related scenario/policy analysis, e.g., to identify environmentally beneficial technologies (industrial ecology, data engineering)
- Using thermodynamics to fundamentally understand environmentally beneficial/harmful materials, e.g., properties of cement binders with low CO2 emissions, persistence of toxic chemicals (materials science, chemistry)
- Assessment and characterisation of natural and anthropogenic resources for environmentally beneficial use, e.g., industrial by-products (industrial ecology, materials science)

Binoy Sarkar
Lancaster Environment Centre (LEC) of Lancaster University

Dr Binoy Sarkar is a Lecturer at the Lancaster Environment Centre (LEC) of Lancaster University. Previously he was a Research Associate at University of Sheffield, and a Research Fellow at University of South Australia from where he also received his PhD. Dr Sarkar’s research aims to improve the understanding of physio-bio-chemical phenomena occurring at the surfaces and interfaces of minerals and other particulate materials (for example, biochar, nanoparticles, plastics). The applied sides of his work extend to atmospheric carbon dioxide capture and carbon sequestration in soils, and remediation of conventional and emerging contaminants in soil and water environments.

Dr Sarkar is an awardee of the Australian Endeavour Research Fellowship (pursued at Indiana University), Desai-Biswas Gold Medal and Geof Proudfoot Award. He was also an Honorary Adjunct Research Fellow at University of South Australia.
Dr Sarkar is an Associate Editor of Clays and Clay Minerals, and European Journal of Soil Science, and an Editorial Board Member of Critical Reviews in Environmental Science and Technology and Minerals. He also served as Guest Editor of multiple special issues in Journal of Hazardous Materials, European Journal of Soil Science, Applied Clay Science, Clays and Clay Minerals, and Journal of Soils and Sediments. Website: https://www.lancaster.ac.uk/lec/about-us/people/binoy-sarkar

Ambika Selvaraj
IIT Hyderabad, India

Dr. Ambika S is currently working as an Assistant Professor at the Department of Civil Engineering, India Institute of Technology Hyderabad, Telangana. She got her Bachelors degree in civil engineering and Masters degree in environmental engineering. During her Ph.D. at Indian Institute of Technology Madras, she worked on 'Sustainable, Iron-based Treatment Systems for Hexavalent Chromium and Toxic-Organics Removal, which is the first of its kind with respect to the focus given on mitigating the impacts of the existing field scale implementation. During her Post Doctoral research at IIT Madras, she worked on 'Beneficial Resource Recovery from Industrial Waste' which focused on applying 3R's concept in a sustainable way. Her research has received considerable attention both here and abroad in the conferences and got published in top journals.
Dr. Ambika is passionate about her research, transfer the knowledge to students/scholars and apply the research in solving real-time social issues. The strategy of her teaching is to inspire students by connecting theory with practical scenarios so that students will be masters in fundamentals and implement their knowledge in solving current environmental issues.
The emphasis of Dr. Ambika's research and teaching are on clean technologies and sustainable development in water quality engineering and energy-environmental management. Her current research is focused on:

- sustainable and cleaner technologies in civil and environmental engineering,
- applications and implications of nanotechnology,
- industrial waste management focusing waste to wealth/energy concepts, and
- optimization of Systems and Strategies in Contaminated-Site Remediation.

She has handled more than 25 industrial and consultancy projects dealing with

- Environmental and Energy Audit of Industry
- Vetting of water treatment plants
- Vetting of design, monitoring, performance evaluation and Augmentation of STPs
- Design Verification of Sewer Network

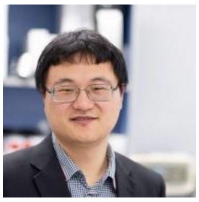
Dr. Ambika was the only women to receive the prestigious WARI fellowship in 2016 to conduct research at Dr. Yusong Li's lab, University of Nebraska, the USA for 6 months. She has published her research in top journals such as Water Research, Journal of Cleaner Production and Journal of Chemical Engineering. Dr. Ambika is a reviewer for the leading environmental sustainability journals including Journal of Hazardous Materials, Journal of Environmental Management, Journal of Environmental Chemical Engineering.

Anne Velenturf
University of Leeds

Dr. Anne Velenturf is a Research Impact Fellow in Circular Economy at the University of Leeds and Managing Director of the consultancy 4Innovation. She works on the interface of academic research and practice, using her expertise in participation process management, knowledge exchange and impact delivery for challenge-led research that supports the implementation of a sustainable circular economy.

Anne has led the £7M Resource Recovery from Waste programme funded by the Natural Environment Research Council, the Economic and Social Research Council and the Department for Environment, Food and Rural Affairs. She also delivered projects on market research, business model innovation, regional and national circular economy implementation, and various projects to create a policy environment that is more amenable to a sustainable circular economy. She has a growing research track record in the application of circular economy principles to the design, operation and end-of-use management of energy infrastructure.

Being involved in implementing circular economy practices has revealed significant gaps in the theoretical foundations of circular economy and its capability to contribute to sustainable development. Anne has published in a variety of media on this subject and is a regularly invited speaker, with a reputation for challenging comments and questions that spark fundamental debates.



Ming Xie
University of Bath

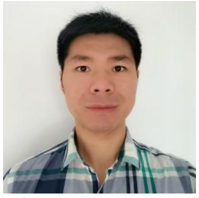
Dr. Xie is a trained Environmental Engineer specialising in membrane-based processes for desalination and wastewater treatment. As a Lecturer (Assistant Professor) in Chemical Engineering at the University of Bath, Dr. Xie is interested in using membrane-based processes to address the water-energy-resource nexus in an interdisciplinary field that bridges chemical and environmental engineering. Dr. Xie is also a receipt of Endeavour Australia Cheung Kong Award in 2018. His research outputs highlight the fundamental aspects of membrane science, with tangible and long-lasting translational impacts towards industry and commercialisation.

Xiaolei Zhang
University of Strathclyde

The main stream of my research is solid waste valorization for the production of power, heat, fuel, and chemicals. I work on thermochemical conversion technologies (pyrolysis, gasification, liquefaction, combustion, co-firing), and further upgrading. The final products of interest include fossil compatible fuel (bio-gasoline, bio-diesel), fuel additives (ethanol, methanol, dimethyl ether, oxymethylene ethers), gaseous products (hydrogen, methane) and bio-chemicals (e.g. levoglucosan); to realize low carbon, low cost, and low GHG emission bio-fuel production. The research approaches include Quantum Mechanics modelling based on Density Functional Theory (DFT), Molecular Dynamic modelling, Process Modelling, Thermodynamic and Kinetic experimental investigation and Techno-economic Analysis. I have been awarded research projects from various funding bodies including EPSRC, Leverhulme Trust, and industry.

I received a Ph.D. degree from Royal Institute of Technology-KTH, Stockholm, Sweden, and worked as a Post-doc Research Fellow in University of Alberta, Canada. From January 2015 to June 2019, I worked at Queen's University Belfast (QUB) as a Lecturer and joined University of Strathclyde in July 2019 as a Senior Lecturer (Chancellor's Fellow) under Strathclyde Global Talent Programme. I am currently on the editorial board of two international journals and I am an academic member of the Institution of Engineering and Technology (IET), a member of the Energy Institute (EI) and a member of American Institute of Chemical Engineers (AIChE).

I am a Fellow of Higher Education Academy in the UK, and have taught core Engineering courses include Thermodynamics, Fluid Mechanics, and Heat Transfer.



Shuaifei Zhao
Deakin University

Dr. Shuaifei Zhao has more than 11-year R & D experience in developing new membrane processes and materials for environmental and energy applications. He received academic training in China, Australia and Singapore. He has been an excellent team player in diverse research groups across Australia, Singapore, China and Japan. His main research interest includes: desalination, water treatment, resource recovery, waste utilization and management, and gas separation through various membrane technologies (e.g. forward osmosis, reverse osmosis and membrane distillation). Dr. Zhao has published more than 80 journal papers in prestigious international journals, such as Journal of Membrane Science, Environmental Science and Technology, and Chemical Engineering Journal. In recognition of his capabilities and excellence, Dr. Zhao has been awarded an Australian Water Association Award, an Endeavour Fellowship (from Australian Government Department of Education), Macquarie University Academic Staff Award, and an Australia-India Strategic Research Fund Early- and Mid-Career Fellowship (from Australian Academy of Science).

ORAL ABSTRACTS

KEYNOTES

Keynote Talk: Wood Waste Biochar for Sustainable Industrial Wastewater Treatment

Daniel C.W. Tsang[1,*], Zhonghao Wan[1], Yuqing Sun[1]

[1] Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China. *Corresponding author email: dan.tsang@polyu.edu.hk

Abstract

Deteriorating aquatic ecosystem and refractory biowastes are causing severe environmental concerns towards the worldwide sustainable development. Conversion of renewable biowastes (e.g., wood) into value-added catalysts/adsorbents can be a promising resolution. The emergence of graphitic biochar provides a versatile platform especially suitable for environmental decontamination. In this work, we fabricated two graphitic biochars derived from lignocellulosic precursors via hydrothermal carbonization and pyrolysis, and elaborated their catalytic performance in the remediation of two representative pollutants omnipresent in industrial wastewater, i.e., bisphenol and 2,4-dichlorophenoxyacetic acid. Excellent catalytic performance of wood-derived biochar could be achieved in both microwave- and peroxide-assisted oxidation systems, suggesting the versatility and prospective potential of wood waste biochar to be applied in sustainable industrial wastewater treatment. An excellent redox surface chemistry and a high microwave absorption capacity originated from the graphitized carbon matrices were regarded to determine their catalytic performance. Besides, the economical and naturally abundant features made them industrially attractive to scientific and engineering communities. Overall, this work unveiled the new strategies to transform wood waste into value-added efficient catalysts/adsorbents and elucidated their catalytic mechanisms in different remediation systems, cultivating valuable insights in the future waste and biomass valorisation.

Dr. Patricia Thornley, *Aston University*

Abstract:

In a net zero future we will need to carefully balance, manage and extract maximum value from all carbon-based resources. That demands careful consideration of what the best route is for biogenic and non-biogenic waste. The environmental benefits and impacts of energy and/or resource recovery will need to be carefully evaluated and weighted to develop appropriate circular economy strategies. The Energy Research Accelerator's policy commission examined the state of play, barriers, challenges and opportunities to form part of the circular economy. It concluded that there was significant potential for regional activity and actors to develop facilities that would address not only waste disposal, but also critical issues such as fuel poverty and air quality. However, insights from regional and national businesses and policy makers revealed that current policy and regulation is inadequate to promote investment in the sector and there is a need to build confidence with small scale, innovative, demonstration facilities. This presentation will review the waste disposal and processing sector in the UK, present key insights from commercial stakeholders, discuss recommendations for progressing the circular economy in the UK and associated environmental trade-offs.

Upcycling plastic waste for climate change mitigation in plastic pandemic era: COVID-19

Xiangzhou Yuan, Yong Sik Ok

Korea Biochar Research Center, APRU Sustainable Waste Management Program & Division of Environmental Science and Ecological Engineering, Korea University, Seoul 02841, Republic of Korea

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Abstract:

The treatment of plastic waste is a global issue, and the demand for technologies to reuse or upgrade plastic waste is increasing. Meanwhile, current atmospheric CO_2 levels are over 410 ppm and could be over high-risk levels of 550 ppm in 2050, due to that fossil fuels will be still the dominant energy source, suggesting that high-risk climate change will significantly impact humans and entire ecosystems before 2050 if more efforts are not effectively taken. Environmental pollution caused by plastic waste and global warming caused by CO_2 emissions are commonly considered as two urgent, yet stand-alone, environmental issues. Using plastic waste such as PET bottles as a carbon precursor to synthesize porous carbons for CO_2 adsorption could provide a promising and sustainable approach to solve the two environmental issues, simultaneously. Through performing experimental investigation, numerical simulation, and life cycle analysis, the major findings verified that waste PET-derived porous carbon coupled with temperature swing adsorption (TSA) of CO_2 could be a promising approach for achieving carbon neutrality or even negative emissions from a life cycle perspective. It implies that limiting environmental pollution without losing the many benefits that plastics provide could be well achieved and climate change also could be efficiently mitigated, simultaneously.

Ultra-low cost ionic liquids for lignocellulose deconstruction of contaminated waste wood

Professor Jason Hallett

Department of Chemical Engineering, Imperial College London, United Kingdom

E-mail: j.hallett@imperial.ac.uk

Abstract:

Ionic liquids (ILs) have proven to be highly tunable ‘designer solvents’ capable of a wide range of exciting chemistries. However, industrial application at large scale is hampered by high solvent cost. This cost is, however, a tunable feature of the solvent itself – provided the ion selection is handled with a careful eye aimed at limiting synthetic complexity. Lowering the solvent cost will increase the attractive opportunities of ILs for bulk processing of lower cost end products – including such applications as biofuels.

One of the key challenges in biorefining is the initial separation or deconstruction of lignocellulosic feedstock into separate components. ILs offer unique advantages in this area, due to their unusual thermochemical properties. However, there are serious concerns about the economic viability of their use due to the very high cost of most ionic liquids (> €50/kg).

We have overcome this by redesigning the IL based deconstruction process to use low-cost, acidic ILs for lignin dissolution rather than cellulose dissolution, yielding filterable cellulose and a dissolved lignin for precipitation or conversion to high-value chemicals. We have found that processability of the cellulose is high and lignin recoveries near quantitative. We use a range of ‘protic’ ILs, the family typically used in IL industrial processes, because their simple acid-base chemistry results in a simple and cheap synthesis, with a cost (< €1/kg) similar to common organic solvents such as acetone or toluene.

However, another challenge in the production of bulk fuels and chemicals from biomass is the feedstock cost. To overcome this, waste biomass is being investigated as a low-cost alternative to pristine wood. A

proportion of construction wood is treated with various copper containing preservatives in order to prolong its lifetime. Most prominently, chromated copper arsenate (CCA, Tanalith C) was used extensively until 2001 for outdoor applications. CCA treated timber can contain, in addition to copper, over 5000 mg kg-1 of arsenic and chromium. These preservatives pose a problem at the end of life, as they require costly specialist disposal of the metal treated wood as hazardous waste (Grade D, $180/ton). Recently wood is mainly treated with more benign, yet still copper containing, preservatives such as copper azole (CA).

Our process has now been optimised for pretreatment of metal-treated construction wood. CA and CCA treated wood was successfully pretreated, yielding highly digestible cellulose rich material with a glucose release of 76% and 52% for CA and CCA treated wood, respectively. We show that, in both cases, 98-99% of the metals could be extracted into the ionic liquid. We were also able to demonstrate that redeposition of copper from ionic liquid liquor is easily achieved by applying an electrical bias.

This presentation will discuss how ionic liquids can be 'tuned' to control cost structure of the final solvent, and what implications this will have for the chemical processes involved. The impact of the solvent on large-scale applications, such as biomass pretreatment, will be discussed, with a focus on performance and process considerations such as how the ILs maintain solvent stability under long-term processing conditions, that they can be recovered and continue to exhibit very good performance after multiple reuses. These properties highlight that the ILs have the flexibility to be useful for a variety of downstream chemical processing techniques, and for use in other applications.

[1] Gschwend et al, Towards an environmentally and economically sustainable biorefinery: heavy metal contaminated waste wood as a low-cost feedstock in a low-cost ionic liquid process, Green Chem 2020, 22, 5032

[2] Baaqel et al, Role of life-cycle externalities in the valuation of protic ionic liquids–a case study in biomass pretreatment solvents, Green Chem, 2020, 22, 3132

[3] Brandt-Talbot et al., An economically viable ionic liquid for the fractionation of lignocellulosic biomass, Green Chem, 2017, 19, 3078

TECHNICAL SESSION 1: PROCESS APPLICATIONS AND CIRCULAR ECONOMY

Representation of Waste in Material Flow Analysis: A Review.

Stijn van Ewijk *and Alessio Miatto*
Center for Industrial Ecology, Yale University, New Haven, CT

The challenge of using waste as a resource is at the core of the transition to a circular economy. Material flow analysis (MFA) – a systematic assessment of material stocks and flows in a defined system – can be used to assess current and potential levels of waste generation, prevention, recycling, and recovery.

To realistically identify opportunities for the use of waste as a resource, MFA needs to meaningfully distinguish primary (virgin) resources from secondary (waste) resources, and represent the relevant properties of waste that enable or obstruct reuse and recovery, such as dispersed generation, mixing with other wastes, and contamination.

We review approaches to representing waste in MFA in peer-reviewed journal articles. First, we review the transparency and consistency of categorisations of primary and secondary stocks and flows. Second, we review how relevant properties of waste are represented through the modelling of stocks, flows, processes, and system boundaries.

Based on the preliminary results from our review, we find that many MFA studies inconsistently or opaquely distinguish between flows of wastes, by-products, and co-products. There are also inconsistencies regarding the categorisation of stocks of materials and waste, whether in-use, discarded, hibernating, or landfilled.

We find that MFA studies commonly estimate quantities of waste but without the precision or depth that is necessary to estimate the recovery potential. Of the relevant properties we identified, the concentration of contaminants, and the implications for recovery, is studied most often, through a combination of material and substance flow analysis.

Our provisional recommendations are two-fold. First, we argue for greater transparency and granularity in the categorisation of waste and non-waste flows and stocks, based on the best practices we identified. Second, we see ample opportunity for studies that innovatively incorporate key waste properties in MFA to better assess the potential for greater circularity.

Techno-Economic and Environmental Feasibility of Waste-to-Energy Technologies to Support Net Zero Energy Buildings: A Case Study of Glasgow.

Asam Ahmed[1] *and Siming You*[2]
(1)University of Glasgow, Glasgow, United Kingdom, (2)Division of Systems, Power & Energy, School of Engineering, University of Glasgow, Glasgow, United Kingdom

Buildings consume a large amount of energy in heating, cooling, air conditioning, and lighting systems, leading to significant greenhouse gas emissions, which account for 77% of building-related emissions. The main opportunities to solve the issues of carbon dioxide emissions are reducing the total energy consumption and using renewable energy resources. This can be facilitated through the development of energy recovery from waste to support net-zero energy buildings for which energy is supplied from clean energy sources as considered as a means of decarbonizing the building sector.

Glasgow contains important sources of wastes that ensuring a steady supply of raw materials. Waste (e.g., agricultural residue, food waste, and gardening waste)-to-energy technologies are used to generate renewable energy for the development of net-zero energy buildings in Glasgow, Scotland. In this work, a model has been developed to treat wastes based on two technologies (gasification and anaerobic digestion). A multi-criteria analysis method was developed to identify the capacities and the number of units for the optimal implementation of each technology. Technical, economic, and environmental criteria were considered for developed the model. The overall energy potential was evaluated and was used to satisfies electricity demands and heat demands in the peak demand of net-zero energy buildings. The extent to which the use of waste-to-energy technologies can contribute to support net-zero energy buildings was identified based on the current status of wastes production. This work serves as the basis for developing policies for net-zero energy buildings-supported by waste-to-energy technologies. The expected results can be used for the cases of different cities in both developing and developed countries.

Amending Butterhead Lettuce with Recycled Shellfish Food Waste to Improve Yield and Antioxidant Activity.

Edward Collins
University of Portsmouth, Portsmouth, United Kingdom

A major waste product of the shellfish industry is crustacean shells composed of a biopolymer called chitin. Approximately 6-8 million tonnes of waste crab, shrimp, and lobster shells are produced globally, and this waste is either incinerated, disposed of in the sea, or in landfill. Chitin is known to positively influence plant growth. This study investigates a role for this waste in greenhouse horticulture which is relevant to the circular economy and sustainable horticulture.

The yield, and antioxidant activity of butterhead lettuces (*Lactuca sativa*) were monitored in a greenhouse, where growing media were supplemented with chitin (1, 2, 3% w/w) derived from crab and shrimp shells from fishery waste streams. Leaf area, leaf number, and whole plant fresh mass identified that 1%, 2%, and 3% chitin amendments resulted in an enhancement of crop growth compared to the control. 2% chitin amendments resulted in the largest increase in average fresh mass of 30% per plant more than the control.

Using the FRAP antioxidant assay it was observed that the antioxidant activity of leaves grown in the chitin supplemented media increased significantly (one-way ANOVA test; Tukey post hoc test; $P<0.05$) for 2% and 3% chitin amendments with 3% yielding the largest increase. This was also observed, using the Folin's phenolic assay, which measured the phenolic content of these leaves. Both these assays suggest the potential for enhanced health benefits from consuming such leaves.

Overall, this study illustrates that the food waste product chitin can be utilised to improve the yield and antioxidant activity of crops such as lettuce. The effects seen may be transferable to other crops and a commercial trial with tomatoes will also be discussed.

Nutrient and Carbon Recovery to Biomaterials.

Gary Hilberg
Continuum Energy, Cypress, TX

This paper describes the opportunity for wastewater treatment facilities (WWTF) to capture and store CO_2 produced by their anerobic digesters on-site. This natural process produces high value algae biomass that will is utilized to displace traditional oil & gas feedstocks for plastics and renewable fuels. This technology transforms WWTFs into carbon negative facilities, capturing more carbon than they produce. Expanding urban development and infrastructure continues to burden the environment and produces harmful emissions. WWTFs are leaders in reducing their environmental footprint and have the potential to be a key contributor to the Urban Biocycle. This presentation will provide operating data from systems to confirm the on-site carbon capture and production of beneficial biomass. The overall process captures carbon and nutrients while performing tertiary water treatment.

Agricultural and Food Waste Managementmany Developing Countries Have Successfully Reduced Agricultural and Food Waste By Turning Them to Organic Fertilizer. in a Country like the United States, It Is Hard to Convince People That It Can be Done at Home but That's Why We Need Younger Generation of People to Raise Awareness to Their Parents about Agricultural and Food Waste.Agricultural and Food Waste Management Can be a Way to Convert Waste to Energy Providing a Valuable Resource If Managed Properly. Agricultural and Food Waste Can be Converted into Compost at Home without Having to Send It to Landfill. the Compost Can then be Used As Organic Fertilizer Whether at Home or Anywhere Else. One of the Ways It Can be Done Is By Digging a Trench and Dumping All Degradable Food Wastes into the Trench. Eventually, That Waste Will Turn to Compost in the Presence of the Sunlight and Water.Likewise, in the Cities Where People Have Limited Spaces to Dig Trench, They Can Buy a Large Barrel or 55 Gallon Plastic Container Where They Can Collect Their Daily Food Waste without Sending It to Landfill. They Can Close the Container and

Eventually That Food Waste Will Also Turn to Mulch.in Both Cases, People Can Use the Mulch As Natural Fertilizer in Their Garden and If They Do Not Have Garden at Home, a City Can Have a System Where They Collect Compost Once a Month or As Needed. the City Can then Use It in Local City Parks and Garden. This Will Allow to Reduce and Manage the Agricultural and Food Waste. Moreover, the Return in Investment for the City Can be Significant. If All of This Does Not Work, Farmers Will Always Look to Buy Natural Compost As Long As It Is Cheaper Than the Cost of Fertilizer in Stores.

Roshan Pandey
Mr., Pottsville, PA

Many developing countries have successfully reduced agricultural and food waste by turning them to organic fertilizer. In a country like the United States, it is hard to convince people that it can be done at home but that's why we need younger generation of people to raise awareness to their parents about Agricultural and Food Waste.

Agricultural and Food Waste Management can be a way to convert waste to energy providing a valuable resource if managed properly. Agricultural and Food Waste can be converted into compost at home without having to send it to landfill. The compost can then be used as organic fertilizer whether at home or anywhere else. One of the ways it can be done is by digging a trench and dumping all degradable food wastes into the trench. Eventually, that waste will turn to compost in the presence of the sunlight and water.

Likewise, in the cities where people have limited spaces to dig trench, they can buy a large barrel or 55 gallon plastic container where they can collect their daily food waste without sending it to landfill. They can close the container and eventually that food waste will also turn to mulch.

In both cases, people can use the mulch as natural fertilizer in their garden and if they do not have garden at home, a city can have a system where they collect compost once a month or as needed. The city can then use it in local city parks and garden. This will allow to reduce and manage the agricultural and food waste. Moreover, the return in investment for the city can be significant. If all of this does not work, farmers will always look to buy natural compost as long as it is cheaper than the cost of fertilizer in stores.

Analysing and Understanding the Coupling of Human and Natural Systems for Circular Economy Implementation.

***Tsz Yan Yu**[1] and Anthony Halog[2]*
(1)School of Earth and Environmental Science, The University of Queensland, Brisbane, QLD, Australia, (2)School of Earth and Environmental Science, The University of Queensland, St Lucia, QLD, Australia

Circular economy has gained widespread attention in recent years. Circular economy was proved to be a panacea to address environmental degradations and enhance waste prevention. To understand the up-to-date circularity intervention, it is necessary to share the information on how the concept of circular economy is implemented in the world. This presentation will review the situation of circular economy implementation in different countries in the past twenty years. Residual waste management and closing supply chain management were studied as cases. The methods used, the indicators and knowledge gaps of each issue were assessed. Our research found out that the most commonly used method is the input-output analysis. Residual waste management measures the waste flows to reduce waste generation and improve waste recycling system. Closing supply chain management enhances waste prevention. The need of long-period monitoring is highlighted. For future studies, we suggest including more sectors such as trade-offs and international trade in the table when using input-output analysis. The results could provide information for stakeholders to update their current knowledge and propose adaptive management.

TECHNICAL SESSION 2: ENVIRONMENTAL AND SUSTAINABILITY ASSESSMENT

Guiding Environmental Sustainability of Emerging Bioconversion Technology for Sophorolipid Production By Adopting a Dynamic Life Cycle Assessment (dLCA) Approach.

Xiaomeng Hu[1], *Karpagam Subramanian*[1], *Huaimin Wang*[1], *Sophie L.K.W. Roelants*[2,3], *Ming Ho To*[1], *Wim Soetaert*[2,3], *Guneet Kaur*[4,5], *Carol Sze Ki Lin*[1], *and Shauhrat S. Chopra*[1]
(1)City University of Hong Kong, Hong Kong, China, (2)Ghent University, Ghent, Belgium, (3)Bio Base Europe Pilot Plant, Ghent, Belgium, (4)Hong Kong Baptist University, Hong Kong, China, (5)York University, Toronto, ON, Canada

Microbial biosurfactants have been gaining attention as a potential replacement to synthetic surfactants as they can be produced from renewable feedstocks, have lower environmental toxicity and are highly biodegradable. Sophorolipids (SL) is one such microbially produced glycolipid biosurfactant representing the largest market share of the 27 billion USD global surfactant market. Though SL production is based on renewable feedstocks challenges concerning the production of electricity, enzymes, and materials that are primarily fossil based, still exist. From a scale-up perspective, it is imperative to quantify the environmental impacts associated with the SL production pathway and inform improvements at the research and development (R&D) stage, to facilitate commercial exploitation of these new generation biosurfactants. LCA is considered a power tool to evaluate environmental sustainability, its application to emerging technologies is different and is challenged with problems like data scarcity and rapid changes in the technology itself. This study adopts a dynamic LCA (dLCA) framework consisting of two traversals that emphasizes iterative evaluations and collaborative efforts with the experimentalists to tackle these problems. The dLCA framework is used to analyze SL production from organic waste streams, identify hotspots, derive recommendations to reduce environmental impacts at lab scale, to avoid unintended consequences while scaling up. LCA in the first traversal identified food waste as the most suitable feedstock. After accounting for experimental results with food waste as feedstock, two separation technologies were evaluated in the second traversal to find out that fed batch fermentation integrated with *in-situ* separation resulted in lesser environmental impacts compared to conventional separation technique. Results obtained from each traversal will inform the experimentalists to optimize those processes, resultant data sets can be iteratively used in subsequent traversals to account for the technological changes and mitigate the impacts before scaling up.

Alternative Concrete Made with Sugar Cane Bagasse Ash, Recycled Concrete Aggregate, and Powdered Rubber: Compression Tests, Durability and Life Cycle Assessment.

Diego M. Juela
Centro de Estudios Ambientales, Universidad de Cuenca, Cuenca, Ecuador

The high environmental impact (EI) produced by portland cement and the depletion of natural resources has led in recent years to the design of concretes with better environmental performance using supplementary cementitious materials and recycled aggregates. The objective of this work is to design a concrete mix with low environmental impact and that preserves the mechanical properties and durability of ordinary concrete. The ecological concrete mix (EC) was prepared by replacing the three components of conventional concrete, the portland cement was replaced by sugarcane bagasse ash in

30%, the coarse natural aggregate by recycled concrete aggregate in 40%, and the aggregate fine was replaced by 5% powdered rubber. The EC mix was designed according to the ACI 211.1 method, with a water/cement ratio of 0.43. The properties of compressive strength and electrical resistivity were evaluated to the EC mix and compared with a conventional concrete mix (CC). Finally, the EI reduction of the EC mixture was estimated by life cycle assessment (LCA) at the cradle-to-door limits. The results show that the EC mix reduces its compressive strength by approximately 2% compared to CC, however, it increases the electrical resistivity by 55%, which translates into greater durability of the concrete. The LCA shows that the EC mixture reduces the global EI by 38.7%, this being higher, in the Ecotoxicity category with 40.5% lower than the CC. The eco-friendly designed concrete mix has good properties and is an effective alternative to achieve sustainable development in the construction industry.

Solid Waste Management Decision Making for Developing Countries through Life Cycle Assessment Tool.

Ketan Shah
Civil and Environmental Engineering, The University of Texas at Arlington, Arlington, TX

Improper solid waste management (SWM) leads to an estimated 9 million deaths worldwide each year, mostly in developing countries (Vaccari et al., 2019). Open dumps currently serve around 3.5-4 billion people, and this number is expected to grow with increased urbanization and population growth (ISWA, 2015). Open dumps release a variety of air pollutants due to open burning and cause health problems due to uncontrolled disposal of hazardous and healthcare waste. (Wiedinmyer et al., 2014)

To help cities in growing economies select among alternatives to open dumps (material recovery facilities, anaerobic digesters, combustors, landfills, etc.), a tool for solid waste management planning is critically needed. Currently, no such tool exists with SWM processes and data tailored to developing countries. Existing municipal SWM decision support tools have US or European default values (e.g. US EPA, Municipal Solid Waste Decision Support Tool (MSW-DST) and WARM, WRATE, EASETECH). Even Solid Waste Emissions Estimation Tool (SWEET, 2018), which is designed as a tool for developing countries, contains emission factors for waste collection/transportation vehicles and handling equipment based on US emission standards. In addition, it does not estimate costs, which is necessary for selecting among SWM options. Moreover, it does not include low-cost adaptations of developed-country technology, which may be more appropriate for developing countries.

The overall goal is to develop a decision-support tool for growing economies (Solid Waste Assessment Tool, SWAT), which communities can use to choose cost-effective SWM options that protect public health. SWAT is being created taking; Solid Waste Optimization Life cycle Framework (SWOLF) as a base reference, developed by North Carolina State University (NCSU).

Feasibility Study on Surplus Wind Energy Potential Use in Hokkaido to Create Liquid Fuels from Kraft Lignin Valorization.

Abraham Castro Garcia*, Shuo Cheng, and Jeffrey Scott Cross*
Department of Transdisciplinary Science and Engineering, Tokyo Institute of Technology, Tokyo, Japan

Our reliance on hydrocarbons as a source of fuel and raw materials has become a problem in light of our understanding of climate change, air pollution, and fossil fuel's eventual depletion, yet, de-carbonization in many industry sectors is hard to achieve. Notably, aviation, maritime and heavy freight trucks require and are forecasted to require liquid hydrocarbon fuels in the future still.

In this paper, we analyze the case study of Japan's northern most island, Hokkaido, with the intent of showing a path towards a carbon-neutral economy. An extensive literature review of papers and reports regarding renewable energy and biomass availability in Japan and Hokkaido was carried out, assessing the current and future energy mix for 2030. An alternative is proposed where, due to the availability of Kraft lignin in the region due pulp mills' presence and ample wind power potential, the prospect of integrating renewable energy production with Kraft lignin bio-refineries is presented as an alternative to known power-to-fuel processes.

The assessed studies indicate that Hokkaido's wind power potential is likely not to be exploited during this next decade due to lack of local electricity demand, regional monopolies and planned energy developments, which is troubling because the region represents 46.53% of the on-shore wind power potential of Japan. The second half of this work focuses on analyzing an economic feasibility study regarding Kraft lignin valorization and estimating the economic impact that would result from the valorization of the Kraft lignin available in Hokkaido through this process. An estimate of the wind power required to valorize this biomass is calculated.

The implementation of a power-to-fuel process that valorizes Kraft lignin could guarantee carbon neutral production of aromatic and jet-fuel range compounds and take advantage of a source of biomass that is available year round from existing pulp mills.

Novel Chitosan-Biochar Composite Fibers for Removal of Phosphorous from Water.

Kumuduni Niroshika Palansooriya[1]*, Sok Kim*[2]*, Avanthi D. Igalavithana*[1]*, Yohey Hashimoto*[3]*, Yoon-E Choi*[2]*, Raj Mukhopadhyay*[4]*, Binoy Sarkar*[5]*, and Yong Sik OK*[6]
(1)Department of Environmental Science and Ecological Engineering, Korea University, Seoul, Korea, Republic of (South), (2)Korea University, Seoul, Korea, Republic of (South), (3)Tokyo University of Agriculture and Technology, Tokyo, Japan, (4)ICAR-Central Soil Salinity Research Institute, Haryana, India, (5)Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom, (6)Division of Environmental Science and Ecological Engineering, Korea University, Seoul, Korea, Republic of (South)

In the present study, paper mill sludge (PMS) biochars were fabricated under N_2 and CO_2 conditions at 600 ˚C (BC-N and BC-C, respectively). BC-N and BC-C were further modified with chitosan and $FeCl_3$ to produce chitosan-biochar composite fibers (FBCs) (FBC-N and FBC-C, respectively). All the four adsorbents were characterized using SEM-EDS, XPS, Raman spectroscopy, and specific surface area measurement, and then tested for the removal of phosphorous (P) from aqueous solutions. The equilibrium isotherm offered a good fit to the Freundlich model for BC-N, and Redlich-Peterson model for the other three adsorbents. Based on the Langmuir model, the maximum P adsorption capacity was 9.63, 8.56, 16.43 and 19.24 mg g^{-1} for BC-N, BC-C, FBC-N, and FBC-C, respectively, indicating increased P adsorption by FBCs than biochars. The P adsorption was better explained by the pseudo-first-order kinetic model for BC-C and BC-N, whereas FBC-N and FBC-C followed the pseudo-second-order, and Elovich model, respectively. Molecular level observations of the P K-edge XANES spectra confirmed that Fe-P was the primary species in all adsorbents following P adsorption, but the contribution of Fe-P increased in FBCs (up to 59%) compared to biochars (up to 55%). Results of this study implied that FBCs hold high potential as a low-cost and green adsorbent for remediating P in contaminated water.

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Contribution of Waste-Related Workers in the Informal Sector to Sustainable Waste Management, Case of Bandung City in Indonesia.

Ken Ushijima[1]*, Umi Hamidah*[2]*, Koji Hayashi*[3]*, Neni Sintawardani*[2]*, and Mayu Ikemi*[4]
(1)Hokkaido Research Organization / Research Institute for Humanity and Nature, Asahikawa, Japan, (2)Indonesian Instutute for Science, Bandung, Indonesia, (3)Research Institute for Humanity and Nature, Kyoto, Japan, (4)Sapporo International University, Sapporo, Japan

In Indonesia, the municipality owns the responsibility of waste management, however, in reality, street-level collection and transportation are carried out by local garbage collector who is employed by the local community, consists of about 100-300 households. Furthermore, the official recycling system is not systematically working, and therefore informal recycling flow starts from waste pickers' activity are taking an important role. Thus, the contribution to sustainable waste management by waste-related workers in the informal sector is expected to be large. However, revealing the reality of those informal businesses is not easy, and therefore information and data about those systems are limited. This study did a deep interview to three individual garbage related workers in one local community in the Bandung City in Indonesia on July 2018; a garbage collector employed by the local community, a waste picker in transshipping waste station and a waste picker in the street, and explored their working condition such as their cash-flow, working time, regulation or relationship with other garbage-related workers, and also motivation to work for it. Although the interview results are only about a specific case in a specific area, this study found that (1) their income by waste-related work was ranged 670,000 to 1,750,000 IDR/month (about 45 to 119 USD/month), (2) there exist informal rule that 2 or 3 waste collectors are assigned to one waste picker, and those garbage collectors have to pay for the waste picker, and waste picker takes valuables from their waste and also helps to transship the waste, (3) all interviewed garbage related workers experienced other jobs than a waste-related job, (4) all interviewed waste-related workers had chosen current job because of relatively high salary than a previous job and of the flexibility of time use, which enables them to have a side job to supplement their income.

TECHNICAL SESSION 3: TECHNOLOGY AND THEORY DEVELOPMENT

Methane Landfill Production in Ambato.

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Worldwide, Integrate Solid Waste Management System (ISWM-S) is an important issue because it can address global warming and climate change solutions. Waste generation increase, while Population density increase. Population migration from rural to urban areas occurs more frequently and there is an industrial expansion. Managing Municipal Solid Waste (MSW) is a challenging process, one important step is to classify organic and inorganic waste. Because this can help select a best treatment. Waste to energy technologies (WTE-T) allow to turn waste into a useable form of energy. Organic waste frequently is generated in low income nations. The biological treatment technologies is one of the solutions, since the biodegradable (MSW) fraction has a high potential for energy production.

Ecuador is a country with low average income, and it is estimated that by 2025 the generation of urban solid waste (MSW) will be 18,041 tons / day. The present study was developed in Ambato, a district located in the province of Tungurahua. Ambato is characterized for being an agricultural sector, with a majority of the organic matter produced. The Landfill of Ambato receives 120 tons/day of solid waste that contains 65% of organic waste. This sanitary landfill began its operation in 2006 and has an evacuation system for Biogas and leachate. Representative samples of landfill (buried waste) and biogas were taken from each zone to carry out laboratory analysis. The tests performed on soil samples of landfill were pH, organic matter, humidity, and landfill gas (LFG) was characterized. The results of this study demonstrate that zone C contains the highest amount of methane and soil (buried waste) has a basic pH, methane capture and energy production is proposed.

Energy & Integrated-Community Symbiosis Goals for a Next-Generation Water Resource Recovery Facility/Campus.

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Water resource recovery facilities (WRRFs) have often been seen as “dead zones” that loom ominously behind barbed-wire fences rather than engage their surrounding communities. Our objective is to demonstrate how existing New York City water resource recovery facilities (WRRFs) and adjacent sites can be transformed into water resource recovery campuses (WRRCs) that incorporate community-facing elements and renewable energy-producing systems with the facility operations.

The NYC Department of Environmental Protection (DEP) has targeted the 26th Ward WRRF in the economically disadvantaged neighborhood of East New York for potential future integration of energy-modeling systems, and for greater community engagement. We will provide a case study of 26th Ward through a three-pillar sustainability lens that focuses on ways that a WRRC may speak to economic and social justice, and environmental remediation.

We will show how to incorporate synergies and co-benefits from related infrastructural systems (e.g., solid waste, energy, food production/distribution systems) in ways that provide further community benefit than that provided by the primary wastewater-treatment function. These methods include the WRRC’s potential role in local food distribution to its surrounding community, an area known as being a “food desert” bereft of healthy food options, and also therefore an area beset by a high incidence of significant health concerns, like obesity and diabetes.

Concurrently, the WRRC may be seen as a potential economic engine for the surrounding community, through direct education and employment programs. 26th Ward is located on Jamaica Bay, an environmentally sensitive wetland estuary. Opportunities abound for good careers not only for engineers and technicians at the facility, but also for urban farmers, botanists / horticulturalists, marine biologists, and other environmentally focused careers.

Effect of Nitrate-Nitrogen Concentration on Ulvan Accumulation By Macroalga *Ulva Meridionalis*.

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Algae cultivation is a promising approach for recovering nutrients from water. Macroalga *Ulva meridionalis* rapidly grows and highly accumulates a polysaccharide ulvan, which can be used for producing chemicals and energy. Concentration of nutrients such as nitrogen (N) is a key factor that control algal growth rate, and ulvan production might be affected under oligotrophic condition. In this study, the effect of NO_3-N concentration on ulvan accumulation by *U. meridionalis* was investigated. *U.*

meridionalis were cultivated in artificial seawater-based ES medium (1 L, 25 ± 1°C) (Provasoli, 1968) with a cycle of 12:12 h light/dark photoperiod. Every 24 h, the medium was exchanged, and wet weight of the algae was measured. Initial concentration of NO_3-N was adjusted at 0 (N1), 0.363 (N2), 0.738 (N3), 2.12 (N4), and 3.55 (N5) mg N L^{-1}. The algae were harvested after 4 days of cultivation, and ulvan content was measured after freeze-drying. All experiments were carried out in triplicate. The maximum rate for NO_3-N uptake and half-saturation constant were 2.69 mg N g-wet^{-1} day^{-1} and 0.113 mg N L^{-1}, respectively. *U. meridionalis* exhibited rapid growth rate in N2–N5 (μ = 0.816–0.946 day^{-1}) and hardly grew in N1 (μ = 0.247 day^{-1}). The ulvan contents in N1–N2 (17–19%) were lower than those in N3–N5 (21–22%). In algal cell, L-glutamine, which is used for gluconeogenesis and glycolysis, is produced by assimilating NO_3-N via various metabolism processes. We deduced that decrease in ulvan content in N1–N2 was attributed to decrease in the activities of gluconeogenesis and glycolysis owing to N shortage. The results show that NO_3-N concentration is an essential factor affecting ulvan accumulation by *U. meridionalis.*

Acknowledgements

This work was supported by Cabinet Office grant in aid, the Advanced Next-Generation Greenhouse Horticulture by IoP (Internet of Plants), Japan.

Hierarchical Bayesian Modeling for Predictive Environmental Microbiology Towards Safe Resource Recovery from Human Excreta.

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In spite of the public health and environmental benefits, the use of human excreta in agriculture associates with a significant infection risk. The pathogen concentration in human excreta needs to be managed appropriately, however, the predictive approach is yet implemented due to a lack of kinetics models for pathogen inactivation that are available under varied environmental conditions. This study aimed to develop inactivation kinetics models of microorganisms applicable under varied environmental conditions of excreta matrices, and to identify the appropriate indicators that can be monitored at disinfection processes.

We conducted a systematic review targeting peer-reviewed journal articles on the sanitization of excreta matrices which presented a time-course decay of a microorganism and the environmental conditions. Defined as a function of measurable factors including treatment time, pH, temperature, ammonia concentration and moisture content, the kinetic model parameters were statistically estimated using hierarchical Bayesian modeling. The inactivation rates of a microorganism and appropriate storage time of excreta matrices were predicted using the established model.

The inactivation kinetics models were established for *Escherichia coli*, *Salmonella*, *Enterococcus*, *Ascaris* eggs, bacteriophage MS2, phiX174 and adenovirus. *Ascaris* eggs were identified as the most tolerant microorganisms followed by bacteriophage MS2 and *Enterococcus*. Urea treatment was most effective for the *Ascaris* inactivation, and the 9-$\log_{10}$ reduction was achieved within 100 days at 28°C. Ammonia concentration, temperature and moisture content were the critical factors to facilitate the *Ascaris* inactivation.

The predictions by our model were compatible with the current WHO guideline. The developed inactivation kinetics model enable us to predict microbial concentration in excreta matrices under varied environmental conditions, which is essential for microbiological risk management in emerging resource recovery practices from human excreta.

Dissolution Kinetics and Modification of Coal Bottom Ash Treated in Sulphuric Acid Solution.

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DISSOLUTION KINETICS AND MODIFICATION OF COAL BOTTON ASH TREATED IN SULPHURIC ACID SOLUTION

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ABSTRACT

Coal bottom ash obtained as waste from coal power plants contains metal species has been used as effective catalysts in biomass pyrolysis and gasification process for biofuel production. The limitations to its application in these processes are its morphological and chemical properties. The modification of physico-chemical properties of coal bottom ash and dissolution kinetics of iron by treatment in sulphuric acid have been analyzed in this study. The ash was treated by leaching in sulphuric acid solution while varying the acid concentration (1 – 3 M), temperature (303-333 K), L/S ratio (3-5 mL/mg) and time. The treated coal bottom ash had modified chemical properties with indications of sulfonation as observed from FTIR analysis. Physisorption properties revealed a BET surface area increase of 387%, 460% increase in pore size and a significant increase in the adsorptive capacity. The morphology of the treated ash was significantly modified as observed from the FESEM micrograph of the ash. The dissolution kinetic data was analysed using the shrinking core model with an activation energy of 21.8733 KJ/mol.

Ultrasonication an Effective Route for LAB-Scale Catalytic Production of Biodiesel Using Waste Frying Vegetable OIL

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Abstract Text:
Waste Frying oil is not environmentally friendly to dispose off and its use is very harmful to health. The best and effective solution is to use it for industrial purposes, namely to convert it into biodiesel. Ultrasonication, a non-conventional process technique, was applied to directly convert waste frying Soybean oil (WFSO) into biodiesel in a single step. Ultrasonic transesterify WFSO very efficiently due to increased mass/heat transfer phenomena and specific thermal/thermal effects at molecular levels. This research work presents the lab-scale catalytic transesterification to the biodiesel production process using a low-frequency ultrasonic energy method (20 kHz). For this purpose, WFSO is used as biodiesel feedstock. Magnesium oxide (MgO) was used as a catalyst. The heterogeneous catalyst showed an

effective catalytic activity, considerable stability, and helps in the satisfactory conversion of WFSO. Ultrasonication with MgO produced maximum biodiesel yield of 96.5% at optimum reaction conditions of 70°C reaction temperature, methanol to oil molar ratio of 5:1, catalyst dosage of 6 wt%, and reaction time of 45 minutes.

The Fabrication and Design of a Waste Sorting Machine.

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This work is aimed at the design and fabrication of a solid waste sorting machine considering the analysis of domestic waste. This design is modeled after what is currently obtainable in advances countries where waste can be completely conserved for economic use. The design commenced with feasibility studies of parameters such as waste generation, varieties of waste and waste characteristics. The mechanized system is made up of systems capable of separating a variety of components of wastes based on weight, size and properties of waste where air blower separate light materials from the waste stream and the magnetic tray trapped ferrous metals based on their magnetic properties. All the components of the machine put together using the metal of high corrosion resistant, mild steel and powered by an electric motor, the machine separate wastes basically into light materials and heavy materials. The success of the machine is a measure of the effectiveness of the machine, the effectiveness of the machine is put at an average of 78% and for an initial investment of $3301.9, the payback period is 2.4 years.

Chemical Modification of Halloysite Nanotubes for the Preparation of Nanocomposites on Non Polar Matrix.

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The carbonated drinks packaging industry has focused its attention on some nanoparticles such as halloysites (HNTs) to use them as additives in the nanocomposites synthesis, this due to its high availability, low cost, easy processing and a diffusion distance decrease of gas molecules, providing excellent barrier properties. The above is of great importance since it allows to reduce the CO_2 permeability in polymers.In this study, we demonstrated the effects of chemical treatments for Halloysite nanotubes (HNTs) under acid and alkaline conditions using sulfuric acid and sodium hydroxide. XRD results indicate that alkaline treatment destroyed the crystalline structure and morphology for HNTs because the XRD spectrum shows the typical peaks for montmorillonite. For the acid treatment using H_2SO_4, XRD spectrum indicates an intensity reduction for the peak (001) showing a lower concentration of aluminium in the structure. Diffuse reflectance analysis shows a reduction of 40 and 15% for reflectance with H_2SO_4 and NaOH treatments respectively. A terephthalic acid adsorption test was realized with the HNTs, modified halloysites (HNT-H_2SO4) and (HNT-NaOH) samples with a kinetic study and it was quantified with UV spectroscopy at 240 nm where results shown a lower adsorption for HNTs treated with H_2SO_4 in comparison with alkaline treatment and not treated HNT. A decrease of 58% ± 0.3was achieved with the sulfuric acid treatment with not crystalline structure modification using ICP technique to quantify the sample compositions.

SHORT TALKS AND POSTER SESSION

Regional Resource and Energy Circulation By Anaerobic Digestion of Organic Wastes with Lactic Acid and Photosynthetic Bacteria.

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Anaerobic digestion (AD) of waste and wastewater can transform organic material into a renewable energy source and produces digestate, which can be used as bio-fertilizer. In the present study, anaerobic co-digestion of sewage sludge with various kinds of organic wastes such as kitchen garbage is focused on in areas where population density is small, and AD is not widely applied currently.

Collecting kitchen garbage by vehicles frequently, e.g., twice a week, is not effective. We propose lactic acid fermentation for storing kitchen garbage crashed by disposers in septic tanks. Degradation behavior of simulated kitchen garbage inoculated with indigenous lactic acid bacteria was investigated. Lactic acid fermentation resulted in decreased pH of around 3.5 and suppressed the solubilization of suspended solids (SS). A preservation ratio of SS was 80% during the 4-week storage experiment. AD experiments confirmed that the corresponding energy can be recovered as methane.

Photosynthetic bacteria were cultivated to upgrade the digestate as fertilizer. Sludge or soil samples were separately seeded and cultivated using an artificial substrate made of mainly poly-peptone and nutrients. Each sample was cultivated under a fluorescent lamp with a photon flux density of approximately 120 mmol m^{-2} s^{-1} for 12 h every day. The growth rate of the photosynthetic bacteria was evaluated by carotenoid and biomolecular analyses. Rhodospirillaceae was detected using sequencing (MiSeq). The culture liquid at eight months contained a pufM gene copy number of 3.3×10^9 copies g^{-1}. Pot experiments of Komatsuna (Brassica rapa var. perviridis) showed that cultivation under light illumination improves the fertilizer quality, in terms of fresh weight and carotenoid.

These results proved that lactic acid and photosynthetic bacteria can promote anaerobic co-digestion for regional resource and energy circulation.

Optimization of Operational Variables for Aerobic Dynamic Discharge Process to Efficiently Enrich Polyhydroxyalkanoate-Accumulating Bacteria in Activated Sludge.

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The enhanced production of high-value-added materials from waste streams via catalytic functions inherent to waste activated sludge (WAS) is still a big challenge to realize sustainable wastewater treatment. Polyhydroxyalkanoates (PHAs) are biodegradable and biocompatible thermoplastic substances that are completely synthesized by microorganisms, and their production by WAS has been attracting increasing attention from the viewpoint of not only the resource production by beneficial use of waste streams and WAS but also the mitigation of marine plastic pollution. Because PHA production capability of original WAS is not necessarily high, the enrichment of PHA-accumulating bacteria is a key step for efficient PHA production using WAS. However, the enrichment of PHA-accumulating bacteria generally requires a long period (e.g., over months), which consequently limits the beneficial use of WAS generated continuously from wastewater treatment. Therefore, this study aimed to establish a rapid enrichment method of PHA-accumulating bacteria using the aerobic dynamic discharge (ADD) process which has previously been confirmed to enrich PHA-accumulating bacteria within several days. Conditions of nutrients feeding, cycle length and settling time for enrichment of PHA-accumulating bacteria in sequencing batch reactors applying the ADD process were experimentally optimized in this study. Enrichment period was set at 2 d. The enrichment culture obtained by the optimized ADD process could accumulate up to nearly 70% of PHA per cell dry weight within 12 h when acetate was used as the substrate. 16S rRNA amplicon sequencings also identified the dominance of *Rhodocyclaceae* in the enrichment culture, which would be key PHA-accumulating bacteria. The method established in this study will make a great contribution to realize PHA production by the combined use of WAS and waste streams.

Hydrochar Production As an Approach to Nixtamalization Waste Management.

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Corn "tortilla" is a fundamental part of the Mexican diet, and throughout its production a waste called "nejayote" is generated. The lack of regulation on this waste causes a high environmental damage due to its physicochemical characteristics, which mainly affect water quality. This research proposes an alternative to manage "nejayote" through the method of hydrothermal synthesis, a thermochemical transformation performed at low temperatures (180-240°C) and self-generated pressures that is suitable for biomasses with high moisture content. As co-products of the hydrothermal process, a solid similar to coal (hydrochar) is obtained. In the experimental process, the "nejayote" was introduced in a 100 mL hydrothermal reactor under the conditions established by a 2^3 factorial design, and solid and liquid phase obtained were characterized. The results showed that the experimental conditions that enhaced the hydrochar yield were a temperature of 240°C, residence time of 18 hours, and a pH value of 2. The obtained hydrochar yield was 35.77%, which is similar to those reported for other hydrochar produced from biomasses. Also, the results show that the yield of the solid decreases when temperature and pH value increases. Nevertheless, at low yields the amount of fixed carbon present in hydrochar increases, improving its quality. Hydrochar obtained was tested as an adsorbent, with promising results. Furthermore, roughly 60% of the liquid fraction was recovered, and findings indicate the presence of valuable chemicals precursors. Therefore, hydrothermal synthesis could be considered a sustainable strategy for the management of "nejayote", by providing a route for the production of hydrochar and other chemicals from an abundant waste that has not been utilized for this purpose.

Investigation on Addition of Neodymium Magnets in Citric Acid Leaching of Spent Lithium-Ion Cells.

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The development of lithium-ion batteries has brought a revolution in electric devices. However, a growing number of electronics and electric cars pose a severe waste management challenge due to primitive lithium-ion battery recycling methods. For this reason, strong organic acid hydrometallurgical leaching received considerable attention due to its biodegradability and zero production of toxic byproducts. Citric acid, although an excellent choice from a sustainability standpoint, has not been thoroughly investigated as a leaching reagent due to its low leaching efficiency of 80%; whereas,

stronger and more expensive methanesulfonic acid was able to achieve a leaching efficiency of 99.5%. However, in this study, the use of different configurations of N52 neodymium magnets in citric acid leaching was studied to examine its effect on the leaching of lithium and cobalt from $LiCoO_2$ lithium-ion batteries. It was proven that the addition of 25 N52 neodymium magnets in citric acid leaching was able to increase the leaching efficiency of cobalt by approximately 15%. With the addition of N52 neodymium magnets, citric acid leaching efficiency of cobalt was able to achieve 96%, close to that of methanesulfonic acid, making citric acid a competitive candidate for a leaching reagent. Considering the price discrepancy of 4200% between citric acid and methanesulfonic acid and as citric acid can also be easily obtained from fruit waste, citric acid leaching using N52 neodymium magnets can make the battery recycling process cheaper, eco-friendlier, and more sustainable.

Green Adsorbents for Effective Removal of Dyes: A Review

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Abstract Text:

Many industries produce an important class of pollutants (dyes) such as dyestuffs, textile, paper, and plastics, use dyes in order to color their products and also consume substantial volumes of water. As a result, they generate a considerable amount of colored wastewater. To combat the pollutants proper treatment is required for the reuse/ recycling of the precious limited water resource. The treatment facilities are difficult and also expensive. So there is an increased demand for innovative, low maintenance and energy-efficient technology for water treatment. To remove certain classes of pollutants from waters, the adsorption process is used for those that are not easily biodegradable. This review paper introduced a term green adsorbent, it is meant the low-cost materials originated from agricultural waste sources and by-products i.e. waste fruits peels, vegetables and describe their characteristics, limitations, and advantages. It has also highlighted the practical utility of green adsorbents for the effective removal of dyes and their possible uses in the treatment of industrial effluent.

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CODE OF CONDUCT

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