
IWA
the international water association
YOUNG WATER PROFESSIONALS CANADA
2nd Canadian IWA YWP Conference
Leading from the Future
June 1 to 3, 2023
Vancouver, BC

CONFERENCE ORGANIZING COMMITTEE

Dr. Farokh L Kakar

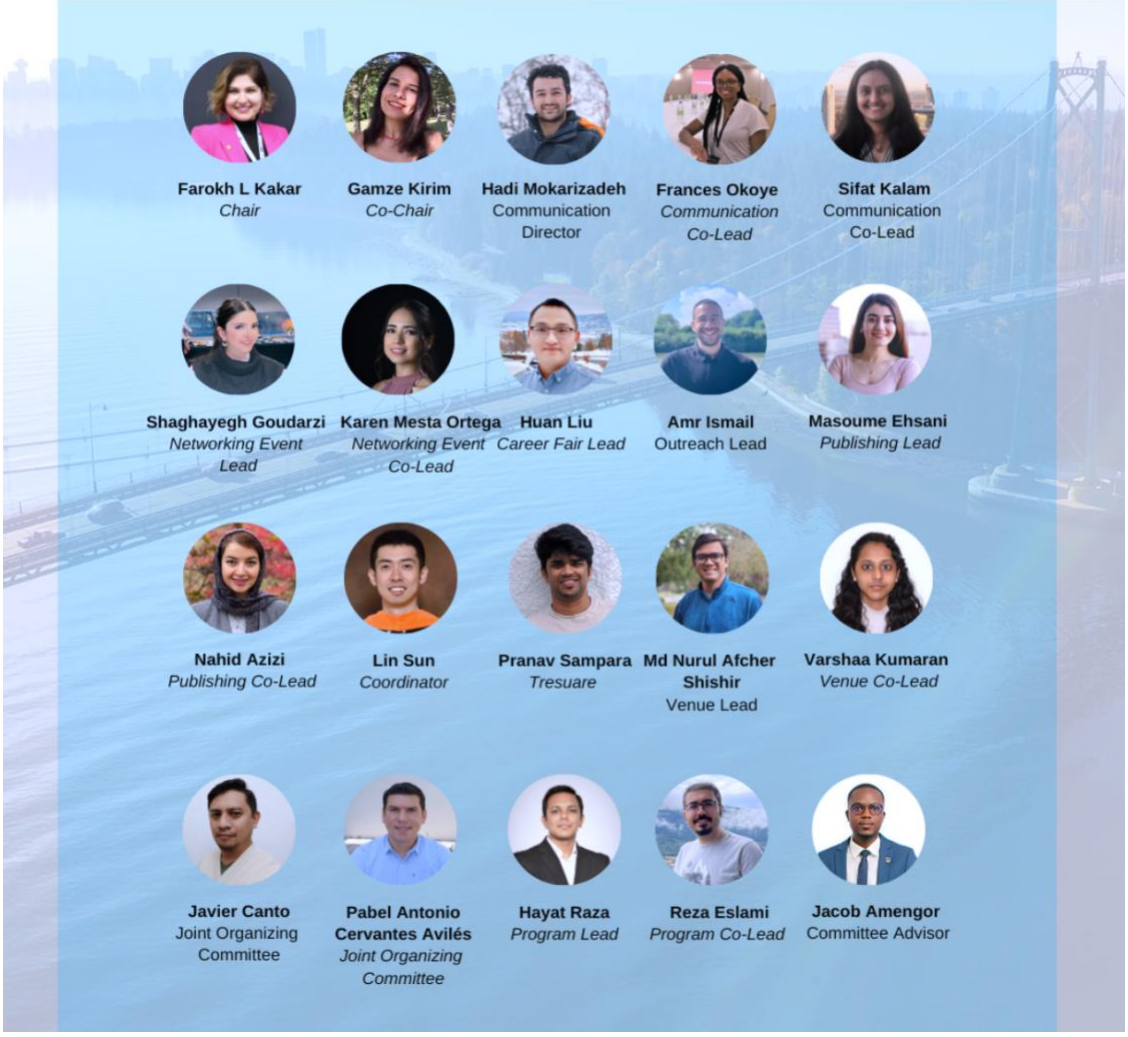
Environmental Engineer at Brown and Caldwell,
Founder of Blue College of Water and Technology

Conference Chair

Dr. Gamze Kirim

Post-doctoral Researcher at Western University,
Coordinator at Ontario Water Consortium

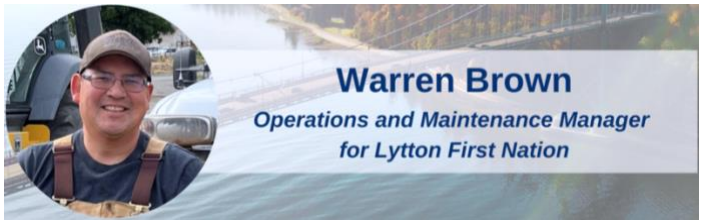
Conference Co-Chair



CONFERENCE PROGRAMMING COMMITTEE

CONFERENCE VOLUNTEERS

KEYNOTE SPEAKERS



Warren Brown is an Operations and Maintenance Manager for Lytton First Nation. Lytton is located in British Columbia (BC), roughly 4 hours north of Vancouver. He currently manages a crew of 10 staff members, Band Buildings, 30+ km of roads and 12 Water Systems.
Warren served the BC Ambulance Service as an active Paramedic for 16 years. In 2010, he was part of the first "all First Nations" cohort to obtain a diploma in Water Treatment Technology from Thompson Rivers University in 2010. He received recognition for being the Top Student during the fourth year of the program.
In 2021, Warren worked through the Lytton fire that consumed about 90% of the town, and again in 2022, when a fire broke out on the West side of Lytton, consuming 6 more Band homes. As part of a four-person team, he kept the local water systems operational without power using generators and gravity.

Awards and Nominations:

- EOCP Water Operator of the Year (2018)
- Water Canada, Water Operator and Water Steward of the year (2021)
- Nominee for National First Nation Water Leadership Award (2022)

Paola Gordon Luna is a natural resources management specialist with more than ten years of experience collaborating with national and international organizations in the formulation, planning, execution, monitoring, and evaluation of projects on issues related to integrated management of water resources, water footprint, innovation, adaptation to climate change, and technical and operational strengthening of water, sanitation, and solid waste services providers. Currently, she coordinates the Research and Development Network of the Water and Sanitation Observatory for Latin America and the Caribbean. At the Inter-American Development Bank (IDB), she provided technical assistance, training, and support with financing mechanisms to governments seeking to increase the efficiency of drinking water provision, improve sanitation and solid waste services, develop integrity and transparency assessments, and design strategies for the conservation of watersheds and the

reduction of food waste. Previously, she was responsible for coordinating the Water Network for Latin America and the Caribbean at the Tecnológico de Monterrey and the National Water Prize for the Stockholm Junior Water Prize. She has also collaborated with USAID, the World Bank, and the National Development Foundation in projects related to innovation and capacity strengthening of public and civil society institutions in the water sector and citizen participation.

Ms. Gordon holds a bachelor's degree in Microbiology from the University of Panama, a Master of Science in Natural Resource Management with a specialization in Integrated Watershed Management from the University of Guadalajara, and a Professional Certificate in Project Management from the University of Utah. She is the author of the massive online course "Water Footprint: a comprehensive look at the use of water" at the Tecnológico de Monterrey, which has registered more than seven thousand enrolments. In 2022 she was recognized as a leading opinion columnist for the Ibero-American Scientific and Cultural News. Also, she has been awarded multiple recognitions throughout her academic and professional career, including the 2019 MujerTec award in the Transformative Power category and the 2003 Violet Richardson award for Leading Women in the Americas.

Panelists

Unleashing the Potential of Water Professionals: Navigating Career Paths in Academia, Industry, Government, and Utility

Description:
What are the options for my career after graduation? This is a question of any undergrad or grad student asks themselves without a clear answer since each individual has different goals, vision, personality, and skillset. We have gathered water leaders who have been through this journey, chosen their career paths, and have become leaders. During this panel discussion, you will learn how they choose their career path. How can you choose which path to go and rise to leadership? What were the criteria, challenges, and opportunities for these leaders to get here and achieve their goals?

John Balanko, President & CEO, Quest Water Global, Inc.
John Balanko, President & CEO of Quest Water Global, Inc., is an experienced corporate executive and serial entrepreneur with vast international experience. John is a Canadian/US dual citizen andresides in West Vancouver, BC with his family. He enjoys actualizing vision, identifying opportunities, introducing new technologies, implementing strategies, and negotiating strategic alliances & global partnerships. John, a passionate 'Water for All' optimist, is on an all-consuming mission to help create a brighter future for people in underserved communities by providing access to safe, affordable water on a global scale. Mr. Balanko co-founded Quest Water Global, Inc., a socially responsible, innovative water solutions company that provides sustainable and environmentally sound decentralized solutions to water scarce regions. Quest uses proven technologies to create economically viable, turnkey products that address the critical shortage of clean drinking water.

Dr. Pierre Bérubé, Professor, University of British Columbia

Dr. Pierre Bérubé is a Professor in the Department of Civil Engineering at the University of British Columbia. He has over 25 years of research and consulting experience in water quality assessment and treatment, with particular emphasis on membrane and other filtration related technologies. His work has generated new research tools, and in partnership with industry, new processes and products that have become standards in the field. He serves on the board of the Canadian Association on Water Quality and is a member of the Management Committee of the IWA Specialist Group on Membrane Technology.

Miles Yi Ph.D., P.Eng., Senior Principal, Business Center Practice Leader, Water

Miles is a Practice Leader in Stantec's Water Business Unit. He holds a PhD in Environmental Engineering from UBC. Miles has designed and delivered water and wastewater projects around the globe for the last 20+ years. His experience includes all aspects of the project and program lifecycles, from technical planning, funding, delivery strategy, business case, governance, decision-making, to design, construction, commissioning, operation and asset management.

Lillian Zaremba, Program Manager, Metro Vancouver

Lillian Zaremba is an environmental engineer with 20 years of experience in the fields of water, energy and climate. As Program Manager of Collaborative Innovations at Metro Vancouver, Lillian leads a team that seeks to close the carbon cycle and improve the sustainability of the wastewater system. In prior roles at Metro Vancouver, Lillian managed the biosolids program, developed projects that recover energy from the wastewater and water systems, and led climate adaptation studies.

Chairs, Co-Chairs, and Guest Speakers

Dr. Elsayed Elbeshbishy

Dr. Elsayed Elbeshbishy is an assistant professor at Toronto Metropolitan University since 2015. For more than 15 years, he has worked in various engineering projects both nationally and internatonally. Dr. Elbeshbishy's areas of expertise include and not limited to anaerobic digestion, biohydrogen production & fermentation process, advanced oxidation processes, and solid waste management. He is collaborating with different industries and municipalities for developing new technologies for value-added products recovery from wastes.

Dr. Kati Bell

Dr. Bell has over 25 years of professional and research experience in water, wastewater, and reuse. She is internationally renowned for her applied research and innovation, advanced technical expertise, and thought leadership. Throughout her distinguished career, Dr. Bell has led the development and introduction of new technologies to the U.S. market, many of which have revolutionized the urban water cycle.

Dr. Cigdem Eskicioglu

Dr. Cigdem Eskicioglu is a Professor at Natural Sciences and Engineering Research Council of Canada (NSERC)/Metro Vancouver Senior Industrial Research Chair in Advanced Resource Recovery from Wastewater in the School of Engineering at University of British Columbia (UBC)'s Okanagan Campus in Canada. She is internationally recognized for her research in developing new bioreactor technologies for maximizing energy (i.e., biomethane and biohydrogen) and for resource recovery from organic waste, particularly wastewater sludge.

Nicole Morris

Dr. Majid Mohseni

Dr. Madjid Mohseni is a Professor of Chemical and Biological Engineering at the University of British Columbia, and an expert in drinking water quality and treatment. As the Scientific Director of RES'EAU-WaterNET, an NSERC Strategic Network of multiple universities and public and private organizations in North America, he dedicates his energies to developing innovative solutions that serve the unique challenges faced by Indigenous and rural communities, especially regarding safe drinking water. RES'EAU's award winning Community Circle Problem Solving Model resulted in the lifting of several decades-old boil water advisories.

Dr. Dean Shiskowski

Dr. Dean is a wastewater-focused environmental & process engineer who has over 25 years of experience in a wide variety of environmental engineering projects for municipal and industrial clients in both the wastewater and water sectors. He is an Adjunct Professor of Civil (Environmental) Engineering at the University of British Columbia and a member of the Water Environment Federation Municipal Resource Recovery Design Committee and its Wet-Weather Working Group.

Dr. Parisa Chegounian

Dr. Parisa Chegounian is a process engineer with over 6 years of experience in integrating business and science and developing practical solutions in regulatory driven environments. As Scientific Innovation Project Coordinator with Metro Vancouver, Parisa's work primarily focuses on bridging research and business for pilot testing and commercialization of projects involving the intensification of liquid and solid processes in wastewater treatment, biogas cleanup and utilization, hydrogen production, and resource recovery. Previously, Parisa worked at Metabolik Technologies, a UBC spin-off that developed a biotechnology platform based on her PhD research and was later acquired by a large international company. Parisa received her PhD in Chemical and Biological Engineering from the University of British Columbia.

Dr. Paul Nyangaresi

Dr. Paul Nyangaresiis Postdoctoral fellow at the Civil Engineering department at the University of British Columbia-Canada; Doctor of Engineering in Electronic Science and technology obtained from Xiamen University-China; MSc in Electronics and Instrumentation from Kenyatta University-Kenya; and BED (Physics and Mathematics) from Kenyatta University-Kenya. His research interest includes: UV light in drinking water, air and surface disinfection Validation of UV water disinfection systems UV light Emitting Diode measurement and validation microbial growth and analysis.

Andrea Clough

She specializes in helping individuals and groups with their career transitions, e.g., from graduate to new employee, employee into management (all levels), and from corporate leadership into entrepreneurships. After a successful corporate career at Microsoft and Boeing and over 10 years of well-respected expertise and experience in Finance, HR, Project Management, Strategic Integration, Business Operations, Marketing and Procurement, Andrea is the founder of Xplor to Xpand and the creator of the program (Re)Engineer Your Life, a 52-week program to discover the life you want to live and how to choose to live it. She is also the host of The Engineer Whisperer Podcast and hosts monthly Idea Parties. Her work includes corporate events (leadership workshops, All-Team offsites, Team Idea Parties), conference activities (speaking, group coaching, roundtable sessions) and both executive and 1:1 coaching. Andrea is currently writing her first book titled 52 Weeks, How I Re-engineered My Life. Andrea believes the collective work of engineers creates the biggest impact in the world. Thus, engineers help us be alive, feel alive and live life to the fullest. Her motto is Choose to Live Life Differently.

Javier de Jesús Canto Ríos

Javier Canto currently works as a full-time professor at the Autonomous University of Yucatán (UADY), impart subjects at the Anahuac Mayab University and the Technological Institute of oil and Energy, he also works as an independent hydraulic design consultor focused on urban hydraulic and hydrology, computational fluid dynamics, and dam design. He obtained his bachelor's at UADY and his Master's and Ph.D. at the National Autonomous University of Mexico (UNAM), working with the hydraulic behaviour in electrocoagulation reactors. He is currently serving as the Chair for IWA YWP Mexico and is one of the founding members of the YWP México group.

Career Fair Exhibition

Date and Time: June 1, 2023, at 4–6 pm
Location: Ponderosa Commons (Ballroom), University of British Columbia, 6445 University Boulevard, Vancouver, BC, V6T 1Z2

Exhibitors

Brown AND Caldwell

GHD

EOCP Environmental Operators Certification Program

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Formerly named Ryerson University, Toronto Metropolitan University is dedicated to creating a culture of action. They believe that education and experience go hand-in-hand. What students learn in the classroom is enhanced by real-world knowledge through internships and co-ops or amplified through zone learning, specialized minors and graduate programs.

Brown and Caldwell is a different company, with an enviable culture centred around collaboration, teamwork, and fun. They strive to be the company of choice — to their clients and partners, who benefit from their passion for delivering exceptional quality, and to their employees, present and future, who share their commitment to client service and innovation. Their employees and clients choose Brown and Caldwell again and again because the experience of working with them and working for them is unlike any other.

GHD is a global network of multi-disciplinary professionals providing clients with integrated solutions through engineering, environmental, design and construction expertise. Our future-focused, innovative approaches connect and support communities around the world, building resiliency and sustainability for generations to come.

Silver Sponsors

Metro Vancouver is a federation of 21 municipalities, one electoral area, and one treaty First Nation that collaboratively plans for and delivers regional-scale services. Its core services are drinking water, wastewater treatment and solid waste management. Metro Vancouver also regulates air quality, plans for urban growth, manages a regional parks system and provides affordable housing.

Kerr Wood Leidal Associates (KWL) is a consulting engineering firm specializing in water infrastructure. Services include infrastructure planning, modelling, design, and construction management. KWL is especially renowned for its expertise in pumping systems. The firm also provides comprehensive project management and survey services. Clients include all levels of government, heavy industry, utilities, mining, First Nations, and developers.

The Environmental Operators Certification Program has been certifying Operators and classifying facilities since 1966 to enable the prudent management of water and wastewater in British Columbia and Yukon.

Established in 1910, McElhanney is an employee-owned company that provides geomatics, engineering, geospatial, planning, landscape architecture, environmental services, and more. We have 30+ locations across Western Canada, and specialty satellite offices in Newfoundland and Labrador and Florida (USA), to service cities, communities & parks, energy & resources, and transportation sectors. We operate locally in the communities where we live and work and share staff resources from across our company.

USP Technologies a leading provider of peroxygen-based technologies and full-service chemical treatment programs for municipal and industrial water and wastewater treatment applications. Utilizing a collaborative problem-solving approach, USP Technologies delivers efficient program results.

Media Partner

ES&E Magazine provides vital information for professionals that are engaged in the design, construction and operation of municipal water and wastewater treatment systems, stormwater management, industrial/hazardous waste management and air pollution.

PROGRAM

2nd Canadian IWA- Young Water Professional Conference 2023 Day 1 (June 1)- Canada YWP Day				
	Registration			
9:00- 10:00 AM	**Opening Ceremony and Keynote Speaker Session – Ponderosa Ballroom** Speaker: Warren Brown, Operations and Maintenance Manager for Lytton First Nation **Everything Can Not Be Solved from Behind a Desk**			
10:00-10:30 AM	**Break & Coffee Service**			
10:30 AM-12:00 PM	**Panel Discussion (Canadian Leaders)- Ponderosa Bllroom** Speakers: Dr. Pierre Bérubé, Miles Yi, Lilian Zaremb, John Balanko, Dr. Farokh L. Kakar **Unleashing the Potential of Water Professionals: Navigating Career Paths in Academia, Industry, Government, and Utility**			
12:00-1:00 PM	**Lunch Break** Buffet lunch at "Gather Dining Hall" located at Place Vanier Residence, 1935 Lower Mall, Vancouver, BC V6T 1X1			
1:00-1:05 PM	**Technical Sessions (French and English)- Join the Rooms stated below**			
1:05-1:20 PM	**Technical Session 1-** Drinking Water PCN 1001 **Guest Speaker/Cahir:** Dr. Kati Bell Managing Director of Water Strategy Brown and Caldwell **Co-Chair:** Carlo Bais	**Technical Session 2-** Wastewater Systems PCN 1002 **Chair:** Dr. Elsayed Elbeshbishy Professor Toronto Metropolitan University **Co-Chair:** Karen Mesta	**Technical Session 3-** Resource Recovery PCN 1003 **Guest Speaker/Chair:** Dr. Cigdem Eskicioglu Professor University of British Columbia **Co-Chair:** Dr. Frances Amoye	**Technical Session 4-** Industrial Water and Wastewater Ponderosa Ballroom **Guest Speaker/Chair:** Nicole Morris Vancouver Island Manager - Waterworks Division EMCO Corporation **Co-Chair:** Pranav Sampara

1:20- 1:30 PM	**Extreme weather adaptation of drinking water treatment plants: A framework to evaluate and improve operational robustness** Kirti Srimani Nemani University of Waterloo	**Towards Sustainable Wastewater Treatment in the North** Hamid Boleydei Université Laval	**The Impact of Hydrothermal Pretreatment on Municipal Sludge Dewaterability** Abir Hamze, Toronto Metropolitan University (UTM)	**Developing a non-substrate specific fabrication technique for antifouling antiwetting Janus membrane for hypersaline wastewater desalination** Sifat Kalam The University of British Columbia
1:30-1:40 PM	**Optimizing backwashing for biological ion exchange removal of natural organic matter** William Chen University of British Columbia	**Removal of 17α-ethinyl estradiol (EE2) mediated by freshwater microalgae Scenedesmus obliquus** Ana Gisell Pazmino-Sosa Institut national de la recherche scientifique	**Ammonia Gas Recovery from Waste Streams Using Bipolar Membrane Electrodialysis: Performance Limiting Study and System Optimization** Aroshi Senanayake University of British Columbia	**Development of Non-fluorinated Omniphobic Membrane for Hypersaline Wastewater Desalination** Yinchuan Yang University of British Columbia
1:40- 1:50 PM	**Understanding the role of natural organic matter fractions in surface water in governing the filtration and chemical cleaning performance of aged ultrafiltration membranes used in drinking water treatment** Rahul Dutta University of British Columbia	**pH Dependent Behaviour of Nanomaterial Supplements in Anaerobic Sludge Digestion** Milad Goodarzi University of British Columbia	**Towards practical implementation of fault-tolerant control based on case-based reasoning as a fault identification tool in WRRFs** Sanaz Mohebali Université Laval	**Evaluating the performance of ceramic nanofiltration membranes to treat liquid waste by-product from a biogas generation facility** Matthew McClure McMaster University

1:50-2:00 PM	**Point-of-Use membrane filtration – Investigating recovery performance after cyclical hydration and dehydration episodes** Andrea Ninabanda Carleton University	**Optimizing a Full-Scale BNR Aeration System Using Artificial Intelligence** Celestine Monday University of Calgary	**The role of thermal hydrolysis for remediating the adverse impacts of polystyrene nanoplastics on anaerobic digestion: significance of solids content** Seyed Mohammd Mirsoleimani Azizi University of Alberta	**Research Gaps in the Digestion of Aerobic Granular Sludge** Mohamed Zaghloul Toronto Metropolitan University
2:00-2:25 PM	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**
2:25-2:35	**Break**			
2:35-2:50 PM	**Technical Session 5-** Drinking Water PCN 1001 **Guest Speaker/Chair:** Dr. Madjid Mohseni Professor The University of British Columbia **Co-Chair:** Dr. Frances Amoye	**Technical Session 6-** Wastewater Systems PCN 1002 **Guest Speaker/Chair:** Dr. Dean Shiskowski Vice President, Water Resource Recovery Associated Engineering Group Ltd. **Co-Chair:** Sifat Kalam	**Technical Session 7-** Resource Recovery PCN 1003 **Guest Speaker/Chair:** Dr. Parisa Chegounian Scientific Innovation Project Coordinator Metro Vancouver **Co-Chair:** Gisell Ana Sosa	**Technical Session 8-** Emerging Technologies Ponderosa Ballroom **Guest Speaker/Chair:** Dr. Paul Nyangaresi Postdoctoral Researcher University of British Columbia **Co-Chair:** Carlo Bias
2:50-3:00 PM	**Responding to the Iqaluit Water Crisis** Ian Moran WSP, Inc.	**Modeling and Simulation of nitrogen removal via partial nitritation anammox in membrane aerated biofilm reactor** Ahmad Shabir Razavi Western University	**Selective extraction of medium-chain fatty acid from organic waste streams using supported liquid membrane** Hiroki Fukuda University of British Columbia	**Ensemble machine learning approach for examining critical process parameters and scale-up opportunities of bioelectrochemical systems for hydrogen peroxide production** Tae Hyun (Calvin) Chung University of Alberta

3:00-3:10 PM	**Investigation of Heavy Metal Presence in the Source Water and Treated Water of a Muninicipal Water Treatment Plant** Jacob Amengor University of Calgary	**Enhancing methane production in modified granular activated carbon (GAC)-amended up-flow anaerobic sludge blanket (UASB) treating complex wastewater** Anqi Mou Univeristy of Alberta	**Resource Recovery from the Digestion and Fermentation of Six Solid Wastes** Mohamed Zaghloul, Toronto Metropolitan University	**Electrochemical oxidation of toxic per- and poly-fluoroalkyl substances (PFAS) from water** Fatemeh Asadi Zeidabadi University of British Columbia
3:10-3:20 PM	**Residence Time and Orthophosphate Impacts on Chloramine Decay, Biofilm Growth and Nitrite Formation in a Model Distribution System** Vedika Bakshi Wildred Laurier University	**Successes and Lessons Learned During Startup and Commissioning of the McLoughlin Point Wastewater Treatment Plant** Sophia Gupta AECOM	**Recovery of Xanthan from Aerobic granular sludge (AGS) wastewater systems** Manveer Kaur University of Northern British Columbia	**Photodegradation of legacy and emerging per- and poly-fluoroalkyl substances (PFAS) using VUV/sulfite process** Ehsan Banayan Esfahani University of British Columbia
3:20-3:30 PM	**Assessment of Robustness of Drinking Water Treatment Plants with respect to turbidity** N. N. Reza & Kirti Nemani University of Waterloo	**Academic-Utility Partnership to Unlock the Potential of Hydrothermal Liquefaction** David Blair Metro Vancouver	**Municipal sludge valorization via hydrothermal liquefaction: On-site treatment of process wastewater** Ibrahim Alper Basar University of Bristish Columbia	**Ozonation intensification by an integrated multiphase system** J. Mata de la Vega University of Western Ontario
3:30-3:55 PM	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**
3:55-4:00 PM	**Coffee service- Ponderosa Ballroom**			
4:00-5:30 PM	**Poster Presentation – Outside Ponderosa ballroom** Judges: Dr. Elsayed Elbeshbishy and Dr. Gamze Kirim			
	PHES-ODM: A Comprehensive, Open-Source Data Model for Wastewater-Based Epidemiology Jean David Therrien Université Laval			

	Land use an important parameter for aquifer protection Roger González Herrera, Javier Canto Ríos, Humerto Osorio Rodriguez Autonomous University of Yucatán
	Nanomaterial-Amended Anaerobic Digestion: Effect of pH as a Game Changer Milad Goodarzi University of British Columbia
	Modeling of Gasification Process for Energy Recovery from Organic Waste Ehssan Koupaie Queen's University
	Performance prediction of anaerobic co-digestion of pulp & paper and municipal sludge with food waste using machine learning algorithms Maryam Ghazizade Fard, Ehssan Koupaie Queen's University
	Biofiltration combinée du méthane et des lixiviats de sites d'enfouissement Marie Moulinier Université Laval
	Phosphorus removal from wastewaters: increase in adsorption capacity and characterization of 3 activated wood species Soureyatou Hamidou Université Laval, Investissement Québec-Centre de Recherche Industrielle du Québec (CRIQ)
4:00-6:00 PM	**Career Fair – Ponderosa ballroom**

2nd Canadian IWA- Young Water Professional Conference 2023 Day 2 (June 2)- Americas YWP Day				
9:00 -10:00 AM	**Keynote (LAC) - Ponderosa Ballroom** **Speaker: Paola Gordon Luna, Natural Resource Management Specialist** **Sustainable Development Goal 6 in LAC Countries**			
10:00 - 10:30 AM	**Break & Coffee Service**			
10:30 - 12:00 PM	**Workshop**			
	PNC 1001 Presenter: **Andrea Clough** **How to be a Great Engineer**		**PNC 1002** Presenter: **Dr. Javier Canto** **What is the "World's Good News" in 2040?**	
12:00 - 1:00 PM	**Lunch** Buffet lunch at "Gather Dining Hall" located at Place Vanier Residence, 1935 Lower Mall, Vancouver, BC V6T 1X1			
1:00 - 1:05 PM	**Technical sessions (Spanish/English) - Join the Rooms stated below**			
	Technical Session 1- Water Resources PCN 1001 **Chair:** Jacob Amengor **Co-Chair:** Kirti Nemani	**Technical Session 2-** Climate Change and Sustainability PCN 1002 **Chair:** Dr. Javier Canto **Co-Chair:** Gisell Ana Sosa	**Technical Session 3-** Wastewater Systems PCN 1003 **Chair:** Hayat Raza **Co-Chair:** Carlo Bais	**Technical Session 4-** Water Health and Governance Ponderosa Ballroom **Chair:** Karen Mesta **Co-Chair:** William Chen
1:05-1:15 PM	**Arsenic removal with biofilters using groundwater-native iron from different wells in Bangladesh** Md Annaduzzaman River Birch Global Water Inc.	**Strengthening Coastal Aquifer Resilience and Groundwater use against Climate Change Effects in the Caribbean Coast of Colombia: case of the Arroyo Grande aquifer** Dayana Carolina Chalá Diaz Universidad de Cartagena	**Multilayer structure of gel-like foulant on nanofiltration membranes purifying surface water with high dissolved organic carbon and hardness** Juan Diaz Salazar University of Manitoba	**Characterisation of faecal material from rural school sanitation systems, for its optimal valorisation and safe disposal** Yuri Ramruthan WASH R&D

1:15-1:25 PM	**Integrating Genome-Resolved Metagenomics with Trait-Based Process Modeling to Determine Biokinetics of Distinct Nitrifying Communities within Activated Sludge** Pranav Sampara University of British Columbia	**HOW TO DEAL WITH THE CONSEQUENCES OF THE OVEREXPLOITATION OF GROUNDWATER ON THE CARIBBEAN COAST: Case study in the Arroyo Grande coastal aquifer, Colombia** Monica Mieles University of Cartagena	**Treatment of Landfill Leachate using Combinatorial Methods** Anusha Atmakuri Institut National de la Recherche Scientifique	**Degradation of Efavirenz and Nevirapine using chlorination - Kinetics and effect of operational parameters** Nhlanhla Hlongwa Durban University of Technology
1:25-1:35 PM	**Determination of the best hydrogeological target for improving the success rate and productivity of boreholes in basement environments** Younaise Adeton International Institute for water and environmental engineering (2iE)	**Fortalecimiento de la cultura hídrica para la gobernanza en la gestión comunitaria del agua** Itzel Yolanda González Jóvenes profesionales y estudiantes del agua	**Impact analysis of PFDA in hydrogels with microalgae-bacteria consortium in nutrient removal during wastewater treatment** Marien Morán Valencia, Escuela de Ingeniería y Ciencias Tecnológico de Monterrey	**Tools for sustainable safe water partnerships** Karl Zimmermann University of British Columbia
1:35-1:45 PM	**Evaluation of groundwater quality for irrigation purposes using multiple graphical and indexing approaches supported with machine learning models and GIS techniques; representative case study** Mohamed Hemida Miskolc University	**MATRIZ DE GESTIÓN PARA EL ABASTECIMIENTO ANTE ESCENARIOS DE CAMBIO CLIMÁTICO** Raúl Adolfo Zapata-Castillo Autonomous University of Yucatán	**Insights into the bioremediation of perfluoroctane sulfone (PFOS) and perfluorooctanoic acid (PFOA) using activated sludge microbiome** Muyasu Grace Kibambe Tshwane University of Technology	**Navigating a Challenging a Future with Strategic Water Distribution Design and Construction** Sam Goshn Ductile Iron Pipe Research Association

1:45-1:55 PM	**EVALUATION OF SCALING AND FOULING IN LOW-PRESSURE UV AND UV LED SYSTEMS FOR USE IN RURAL COMMUNITIES** Adepeju Adeyeye University of British Columbia		**Holistic evaluation for replacing methanol with VFA in Heriksdal WWTP** Andrea Carranza Munoz SLU Swedish University of Agricultural Sciences	**Waste Reduction versus Waste Recovery; A Worldwide Future Concept** Reza Malekzadeh Toronto Metropolitan University
1:55-2:20 PM	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**
2:20-2:30	**Break**			
	Technical Session 5- Emerging Technologies PCN 1001 **Chair**: Hayat Raza **Co-Chair:** Aroshi Senanayake	**Technical Session 6-** Industrial Water and Wastewater PCN 1002 **Chair:** Dr. Javier Canto **Co-Chair:** Gisell Ana Sosa	**Technical Session 7-** Urban Water Systems PCN 1003 **Chair:** Paolo Luna **Co-Chair:** Carlo Bais	**Technical Session 8-** Wastewater Systems Ponderosa Ballroom **Chair:** Jacob Amengor **Co-Chair:** Kirti Nemani
2:30-2:40 PM	**Wastewater Respirometry for data-hungry WRRF digital twins** Karen Mesta Ortega Université Laval	**Contribución de las comunidades microbianas de agregados microalga-bacteria en la resistencia a antibióticos para el tratamiento de aguas residuales** Lizeth Guisa Morales UNAM	**Dynamic Model Development for Management of Water Distribution System** Tej Kulkarni Indian Institute of Technology	**Microbial community changes due the hydrothermal pretreatment of the thickened waste activated sludge prior to anaerobic digestion** Abir Hamze Toronto Metropolitan University
2:40-2:50 PM	**Optimising the ultrasound assisted electrocoagulation process applied for the treatment and reuse of slaughterhouse wastewater** Saif Ullah Khan Aligarh Muslim Universit	**Isolation of Heavy Metal Resistant Fungi and Response Surface Methodology for Biosorption Optimization** Victor Manuel Chávez Rivera Tecnologico de Monterrey	**Micro-Management: Insights from In-Line Bacterial Monitoring of a Drinking Water Treatment System** Fiona Webber Scottish Water	**Microbial extracellular metabolites: biomethane booster for granular activated carbon amended anaerobic reactors** Yingdi Zhang University of Alberta

2:50-3:00 PM	**Accuracy of weather prediction with Machine Learning and Decision Trees** Argely Aguilar Universidad Autonoma de Yucatan	**Study of solar photocatalysis and using LED lighting for the treatment of real wastewater: Recovery and reuse of the TiO2** Enrique Vega Sánchez Universidad Autonoma de Guadalajara	**Capillary-Driven Artificial Trees for Extreme Weather-Resistant Urban Infrastructure: Feasibility and Scalability** Keegan Parkhurst University of British Columbia	**Development of a phosphorus removal process for municipal and industrial wastewaters** Soureyatou Hamidou Université Laval, Investissement Québec-Centre de Recherche Industrielle du Québec (CRIQ)
3:00-3:10 PM	**Biological Ion Exchange: new insights on the contribution of biodegradation vs. ion exchange mechanisms** Karl Zimmermann University of British Columbia	**Gestión del agua de lluvia en un Centro Escolar ubicado en una zona suburbana en el estado de Oaxaca, México** Tania Espinosa Fragoso Centro Interdisciplinario de Investigacion para el Desarrollo Integral Regional- Unidad Oaxaca	**Coding Water Efficiency** Rachel McBrine Mott MacDonald	**Modelling the Impact of Thermal Hydrolysis Pretreatment on Sewage Sludges** Amr Ismail University of Western Ontario
3:10-3:20 PM	**Photoreactors with purple phototrophic bacteria to produce protein biomass from slaughterhouse wastewater** Juana Beatriz Duran Guanajuato University	**Resource recovery of value-added from slaughterhouse wastewater and purple phototrophic bacteria** Karla Ibarra Munguia Guanajuato University	**Assessment of effectiveness on current sewerage/ Septic tanks maintenance guidelines** Amit Gupta National institute of Fashion Technology	**Use of digestates from anaerobic digestion process as prebiotic for plant growth-promoting bacteria** Sheila Tiempo Torres UNAM
3:20-3:45 PM	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**	**Panel Discussion (Q&A)**
3:30-4:00 PM	**Break**			
4:00-5:00 PM	**Speed Friending - GSS Loft (at AMS student Nest)**			
5:00-5:30 PM	**Break**			
7:00-10:00 PM	**Gala dinner - Ponderosa ballroom**			

2nd Canadian IWA-Young Water Professional Conference 2023 Day 3 (June 3)- International YWP Day	
9:00-10:00 AM	**International Young Water Professionals Hackathon (Hybrid)** FSC 1005 (at Forest Science Centre)
10:00-10:15 AM	**Break** FSC 1005 (at Forest Science Centre)
10:15-11:45 AM	**Closing and Awards** FSC 1005 (at Forest Science Centre)

Drinking Water Session

Abstract #: CC002

Extreme weather adaptation of drinking water treatment plants: A framework to evaluate and improve operational robustness

Kirti Srimani Nemani, Sigrid Peldszus, Peter M. Huck

University of Waterloo

Abstract

"Robustness is the ability of a treatment system to achieve the desired finished water quality and deliver safe drinking water even during raw water quality upsets (1). Increasing the robustness of Drinking Water Treatment Plants (DWTPs) is an important climate adaptation tool to combat adverse raw water quality due to extreme weather events (2). This work introduces three robustness frameworks to guide DWTPs during short-term surface water quality disturbances:
a) general framework which outlines the main steps for a systematic evaluation, overall plant assessment, and improvement of robustness of a DWTP
b) parameter-specific framework which expands on the main steps of the general framework for a water quality parameter
c) plant-specific framework which shows the application of a parameter-specific framework to a DWTP
A parameter-specific framework for turbidity will be discussed in this presentation. Quantitative metrics were used to quantify the robustness of individual treatment steps and the overall plant. The turbidity framework was applied to plant A, a full-scale DWTP in southern Ontario, with a focus on historical plant data as well as experimental data simulating extremely high turbidity scenarios. The filters at plant A were found to be very robust during the period of the assessment while the coagulation-flocculation-sedimentation (CFS) steps were slightly less robust than the filters. Bench-scale experiments simulating extremely high turbidity scenarios showed that the chemical dosages currently employed at the plant performed well, even for high raw water turbidities. The results from this study show the applicability and ease of use of the proposed robustness frameworks to a full-scale DWTP, providing insights into the current state of operational robustness of plant A and areas where climate adaptation strategies are required. Future work would include further development of the quantitative metrics used for robustness evaluation and application to more DWTPs.

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1. Huck, P. M., & Coffey, B. M. (2004). The importance of robustness in drinking-water systems. Journal of Toxicology and Environmental Health - Part A, 67(20–22), 1581–1590. https://doi.org/10.1080/15287390490491891
2. IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press. Keywords: Climate adaptation, drinking water treatment, robustness"

Abstract #: DW010

Optimizing backwashing for biological ion exchange removal of natural organic matter

William Chen, Jaycee Wright, Madjid Mohseni

University of British Columbia- Chemical & Biological Engineering

Abstract

"Water treatment challenges persist for remote and small communities in Canada. Biological ion exchange (BIEX) is a cost-effective and simple method for natural organic removal (NOM) from surface water which has been implemented for small communities at pilot- and full-scale with success. (1) Backwashing is performed to reduce headloss and restore flow, but optimal backwashing procedures have not been established for BIEX. Three backwashing procedures were compared: water only, air scour, and simultaneous air and water injection (collapse pulsing). (2) Backwash tests were conducted on a field pilot system treating lake water (Cranby Lake, Texada Island, Canada) and a lab-scale pilot treating creek water (Spanish Banks Creek, Vancouver, Canada). Field pilot studies found significant increase in NOM uptake (as dissolved organic carbon), corresponding to an increase in anion (sulphate) release, for the week following air scour compared to water backwash. Backwash waste turbidity, total suspended solids (TSS), and ATP concentrations were significantly higher in air scour and collapse pulsing compared to water only backwash, confirming higher biosolids removal with air injection. Lab-scale pilot studies, however, gave slightly different results and did not show the NOM improvements observed in the pilot scale. Also, head loss accumulated more rapidly following air scour and collapse pulsing compared to water only. The results obtained from this research indicate that while use of air may improve NOM removal at industrially-relevant scale, this benefit should be weighed against potential drawbacks in system-specific analyses. Further study of air scour at pilot- and full-scale systems over multiple resin operating lives is recommended to assess applicability of study findings in other contexts.

1. K.Zimmermann, B.Barbeau, M.Dezfoolian, C.Cook, and M.Mohseni, “Biological Ion Exchange Provides DOC Removal in Small Communities,” Opflow, vol.46, no.5, pp.26–29, 2020.

2. R.Ahmad, A.Amirtharajah, A.Al-Shawwa, and P.M.Huck, “Effects of backwashing on biological filters,” AWWA, vol.90, no.12, pp.62-73, 1998."

Abstract #: DW015

Understanding the role of natural organic matter fractions in surface water in governing the filtration and chemical cleaning performance of aged ultrafiltration membranes used in drinking water treatment

Rahul Dutta

University of British Columbia

Abstract

"Irreversible changes in membrane performance and characteristics over time is referred to as 'ageing', which eventually triggers their replacement1. The extent to which membrane ageing impacts membrane filtration performance (FP) and chemical cleaning performance (CCP), and the mechanisms governing this impact, are not known. Additionally, the impact of site-specific natural organic matter (NOM) fractions in impacting FP and CCP of an aged membrane is not known. FP of a membrane determines membrane throughput, and its decline can indicate the need for frequent cleanings, leading to extended downtime. CCP determines the effectiveness of a chemical clean and can impact FP of a membrane following the clean. In addressing these knowledge gaps, the present study investigated the impact of individual NOM fractions on filtration and chemical cleaning performance of aged membranes.

Aged membranes were fouled using a bench-scale system that repeatedly cycled membranes between filtration and hydraulic backwash, mimicking full-scale operation. Filtration was performed with a synthetic feedwater of model foulants mimicking biopolymers (BP) and humic acids (HA) in NOM. Normalized permeability (NP) was monitored and analyzed as a metric for FP and CCP

Membrane age was observed to impact FP and CCP for BP, but not for HA. Monitoring NP was observed to serve as an important metric to suggest when a chemical clean should be stopped. Implications from the current study suggested that effective removal of BP need to occur by pre-treatment as membranes age and chemical cleaning protocols at full-scale need to be revised with membrane age.

Abstract #: DW007

Point-of-Use membrane filtration – Investigating recovery performance after cyclical hydration and dehydration episodes

Andrea Ninabanda, Brett Holden, Onita Basu

Carleton University

Abstract

Point-of-use (POU) microfiltration (MF) membrane filters can provide clean and safe drinking water to household in adequate quantities. However, there is a gap in the research regarding cleaning protocols as well as flowrates and flowrate recoveries. Additionally, limited studies examine declining head pressure flowrate data which is a better indicator of field usage or the impact of membrane drying and subsequent recovery. This research examines the performance of two commercially available POU MF filters. The filters were fouled with moderate TOC and hardness water as well as natural river water source to determine flowrate and the efficiency of the examined cleaning methods. The filters flowrate was monitored under conditions where the membrane was maintained hydrated or after a 5-day dry period; subsequently, recovery by different cleaning regimes was investigated. Cleaning the POU microfiltration membranes with room-temperature filtrate, 45°C filtrate with and without gentle system shaking and a vinegar solution (5% acetic acid) was investigated. Under hydrated conditions, the filters flowrate reached its highest performance and ranged between 197 ± 22 mL/min. Backwashing with filtrate at room temperature was sufficient to maintain the flowrate. On the other hand, when the filters dried out, flowrates dropped to 65 ± 35 mL/min. In this case, filtrate at room temperature did not recover the flowrate sufficiently while heated filtrate (45°C) with/without gentle shaking was found successful at recovering the filter for use. Developing easily accessible cleaning methods may assist with recommending cleaning options in community settings.

Abstract #: DW004

Responding to the Iqaluit Water Crisis

Ian Moran, Justin Rak-Banville, Charles Goss

WSP Canada Inc.

Abstract

"On October 12th, 2021, the City of Iqaluit declared a state of emergency upon discovering fuel-like products in the treated water system. This resulted in the issuance of a Do Not Consume water quality advisory that affected over 8,500 residents of the territory's capitol city.

Bottled water supply in the City's stores city dried up quickly and Iqaluit's lone hospital cancelled surgeries due to concerns about for sterilizing their medical equipment. The Territorial government flew in millions of dollars worth of bottled water, and the Canadian Armed Forces arrived in the city with a water purification system.

WSP was called to the scene in early October to assist the City in identifying the source of the contamination and implementing immediate response measures to protect the public from potentially unsafe water.

The contamination was first observed in the one of the below-ground treated water tanks. Working remotely with City Staff, the team were successfully able to isolate the contaminated tank, empty it out, and inspect the tank. However, there was no clear evidence of a contamination entry point. A number of questions remained, including how the fuel entered the tank, and what were the long-term impacts on the system.

WSP arrived in Iqaluit on October 19th to respond to these questions. During the investigation, the Team discovered a massive, sub-surface cavity beneath the WTP (which became known as ""The Void"") with an abandoned 60-year old fuel storage tank, and evidence that the fuel contents of the tank had been discharged across the entire cavity.

Within one week of their arrival, the WSP Team discovered the complex pathway the contamination took to enter the treated water supply and quickly and severed it. Soon later, water quality was restored, and consumer complaints stopped.

YOUNG WATER PROFESSIONALS CANADA
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Abstract #: DW006

Investigation of Heavy Metal Presence in the Source Water and Treated Water of a Muninicipal Water Treatment Plant

Jacob Amengor

University of Calgary

Abstract

This research seeks to find out if heavy metals are present in the source water abstracted for treatment at the Kibi and Akim Oda Water Treatment Plants (WTPs) in Ghana, and if really the detected heavy metals are present in the treated water, since the WTPs are not designed to include heavy metal removal units.

Abstract #: DW008

Residence Time and Orthophosphate Impacts on Chloramine Decay, Biofilm Growth and Nitrite Formation in a Model Distribution System

Vedika Bakshi, Mahmoud Badawy, Sigrid Peldszus, Robin Slawson, Peter Huck
Department of Biology, Wilfrid Laurier University, Waterloo, Ontario, N2L 3C5, Canada

Abstract

"Orthophosphate is a common corrosion inhibitor which is frequently applied to control lead release in drinking water distribution systems (DWDSs). In chloraminated DWDSs, orthophosphate addition is suspected to enhance monochloramine residual decay and biofilm growth. The literature to-date exploring these issues is limited and somewhat contradictory. Hence, the main goal of this study was to understand the effects of orthophosphate addition and different residence times (~ 6 and 12 days) on monochloramine decay, biofilm development and nitrification in the presence and absence of orthophosphate. Two bench-scale systems were operated in parallel, each consisting of a feed tank, 2 residence tanks, and 2 annular reactors. The first system acted as a control (without adding orthophosphate), while the orthophosphate dose of 2 mg-PO4/L was applied in the other system. Microbiological and chemical parameters such as biofilm formation potential, heterotrophic plate counts, Average Well Color Development, monochloramine, ammonia, nitrite and nitrate were continuously monitored throughout the 4-month operating period.

Results show that chloramine residuals were more stable at the lower residence time, while chloramine decay substantially increased at the higher residence time. Nitrite levels increased at the higher residence time, especially in the presence of orthophosphate, while remaining stable at the lower residence time in both systems. The results of the microbiological analysis showed that higher residence times impacted microbial growth potential, as measured by HPCs, and increased biofilm formation potential. Overall, the low residence time was found to have less of a notable impact on the chemical and microbiological parameters measured.

Findings to-date show that the addition of orthophosphate to DWDSs can have a noticeable effect on monochloramine degradation, biofilm growth, and nitrite formation. These trends should be considered when using orthophosphate corrosion inhibitors in DWDSs."

Assessment of Robustness of Drinking Water Treatment Plants with respect to Turbidity

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Abstract

Drinking water treatment plants (DWTPs) must be robust to maintain regulated water quality parameters during extreme weather events caused by severe and untimely precipitation events that can potentially increase suspended and dissolved particles in surface water bodies. Robustness is defined as the ability to meet regulatory requirements under normal conditions and deviate minimally during upsets. A robustness framework was applied to two full-scale DWTPs to assess their robustness with respect to turbidity for three scenarios: (a) baseline turbidity representing normal weather, (b) elevated turbidity representing historical precipitation events, and (c) extremely high turbidity representing future precipitation events that are beyond general experience. For evaluating scenarios (a) and (b), on-line turbidity data were provided by the two plants which have different raw water sources and treatment processes. To quantify the robustness of the affected treatment steps for turbidity removal, the turbidity robustness index (TRI) was used. No correlation was found between higher TRIs and weather events characterized by historical raw water turbidity. The overall robustness of the two plants indicated that Plant A was more robust than Plant B in general. To assess scenario (c), the full-scale coagulation and SBC process of Plant A was simulated using modified bench-scale jar tests. A factorial design experiment was conducted to determine the significant factors for turbidity removal and optimize the process. The TRI can be used as a tool to evaluate the operational regimes of DWTPs retroactively and improve the robustness of the treatment steps using the outcomes of the optimization experiments.

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Keywords: Turbidity, Robustness Index, Drinking Water.

Wastewater Systems Session

Abstract #: [WS010]

Towards Sustainable Wastewater Treatment in the North

Hamid Boleydei

Laval University, Quebec, Canada

Abstract

Water pollution has become a major problem for the rapid development of human society, and wastewater treatment is an issue of utmost importance. A significant source of environmental pollution is municipal effluents, as the most abundant type of wastewater. A considerable part of rural and decentralized regions are still waiting for appropriate treatment systems or intending to improve the performance of current systems. In these remote communities, wastewater treatment infrastructure is either unavailable or inadequate. It results in the discharge of wastewater without or with minimal treatment, leading to environmental and human health consequences. Recently, regulations across Canada have become more stringent for water quality. However, the majority of wastewater treatment lagoons which are the most common treatment systems in the North of Canada, are not able to treat wastewater to the latest Canadian guidelines and upgrading them will be costly for rural municipalities. Thus, developing efficient, practical, easy-to-operate and cost-effective wastewater technologies is necessary while adapting them to the prevailing environmental conditions. Membrane bioreactor (MBR) systems which consist of a biological reactor and a membrane filtration, can be investigated as an appropriate alternative for implementation in remote communities. This investigation aims to study, design, develop and assess an innovative MBR system in two laboratory-scale and pilot-scale phases to treat municipal wastewater in low-temperature conditions with minimum energy, consumables, and construction footprint requirements. For this purpose, a novel bacterial nanocellulosic membrane will be used to treat the sewage of Kangiqsualujjuaq village, Nunavik. Several physicochemical and biological parameters will be assessed based on the various variables and experiment conditions to evaluate the system's efficiency.

Abstract #: [WS011]

Removal of 17α-ethinyl estradiol (EE2) mediated by freshwater microalgae Scenedesmus obliquus

Ana Gisell Sosa

Institut national de la recherche scientifique, Canada

Abstract

Synthetic estrogen, 17α-ethinyl estradiol (EE2), used in birth control formulations has high bioavailability in oral consumption, however, 80% of the dose is excreted un-metabolized in feces and urine. Therefore, it is detected in different water sources such as surface, tap, drinking water, and in the effluent from conventional wastewater treatment plants. Since its removal is not achieved completely in treatment facilities, studies have shown the negative impacts in aquatic ecosystems, reporting disruption to the endocrine system of organisms causing feminization in males, perturbation to egg production and fertilization.

Microalgae-based wastewater treatment has the potential to remove different compounds from the environment, including emergent and persistent contaminants. Processes like uptake, accumulation, sorption, and biodegradation may occur. However, the degradation efficiency depends upon a variety of conditions, such as EE2 concentrations, microalgal species, cultivation media, and environmental conditions, among others. This project aims to determine the tolerance of microalgae to EE2 concentrations and their removal potential for subsequent application to treat municipal wastewater. The freshwater microalgae Scenedesmus obliquus was cultivated with 50, 100, 200, 300, 1 000, 8 000 and 22 000 µg/L EE2 for twelve days, including controls. Growth of the cultures was monitored following optical density at 680 nm and chlorophyll fluorescence (excitation and emission wavelength, 440 nm, and 680 nm, respectively). Moreover, EE2 concentrations were analyzed at the beginning and at the end of the experiments to determine the removal percentage. Preliminary results showed a significant decrease in microalgal growth as concentrations increased, while at low EE2 levels, growth was like the algal control. Moreover, for most of the concentrations tested, EE2 was reduced lower than our limit of detection (40 µg/L). Therefore, S. obliquus could potentially be used to treat EE2-contaminated effluents up to 8,000 µg/L EE2 without compromising its growth.

pH-Dependent Behavior of Nanomaterial Supplements in Anaerobic Sludge Digestion

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Abstract

Using nanomaterials as supplements in batch-fed anaerobic digestion (AD) has led to conflicting results in the literature, warranting the need for a standardized approach. Here, we investigate the role of pH in AD by performing batch biochemical methane potential (BMP) assays under two conditions: optimal initial pH (≈ 7.5) and elevated initial pH (≈ 9). We also examine the effects of synthesized nanomaterials, e.g., graphene oxide (GO), magnetite, magnetic GO, and magnetic reduced GO (MrGO), with different surface functionalities on BMP performance under these pH conditions. Our results show that the AD system is sensitive to pH, with the ultimate BMP reached much earlier at the neutral pH condition (20 days) than at the elevated pH condition (45 days). Furthermore, the effects of nanomaterials on BMPs are pH-dependent, with MrGO improving the BMP rate by 51% on the onset of plateau in methane production graph at neutral pH, while the BMP rate decreased by 14% at the same time scale at elevated pH. Our findings demonstrate the need for standardized methods and highlight the importance of closely monitoring pH in future studies on nanomaterials-amended AD systems.

Keywords: pH dependence; Anaerobic digestion; Wastewater sludge treatment; BMPs; Nanomaterials; Instability.

Abstract #: [WS014]

Optimizing a Full-Scale BNR Aeration System Using Artificial Intelligence

Celestine Monday

University of Calgary, Canada

Abstract

One of the most power sinks in urban wastewater treatment plants is the aeration system of the biological reactors which need oxygen to perform treatment, with more than 60% of the total plant power [1]. Air is constantly injected into the bioreactors using diffused compressed air or surface aeration turbines, then oxygen in that air is utilized by the bacteria for oxidizing organics and ammonia. Current practices utilize SCADA systems for monitoring the dissolved oxygen (DO) concentration in the bioreactors and controlling the aeration blowers' power to maintain a pre-determined DO setpoint [2]. In many treatment plants, the setpoint is fixed, leading to periods of over aeration and under aeration due to the diurnal wastewater loading cycles. In this research, an optimization approach aims at reducing the aeration power demand at a full scale wastewater treatment plant in Canada. A simulation model was developed using Decision Trees for predicting the air blower flow rates, which served as the objective function for a genetic algorithm optimization. The optimization was achieved by minimizing the air blower flow rates while meeting the provincial effluent requirements. Online sensor data with 10 minutes interval, between 2012 and 2022 was used for training and validating this model. This approach resulted in a 12% reduction in aeration without impacting the effluent quality. The next phase of this project is the deployment of the optimization tool at the treatment plant to test its performance in real-time.

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Keywords:
Wastewater Optimization, Wastewater Modelling, Artificial Intelligence, Decision Trees, Genetic Algorithms.

Abstract #: [WS017]

Modeling and Simulation of nitrogen removal via partial nitritation anammox in membrane aerated biofilm reactor

Ahmed Shabir Razavi

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Abstract

Partial nitritation anammox (PNA) process in wastewater treatment is a more economically feasible approach as it reduces the oxygen demand, sludge production and organic carbon requirement by 60%, 90% and 100% respectively (Wen et al., 2020). This process comes with some draw backs, anammox is sensitive to environmental condition and are slow growing microorganisms.

Membrane aerated biofilm technology, an innovative technique that enables the counter-diffusion biofilm process, was used previously to start-up PNA. The studies were limited evaluating only the potential of this technology for total nitrogen removal using the PNA process. Additionally, there are researches on modeling aspects of MABR such as oxygen transfer and the role of intermittent aeration to suppress NOB [(Zeng et al., 2020) (Gilmore et al., 2009) (Casey et al., 2000)], but the effect of critical parameters like, DO, biomass thickness and boundary layer thickness on PNA performance were not studied.

A biological wastewater process simulator, SUMO, was used to simulate the PNA process with 132 days of data from two MABRs stable operation. The simulation and experimental data results were compared using root mean square error (RMSE) and Nash-Sutcliffe efficiency (NSE) statistics.

The model was calibrated using biofilm thickness and boundary layer thickness of 100 and 60 microns respectively. Based on the calibrated model and sensitivity analysis within the studied interval, in partial nitritation, boundary layer thickness showed the highest sensitivity coefficient, where a thicker boundary layer thickness enhanced nitrite accumulation. In the PNA phase, OTR and boundary layer thickness did not significantly impact ammonia removal, however significantly changing the ammonia removal pathway.

Abstract #: [WS015]

Enhancing methane production in modified granular activated carbon (GAC)-amended up-flow anaerobic sludge blanket (UASB) treating complex wastewater

Anqi Mou

University of Alberta, Canada

Abstract

To improve the performance of anaerobic digestion (AD), incorporating granular activated carbon (GAC) in the form of self-floating GAC can be effective in enhancing methane production by promoting direct interspecies electron transfer (DIET) through syntrophic microorganisms (Yu, et al., 2021, Zhang, et al., 2020). This study focused on enhancing the performance of UASB reactors in treating complex substrates by optimizing the spatial distribution of GAC, aiming to better integrate GAC into AD system. Results indicated that when treating high solid-content wastewater at low OLR, the highest methane yield was observed for UASB supplemented with self-floating GAC (74%), where fermentation process was enhanced on the bottom layer of the reactor while the methanogenesis process was improved on the top layer of the reactor. However, the highest methane yield was achieved with a combination of settled and self-floating GAC reactor (83%) when treating low solid-content wastewater, where both settled and self-floating GAC can reduce VFA, making anaerobic process more effective. Under high OLR treating high solid-content wastewater, the combination of both settled and self-floating GAC reactor was effective and robust, where hydrolysis process and methanogenesis process were enhanced on both bottom and top layers of reactor. The DIET participants were enriched in GAC-amended reactors, especially with self-floating GAC reactors. The results demonstrated the importance of considering reactor design and organic capacity when treating different types of wastewater.

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Keywords: direct interspecies electron transfer, microbial community, specific methanogenic activity.

Successes and Lessons Learned During Startup and Commissioning of the McLoughlin Point Wastewater Treatment Plant

Sophia Gupta

AECOM, Canada

Abstract

The McLoughlin Point Wastewater Treatment Plant (MPWWTP) is a 108 MLD ADWF tertiary treatment facility servicing the Greater Victoria Region in British Columbia, Canada. The MPWWTP was commissioned and brought into service in Autumn 2020, replacing the Region's existing preliminary treatment system in advance of the Canadian Federal Wastewater Systems Effluent Regulations (WSER) deadline of meeting updated regulatory water quality effluent requirements by the end of 2020. The successful commissioning and acceptance testing of this project, delivered on schedule, was largely due to the collaboration, commitment, and perseverance of the AECOM Graham Joint Venture (AGJV) design-build project team.

The commissioning effort took place over a compressed six-month timeline in the height of the COVID-19 pandemic, which brought unique challenges such as border restrictions which prevented equipment vendor technicians based in the United States and Europe from visiting site during start-up. Coupled with technical challenges surrounding compact plant site location, decentralized facilities for screening and residuals handling, combinations of treatment technologies in series, and stringent regulatory consent requirements, these hurdles incited fast-paced problem-solving, collaboration, and real-time learning for the project team. The lessons learned are widely applicable to full-scale commissioning efforts and will be considered in future projects.

Abstract #: [WS020]

Academic-Utility Partnership to Unlock the Potential of Hydrothermal Liquefaction

David Blair

Metro Vancouver, Canada

Abstract

Wastewater utilities are exploring novel thermochemical processes as alternatives to traditional solids management. Hydrothermal liquefaction (HTL) offers a solution that reduces the volume of land-applied solids and creates valuable low-carbon fuels, along with potential opportunities to recover nutrients and other resources. Metro Vancouver is planning the world's first pilot-scale continuous flow HTL facility using wastewater sludge as a feedstock1 and engaged the Bioreactor Technology Group (BTG) at UBC Okanagan, by co-funding an NSERC Industrial Research Chair2, to conduct research into HTL integration.

HTL products are liquid hydrocarbons (biocrude), aqueous co-product, and solid precipitate (hydrochar). Biocrude will be further upgraded at a refinery. The other products need to be integrated into existing Wastewater Treatment Plant (WWTP) processes, beneficially used offsite, or disposed as a last resort. Metro Vancouver sought a research partner to better understand the challenges and opportunities of HTL and prepare for integration of the HTL pilot into its WWTP. BTG research includes optimizing HTL operation for biocrude quantity and quality, characterizing the products and potential for resource recovery, and identifying toxic compounds and limits for integration of the aqueous co-product into WWTP processes. The research is reducing the risks of Metro Vancouver's pilot operation and future full-scale implementation of HTL, while advancing the state of science.

The academic-utility partnership is a promising model for developing local expertise, focusing applied research, allowing a risk-adverse industry to explore innovation, and leveraging available funding. This project exemplifies a sustainable future based on the strengths of researchers and utility collaboration.

Abstract #: [DW013]

Multilayer structure of gel-like foulant on nanofiltration membranes purifying surface water with high dissolved organic carbon and hardness

Juan Fernando Diaz Salazar, Beata Gorczyca,

University of Manitoba

Abstract

Surface waters with high concentrations of dissolved organic carbon (DOC) and hardness, such as those common in the Canadian Prairies, cause significant fouling of Nanofiltration (NF) membranes. DOC and hardness can promote the formation of a gel-like foulant that decreases water flux, increasing the operational costs. This research aims to provide a deeper understanding of this foulant by characterizing the organic substances forming it. Water and fouled NF membrane samples, collected from an Ultrafiltration (UF) and NF pilot plant supplied by a high DOC and hardness surface water were analyzed for DOC, carbohydrates and peptides (colorimetry), UV and fluorescence spectrophotometry, and size exclusion chromatography. Results show that NF foulant is 90% organics with hydrophobic substances preferentially retained. The gel-like layer of the foulant scraped from the membrane indicated high concentrations of carbohydrates with some physical-chemical properties (e.g., low UV and SUVA) related to hydrophilic substances. Conversely, foulant that remained on the membrane (after scraping) displayed opposed and hydrophobic characteristics. This led to speculation that foulant may have a bilayered structure with a hydrophobic inner layer (i.e., humic substances) and a hydrophilic outer layer consisting of low molecular weight compounds and transparent exopolymer particles (TEP) forming a hydrogel. This theory highlights the possibility that aquatic humic substances and TEP are formed from organic precursors by spontaneous abiotic processes. The knowledge about freshwater-NF membrane system interactions is limited. This research advances our knowledge of the methodologies suitable to characterize TEP and organics in membrane foulants and their role in membrane fouling.

Abstract #: [IW004]

Treatment of landfill leachate using combinatorial methods

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Institut national de la recherche scientifique

Abstract

"Landfilling is the most familiar and easy way to dispose solid waste, generally received via wastes from municipal near to a landfill. Landfill leachate (LFL) is formed when rainwater passes through the waste placed in landfills and consists of several dissolved organic materials, for instance aquatic humic substances (AHS), volatile fatty acids (VFAs), heavy metals, inorganic macro components, and xenobiotic organic matters, highly toxic to the environment. Various methods have been used to treat LFL over the years, such as physical, chemical, biological, physicochemical, electrical, and advanced oxidation methods. This study focuses on the combination of biological and electrochemical methods- extracellular polymeric substances(EPSs) and electrocoagulation(EC). This study utilised waste substrates such as activated sludge, crude glycerol, and waste cooking oil for the production of EPS using fermentation technology. A comparison of different scenarios for the treatment of landfill leachate is presented- such as using EPS alone as bioflocculant, EPS and EC with EPS being the 1st stage and EPS and EC with EC being the 1st stage. The work establishes the use of crude EPS as a bioflocculant for the treatment of landfill leachate and wastewater from a site near a landfill along with EC being successful in removal of some major pollutants such as COD, turbidity, total suspended solids. Preliminary results suggest unwashed sludge fortified with crude glycerol produced EPS of higher concentration (11.4 g/L) as compared to unwashed sludge with pure glycerol (8.3 g/L) at 96th hour of fermentation. EPS as bio-flocculant can be considered an appropriate alternative to chemical flocculant, attributed to their good flocculation activity, economic impact and sludge settling among others. A combination of these two methods is to be explored more for the complete removal of all pollutants from landfill leachate.

Keywords: Landfill leachate, extracellular polymeric substances, electrocoagulation, bioflocculant."

Abstract #: [WS009]

Impact analysis of PFDA in hydrogels with microalgae-bacteria consortium in nutrient removal during wastewater treatment

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Abstract

The analysis of the impact of the presence of per- and polyfluoroalkyl substances (PFAS) during the biological treatment of wastewater is necessary for their persistence, toxicity and bioaccumulation capacity. For this research, the impact of perfluorodecanoic acid (PFDA) on nutrient removal during wastewater treatment was analyzed using hydrogels containing biomass (HB), activated carbon (AC) (HC) or both (HBC). The performance of hydrogels was analyzed according to the elimination of ammonium nitrogen (NH4-N), nitrate nitrogen (NO3-N), phosphate (PO4), chemical oxygen demand (COD) and fluoride (F-) in a period of 72 h. Results indicated that the presence of PFDA did affect the removal of nutrients from the media, especially hydrogels with biomass, resulting in poor performance. The initial concentration of NH4-N was 35.64 mg/L, HB was the hydrogel with the lowest removal (66.27%). The hydrogel with the lowest NO3-N production was HBC (27.4 mg/L). On the other hand, PO4 removal was 29.16% and 4.16% of HBC and HB, respectively. COD increased in all hydrogels, which can be attributed to a possible leaching of the components of the hydrogel. Finally, the hydrogel with the highest F- removal from the medium was HC (38.5%). AC, as an adsorption medium, may have contributed to the efficiency of HC during the experiment. It was concluded that the presence of PFDA in the aqueous media did impact overall hydrogels containing biomass in nutrient removal, due to its toxicity over microalgae and bacteria. Future work includes the incorporation of advanced processes to improve wastewater treatment with hydrogels in the presence of PFAS.

Abstract #: [WR006]

Insights into the bioremediation of perfluoroctane sulfone (PFOS) and perfluorooctanoic acid (PFOA) using activated sludge microbiome

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Abstract

In this study bacteria community from the activated sludge during bioremediation experiment was used to assessed the removal of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in aqueous solution. The bioremediation experiment of these compounds was investigated by a batch experiment. All kind of parameters affecting the bioremediation experiment of PFOA and PFOS, including the initial pH, initial inoculum and initial concentration were studied; thus, the Box-Behnken design and the effects of the three parameters were evaluated. The results and several coefficients showed that the obtained model was acceptable for predicting the PFOA and PFOS removal using activated sludge microbiome. Optimum conditions were determined by means of variance analysis (ANOVA), using Box-Behnken design under response surface methodology developed by the use of Design Expert 13.0.1.0 software program. According to the results obtained by the application of response surface method, a two-factor interaction (2FI) model and a linear model were respectively developed for PFOA and PFOS. From the analysis of variance (ANOVA), the most influential factor on each experimental design response was identified. The predicted removal efficiency after the optimization of different parameters was found to agree satisfactory with the experimental values. The optimum conditions for removal efficiency of PFOS using activated sludge microbiome were found as follow: pH (9.00), initial concentration (99999.79) and initial inoculum concentration (0.32). For the PFOA were also reported as follow: pH (8.99), initial concentration (99999.89) and initial inoculum concentration (0.279). At this optimum condition, the removal efficiency of PFOA and PFOS were found to be 64.65 % and 79.07, respectively; with a desirability value of 0.904 and 0.970 for PFOA and PFOS, respectively. The experimental values agreed with the corresponding predicted values.

Abstract #: [RR004]

Holistic evaluation for replacing methanol with VFA in Heriksdal WWTP

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Abstract

Due to the high eutrophication in the Baltic Sea, the discharge limit for WWTPs in Sweden will be 6mgTN/L and 0.20mgTP/L; therefore, Heriksdal WWTP (Stockholm) is upgrading to MBR with pre- and post-denitrification. The use of methanol in post-denitrification is calculated to be around 2000 - 2500 tonMeOH/y by 2040, influencing operational costs and CO2 emissions, not to mention the risk that methanol might become unavailable in the near future.

This study presents a holistic approach to evaluating the feasibility of replacing methanol with a carbon source produced within the WWTP through fermentation of sludge (PS and WAS), and food waste. A mass balance (N, C, P) of Henriksdal WWTP, including the sludge line and biogas production, was prepared using design values for the year 2040, including methanol as a carbon source. The data from two pilots (fermentation reactors and MBR line[1]), denitrification tests and biomethane potential (BMP) tests were used for calculating how the balances of the plant would change if methanol were to be replaced with the fermentation carbon source. The loss of biogas production was also investigated.

In one scenario: mixed substrate of 25%PS and 75%FW, the fermentation pilot achieved yields of 338gCODs/kgVSin, and 285gVFACOD/kgVSin. VFA/sCOD was 65%, and carbon consumption for denitrification was 7gCOD/g NO3removed in lab tests, and 2-7gCOD/g NO3removed in pilot trials, depending on the dose. This means 15% of PS in Henriksdal and 21368kgVSFW would be needed to produce enough carbon source. Furthermore, biogas production would be reduced by ~3-6%. This scenario could be feasible, pending the cost-benefit analysis.

Microbial community changes due the hydrothermal pretreatment of the thickened waste activated sludge prior to anaerobic digestion

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Abstract

Anaerobic Digestion (AD) is a well-established biological process for sewage sludge treatment. The majority of water resource recovery facilities (WRRFs) implement AD to stabilize and reduce the large volume of the produced sludge to comply with the Environmental Protection Act (EPA) standards. Thickened Waste Activated Sludge (TWAS) is rich in complex organic compounds bounded by extracellular polymeric substances (EPS), making the hydrolysis stage a rate-limiting step in the AD process. Hydrothermal pretreatment (HTP) has been recognized as one of the most effective in improving the process of AD. However, there is still limited information in the literature on optimum HTP conditions and its impact on the microbial community and dewaterability of the digestate. In this presentation, the impact of the HTP on the microbial community as well as the dewaterability of the digestate will be presented.

Abstract #: [WS018]

Microbial extracellular metabolites: biomethane booster for granular activated carbon amended anaerobic reactors

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Abstract

Microbial metabolites of small molecules (e.g., signaling molecules, cofactors, vitamins) play vital roles in mediating microbial interactions and affecting reactor performance in anaerobic digestion (AD). However, our understanding on microbial metabolites in AD is still limited due to the complexity of microbial communities and the multitude of genes involved in metabolite assembly, transport and regulation. Our recent study identified microbial metabolites generated within a granular activated carbon (GAC) amended up-flow anaerobic sludge blanket (UASB) can stimulate downstream microbial activities (Zhang et al., 2023), which may underline an important pathway linked to the biosynthesis of small molecule metabolites (i.e., vitamins and amino acids), previously ignored. Our study further explored and demonstrated the impacts of metabolites with various ranges of molecular sizes on AD microbial community dynamics, activities and biomethane yields. Two laboratory-scale UASBs were operated for over one year, with GAC added into one UASB. The effluents of the two UASBs were collected, and metabolites in the effluent were separated by their molecular weights. Large molecules (Mr > 5000) and small molecules (Mr < 5000) were used as stimulators for downstream anaerobic microorganisms, respectively. Small molecules in the effluent significantly improved microbial activities and increased methane production by 20%. Further, microbial metabolites present in the UASB effluents were analyzed by various analytical methods, and biosynthetic genes and related clusters in AD were analyzed to deepen the understanding of microbial ecology and synthetic biology. Our study revealed that microbial extracellular metabolites represent a key mechanism in promoting biomethane yield in anaerobic digestion reactors.

Keywords: extracellular metabolites, granular activated carbon (GAC), anaerobic digestion.

Reference

Zhang, Y., Zhang, L., Sun, H., Yuan, Y., Liu, Y. 2023. Granular activated carbon stimulated microbial extracellular secretions in anaerobic digesters: An egalitarian act and beyond. Chemical Engineering Journal, 456, 140850.

Abstract #: [WS005]

Development of a phosphorus removal process for municipal and industrial wastewaters

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Abstract

The Quebec Government is tightening phosphorus discharge requirements. Conventional phosphorus removal processes require maintenance and are expensive. There are only two passive phosphorus removal technologies certified in Quebec by the Bureau de Normalisation du Québec (BNQ). Therefore, it is necessary to target a robust and low-cost phosphorus removal process based on natural material. Research (1, 2) conducted at Investissement Québec-CRIQ focused on the development of a passive phosphorus capture process (Techno-P) characterized by biofilters with active media based on wood impregnated with iron hydroxide. These studies have shown that anaerobic columns were able to maintain phosphorus concentration in the effluent below 0.3 mgP/L through adsorption and precipitation by reductive dissolution. The objective of the study is to increase the dephosphatation capacity of Techno-P technology. Three wood by-products (yellow birch, red oak, and softwood mixture) were harvested from a sawmill. A specific method was applied to obtain activated wood media. Different concentrations of FeCl3, contact times and liquid/wood ratios were tested during the impregnation process. Results indicate that the maximum phosphorus adsorption capacity differs according to the wood species tested and a greater phosphorus adsorption capacity is achieved with a higher FeCl3 dose and liquid/wood ratio. Figures 1 and 2 show that Langmuir and Freundlich isotherms fit the data and were suitable to describe phosphorus adsorption capacity of yellow birch impregnated with FeCl3. The next stage is to conduct an experimental set-up of 6 biofilters filled with activated yellow birch and fed with a synthetic solution containing phosphorus and nitrate.

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Keywords: dephosphatation, adsorption, biofilters.

Modelling the Impact of Thermal Hydrolysis Pretreatment on Sewage Sludges

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Abstract

The efficacy of thermal hydrolysis at the full-scale is a function of the aerobic solids retention time (SRT) of the activated sludge (AS) system. The increase in the aerobic SRT is associated with an increase in the inactive fraction of the biological sludge, including endogenous decay products which are hardly biodegradable except under starvation conditions. In this study, the impact of biodegradability and thermal hydrolysis pretreatment (THP) where investigated on sewage sludge produced at different aerobic SRTs of 5, 10, 15 d in a Modified Ludzack-Ettinger (MLE) configuration and 20, 30, 60 d in a Carrousel configuration. A fraction of the endogenous products is converted with THP to particulate materials, more favourable for microbial consumption. The solubilization of a mixture of primary sludge (PS) and thickened waste activated sludge (TWAS) is lower relative to TWAS only, since two of the main components of PS (i.e. starch and cellulose) do not degrade at common THP temperatures of 160–180 ˚C. Methane yields with THP increased as the SRT of the AS system. At a 60 d SRT the methane yield increased by 262%, almost equal to that of the raw sludge produced at a 10 d SRT. Improvements in anaerobic biodegradability with THP stem from improvements associated with the TWAS not PS; primarily, the conversion of endogenous products which unlocks methane potential, while the improved kinetics allow for improved degradation at shorter anaerobic SRTs.

Abstract #: [RR008]

Use of digestates from anaerobic digestion process as prebiotic for plant growth-promoting bacteria

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Abstract

T Anaerobic digestion as a treatment of organic waste has been successful. In addition to obtaining biogas, which can be used as biofuel, digestates were also obtained, which can be used as a soil conditioner, biofertilizers, and prebiotics. This work aimed to evaluate different digestates as a culture medium for plant growth-promoting bacteria. Four dilutions were considered for two different digestates (0.3%, 1%, 3%, and 5%), in which bacteria Streptomyces venezuelae, Bacillus megaterium, and Bacillus thuringiensis were inoculated and incubated for 72 hours at 36 °C and 105 rpm. Subsequently, cell growth was determined by optical density. In addition, a combination of the digestates with a nutritive culture medium was carried out for each test to carry out a growth control and determine if the digestate promotes the growth of the bacteria in the same medium. The bacteria have shown better growth in one of the digestates with the 5% dilution, followed by 3%, 1%, and 0.3%. While in the other digestate little growth was demonstrated, possibly due to the inhibition of some toxic compound. So far, it would be possible to say that digestates could promote the growth of these bacteria, which in turn have a significant impact on agriculture, seeking to counteract the deterioration of soils due to the excessive use of chemical fertilizers and pesticides.

Keywords: anaerobic digestion, biofertilizer, plant growth-promoting bacteria, agriculture

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Möller, K., & Müller, T. (2012). Effects of anaerobic digestion on digestate nutrient availability and crop growth: A review. Engineering in Life Sciences, 12(3), 242-257.

Recourse Recovery

Abstract #: [RR011]

The Impact of Hydrothermal Pretreatment on Municipal Sludge Dewaterability

Abir Hamze[1*], Mohamad Zaghloul[1], Bipro Dhar[2], Elsayed Elbeshbishy[1]

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Abstract

Anaerobic Digestion (AD) is a well-established biological process for sewage sludge treatment. The majority of water resource recovery facilities (WRRFs) implement AD to stabilize and reduce the large volume of the produced sludge to comply with the Environmental Protection Act (EPA) standards. Thickened Waste Activated Sludge (TWAS) is rich in complex organic compounds bounded by extracellular polymeric substances (EPS), making the hydrolysis stage a rate-limiting step in the AD process. Hence, intensive work was performed to disintegrate EPS using different pretreatment methods that make the intracellular content available to the microorganisms. Sludge pretreatment can be chemical, physical, biological, or thermal. Among these pretreatment methods, hydrothermal pretreatment (HTP) has been recognized as one of the most effective in improving the process of AD. However, there is still limited information in the literature on optimum HTP conditions for improving the dewaterability of biosolids. This study focuses on investigating: (1) the difference between raw and pretreated sludge in a semi-continuous AD reactor, and (2) the difference in dewaterability of the AD biosolids for raw and pretreated sludge. The results showed that the biogas production of the hydrothermally pretreated TWAS was 35% higher than that of non-pretreated TWAS. The methane yield for the hydrothermal pretreatment was found to be 204 mL CH4/g TCODadded compared to 143 mLCH4/g TCODadded non-pretreated TWAS. Reactors fed with HTP sludge exhibited an improvement in biodegradability compared to reactors fed with untreated TWAS with 52% and 38%, respectively. The dewaterability test results emphasized that the HTP improved the dewaterability of ADS by 50% compared to untreated TWAS.

Abstract #: RR009

Ammonia Gas Recovery from Waste Streams Using Bipolar Membrane Electrodialysis : Performance Limiting Study and System Optimization

Aroshi Senanayake, Jongho Lee

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Abstract

Ammonia is a versatile chemical that can be used as a fertilizer and has been recognized as a possible hydrogen carrier for fuel cell vehicles. Wastewater is a promising source of ammonia, potentially supplementing the ammonia production from the conventional Haber-Bosch process. Bipolar membrane electrodialysis (BMED) combined with a membrane contactor presents a potentially effective method to recover ammonia gas from wastewater by enabling pH-swing by renewable electricity. However, the leakage of ammonia across the ion exchange membranes (IEMs) as well as the relatively low recovery, present major challenges for BMED. In our work, we identify the performance limiting factors and optimize the BMED system to address these challenges. First, we find that ammonia leaks through IEMs in gas form, resulting in a loss of this chemical and consequently a reduced recovery. Subsequently, the impact of the operating conditions (such as voltage, initial pH, and initial concentration) and system configurations on ammonia leakage and its final recovery are examined. Through varying the electrical potential applied to the system, we also find that the pH elevation by the applied potential modulates the trade-off relation between ammonia leakage and recovery. In addition, we examine the interplay between the electrical resistances across the IEMs and the solutions on the ammonia leakage and recovery. Our study can provide a guideline for developing and operating highly efficient BMED processes for sustainable ammonia recovery from waste streams.

Abstract #: RR005

Towards practical implementation of fault-tolerant control based on case-based reasoning as a fault identification tool in WRRFs

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Abstract

A closed-loop control system can amplify the effect of faults or hide them to the point where complete system failure occurs. Fault-tolerant control can be a potential solution to preserve the availability of the whole system by adapting its actions to the plant's malfunctioning behaviour [1]. Fault identification which includes fault detection and isolation (FDI) and controller redesign, i.e., adaptation of the controller to deal with the faulty situation, are the main parts of the fault-tolerant control (FTC) structure (Figure 1). A review of the literature has led to the methodology that benefits from the advantages of knowledge-based systems (Case-Based Reasoning (CBR)) to improve fault detection and isolation and to integrate it into a FTC that maximizes the performance of a WRRF. CBR is a knowledge management approach that uses previous experiences to “recognize” new problems that emerge in a process. The proposed strategy employs Principal Component Analysis [2], to reduce data dimensionality and monitor the process with the Q-statistic and the Hotelling T2 multivariate statistic that allow the detection of faults. These monitoring statistics are subsequently used as case descriptors to build the case-based library [3] during the training of the FTC-system. When the trained FTC is applied, the most similar past experiences are retrieved from the case base by evaluating the similarity between a new case and the cases in the library. Based on the fault type, control reconfiguration will be achieved by either accommodating the controller setpoint, altering the reference model for monitoring and control, adding soft sensors, activating alternate controllers, etc.
As much as a WRRF can benefit largely from employing fault-tolerant control, it has been rarely used practically. Using the proposed methodology in a large (12 m3) pilot plant instead of in simulation models is one of the main original scientific contributions of the work.

Abstract #: RR002

The role of thermal hydrolysis for remediating the adverse impacts of polystyrene nanoplastics on anaerobic digestion: significance of solids content

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Abstract

The widespread production, utilization, and improper disposal of plastics have resulted in the release of microplastics (MPs) and nanoplastics (NPs) into the environment. MPs/NPs are commonly found in sewage sludge and eventually end up in anaerobic digestion (AD), causing oxidative stress on the anaerobic microbiome. The thermal hydrolysis process (THP) is a common pre-treatment approach of sludge for boosting methane production and solids reduction in AD. While some recent studies have suggested that THP can reduce oxidative stress from MPs/NPs in AD, the impact of different operating conditions on its effectiveness remains unclear. This study particularly focused on understanding the impact of the solids content of sludge on the effectiveness of thermal hydrolysis in remediating the adverse impacts of polystyrene nanoplastics (PsNPs), one of the most detected MPs/NPs in the sludge, on AD.

Here, we examined the effect of THP (160˚C) on AD of primary sludge with different total solids (TS) content (4%, 8%, and 12% TS) when exposed to PsNPs. Our results showed that the presence of PsNPs (150 µg/L) led to higher levels of reactive oxygen species (ROS) at lower solids content (4% and 8% TS) compared to higher solids content (12%), and reduced methane production by 7.25% and 15.1%, respectively. Nevertheless, the application of THP could effectively counteract ROS-induced stress and improve methane production. Further, THP was efficient in decreasing most antibiotic resistance genes (ARGs) increased by PsNPs exposure and minimizing the risk of ARGs spread through digestate; however, this was more evident at higher TS%. These findings provide novel perspectives on the importance of sludge solids content in THP for simultaneous remediation of oxidative stress caused by PsNPs and ARGs evolution in the AD process.

Abstract #: RR007

Selective extraction of medium-chain fatty acid from organic waste streams using supported liquid membrane

Hiroki Fukuda, Jongho Lee

The University of British Columbia

Abstract

Medium-chain fatty acids (MCFAs) produced biologically from organic waste have recently been recognized as high-value biochemicals and promising sources for biofuels, pharmaceuticals and cosmetics, but their selective recovery from the waste is still a challenge.

This study develops a supported liquid membrane (SLM) for selective MCFA recovery from organic waste streams. The SLM is fabricated by filling a nonpolar solution of trioctylphosphine oxide (TOPO) in dodecane into a porous and hydrophobic membrane. By mimicking the effluent of MCFA-producing anaerobic bioreactors, we prepared an acidic feed solution containing ethanol, short-chain fatty acids (SCFAs) and MCFAs. Placed between the feed solution and a base draw solution, the SLM transfers MCFAs to the draw solution by selective absorption by the membrane liquid and the concentration gradient of protonated MCFAs.

We demonstrated >90% recovery of MCFAs in the draw solution while ethanol and SCFAs were effectively rejected. The partition coefficients of SCFAs and MCFAs into the membrane liquid were altered by using different TOPO concentrations in dodecane. A higher concentration of TOPO resulted in a higher MCFA recovery due to the enhanced complexation of MCFAs by TOPO. Conversely, the selectivity of MCFAs over SCFAs increased with a lower TOPO concentration owing to the larger contrast in partition coefficients of SCFAs and MCFAs. A mass transfer model revealed that the MCFA transfer through the SLM is governed by the mass transfer resistances in the feed side. Finally, interfacial polymerization technique, which makes a thin film layer on top of a membrane, has been used to improve the stability of the SLM. The steadiness of the SLM is evaluated by electrochemical impedance spectroscopy.

Our study demonstrates the facile and selective recovery of MCFAs and shows the potential of SLMs for selective MCFA recovery in building a new production stream for biochemicals from organic wastes.

Abstract #: RR010

Resource Recovery from the Digestion and Fermentation of Six Solid Wastes

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Abstract

Solid waste is one of the largest sources of greenhouse gases (GHGs) today. The carbon footprint of landfills also has a large impact on global warming. Therefore, it is becoming more urgent to study the possibility of better environmentally friendly approaches for solid waste management and its safe disposal. The digestion of solid waste is a biological process that breaks down the organic content of the solid waste and thus stabilizes it. It also allows the recovery of valuable resources (such as biogas) and the utilization of stabilized waste in various industries. In this study, six substrates were studied to determine their biomethane potential (BMP) in anaerobic digestion. The substrates were fermented and digested anaerobically, and the biogas production was measured. The methane yield of food waste substrates had a higher methane yield between 354 and 347 mL/g-TCOD, and a biodegradability of 89–87%. Wastewater sludge substrates yielded between 324 and 288 mL/g-TCOD with a biodegradability of 81–73%. A kinetics analysis using first order and Gompertz models was performed for biodegradation and methane production.

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Keywords:
Biogas recovery, Methane potential, Biosolids digestion, Anaerobic digestion, Solid waste stabilization.

Abstract #: RR006

Recovery of Xanthan from Aerobic granular sludge (AGS) wastewater systems

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Abstract

Xanthan is one of the major polysaccharide biopolymers used in many industries due to its unique structure and physicochemical properties which gives the high degree of pseudoplasticity and functionality in different environments such as acid, high salts, and high shear stress. Due to its non- toxicity and biodegradability, it is extensively used in food industry as thickening and stabilizing agent for canned foods and various syrups. In tissue engineering, it has various applications in the area of bone and skin regeneration. The expensive carbon sources used in the production of xanthan has resulted in the direction of cost reduction that could be achieved by using inexpensive and eco-friendly sources such as recovery from waste sludge from aerobic granular sludge (AGS)-based wastewater treatment systems. The granules contain high concentrations of extracellular polymeric substance (EPS) which plays the crucial role in the formation and stabilization of sludge granules in the biological wastewater treatment. EPS contains polysaccharides, proteins, nucleic acids, etc. Due to the advantages of AGS over conventional wastewater treatment processes such as, the activated sludge process, sustainable approach towards the recovery of biopolymers is now emerging on the wide scale to obtain high value-added products such as xanthan, curdlan, tyrosine etc. One of the main components of EPS, Alginate-like exopolysaccharide (ALE), is already extracted from the EPS matrix and has wide range of applications. Current research is focused on the optimization of xanthan in the AGS matrix and development of suitable quantification and recovery protocols. The outcomes of the proposed research will contribute to attaining circular economy in the wastewater management industry.

Abstract #: RR003

Municipal sludge valorization via hydrothermal liquefaction: On-site treatment of process wastewater

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Abstract

Hydrothermal liquefaction (HTL) is a thermochemical biomass-to-biofuel conversion method performed typically at 250-374°C. The HTL technology could be utilized in wastewater treatment plants (WWTP) to convert municipal sludge into a petroleum-like biofuel, bio-crude, and a carbonaceous solid product, hydrochar [1]. However, HTL process produces a large volume of highly polluted aqueous stream [2]. In this study, extensive characterization and biodegradability assays of HTL aqueous stream were performed to evaluate on-site treatment options in a WWTP. Various HTL aqueous samples were obtained from the liquefaction of dewatered (20% solids) mixed sludge performed at 290-360°C and 0-30 minutes retention time. Spectrophotometric analyses of chemical oxygen demand (COD), ammonia, total phenol, phosphorus, soluble protein, and total sugar were conducted. To evaluate the aerobic and anaerobic biodegradability, biochemical oxygen demand (BOD) and mesophilic/thermophilic biochemical methane potential (BMP) tests were performed. HTL aqueous samples were found to have 87,411-102,845 mg/L COD, 3,230-5,800 mg/L ammonia, 1,450-2,300 mg/L phenol, 332-587 mg/L phosphorus, 11,591-21,493 mg/L protein, and 229-960 mg/L sugar. In aerobic biodegradability test, the BOD values were in range of 40,750-53,985 mg/L. In mesophilic and thermophilic BMP tests, 0-0.18 mL CH4/g COD and 0-0.12 mL CH4/g COD methane productions were measured, respectively. The highest biodegradability levels of 56%, 51%, and 35% for aerobic, mesophilic anaerobic, and thermophilic anaerobic tests, respectively, were obtained for HTL aqueous samples produced at HTL conditions of 325°C, 0 min. Results indicated that 50% of the organics in HTL aqueous samples were recalcitrant and cannot be treated in downstream biological processes, without a pretreatment step.

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Keywords: Resource recovery, Biofuel, Sewage sludge

Industrial Water and Wastewater

Abstract #: IW003

Development of Non-fluorinated Omniphobic Membrane for Hypersaline Wastewater Desalination

Yinchuan Yang[1], Sifat Kalam[1], Sadaf Shabanian[2], Kevin Golovin[3], Yalei Zhang[4], Jongho Lee[1]

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Abstract

Membrane distillation (MD) is a promising technology for desalination of highly saline industrial wastewater. The development of omniphobic (i.e., non-wetting) membranes is essential to sustainable MD operation treating industrial wastewater containing low-surface-tension organic contaminants (e.g., surfactants). However, the most omniphobic membranes are currently fabricated using fluorinated substances, which pose substantial health and environmental concerns. In this study, we propose a facile and scalable approach to fabricate fluorine-free omniphobic membranes for MD. We first attached silica nanoparticles (SiNPs) to a quartz fiber substrate to create multilevel re-entrant structures. Subsequently, the membrane substrate was coated with polydimethylsiloxane (PDMS) as fluorine-free, low surface energy molecules, to reduce the surface energy of the substrate. The multilevel re-entrant structures and successful modification by PDMS were characterized by scanning electron microscopy and attenuated total reflectance−Fourier-transform infrared spectroscopy, respectively. The fabricated membrane showed excellent omniphobicity, resisting its wetting against liquids with surface tension as low as 28.0 mN/m. Finally, the fabricated omniphobic membrane exhibited stable desalination performance with nearly perfect salt rejection. Our work highlights the potential of omniphobic membranes fabricated using non-fluorinated chemicals, promising to reclaiming water from challenging industrial wastewaters through MD.

Abstract #: IW002

Developing a non-substrate specific fabrication technique for antifouling antiwetting Janus membrane for hypersaline wastewater desalination

Sifat Kalam[1], Abhishek Dutta[1], Xuewei Du[2], Xuesong Li[3], Tiezheng Tong[2], Jongho Lee[1]

[1] Department of Civil Engineering, The University of British Columbia, Canada
[2] Department of Civil and Environmental Engineering, Colorado State University, USA
[3] Department of Environmental Engineering, Tongji University, China

Abstract

"Wastewater effluent from industries (e.g., shale oil and gas) are often highly saline, beyond the treatment limit of reverse osmosis processes. Instead, water reclamation from industrial wastewater via membrane distillation technology (MD) has emerged as a promising technique to reduce the burden of freshwater supply. However, the complex nature of industrial wastewaters with the presence of organic foulants, surfactants, and low-surface-tension compounds pose challenges of fouling and wetting in the MD technology. Janus membrane, comprising a hydrophilic antifouling layer on a wetting-resistant membrane substrate, has emerged as a promising approach to simultaneously prevent fouling and wetting. Despite the recent research on Janus membrane, most methods are material specific and lack a universal technique for robust Janus MD membrane.

In our study, we develop a non-substrate specific universal modification technique to fabricate Janus membranes using polydopamine-assisted, surface-initiated atom-transfer radical-polymerization (ATRP) for grafting antifouling zwitterionic polymer brush layer that can be applied to any wetting-resistant omniphobic substrate. The tunability of the zwitterionic polymer layer structure is characterized by electron microscopy, profilometry, and Fourier-transform infrared spectroscopy. The fabricated omniphobic base layer resists wetting against various low-surface-tension liquids as well as water. The excellent antifouling functionality by the zwitterionic polymer layer is confirmed by static oil-fouling test. Our modification technique is further applied to commercial omniphobic membranes to demonstrate the universal applicability of the developed technique for Janus membrane fabrication. We demonstrate long-term antiwetting and antifouling behavior of the fabricated Janus membrane in the direct contact MD experiments using simulated highly saline industrial wastewater."

Abstract #: IW006

Evaluating the performance of ceramic nanofiltration membranes to treat liquid waste by-product from a biogas generation facility

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1. Department of Chemical Engineering, McMaster University
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Abstract

Production of biogas results in a liquid wastewater by-product, known as centrate, which must be treated as it contains high levels of total dissolved solids (TDS), and chemical oxygen demand (COD). Biogas generation facilities currently treat centrate using a combination of biological and physical treatment (via a membrane bioreactor (MBR)), which produces a stream known as MBR permeate. Although the MBR permeate achieves improved quality, treatment via an MBR has several challenges including higher capital and operational costs, difficulty scaling biological processes, and handling capacity limitations. In this study, crossflow filtration experiments were conducted to investigate the viability of using a commercial, tubular, nanofiltration (NF) ceramic membrane (0.0055 m2, Inopor) to treat centrate, collected from an operating biogas generation facility, as an alternative to MBRs. Centrate filtered with the ceramic membrane at a pressure of 120 PSI produced a permeate with a 34% decrease in TDS and an 88% decrease in COD, which was comparable to MBR permeate. After some initial fouling, the permeate flux through the ceramic membranes remained somewhat consistent in the range of 23 – 15 LMH. To further improve the quality, flat sheet RO membranes (0.014 m2, BW30 – Dupont) were used to independently filter MBR permeate (sampled directly from the operating biogas generation facility) and the produced ceramic NF permeate. The measured flux and permeate quality from the RO membrane were statistically the same across three independent experiments for each feed. This suggests that a two-stage NF-RO process can replace a multistage MBR process. The results from this study directly benefit biogas generation facilities, as it provides an effective and scalable treatment process for the liquid waste by-product stream. This will enable them to handle higher upstream loadings without the bottle neck in downstream treatment that is created by biological treatment processes.

Abstract #: [WS013]

Research Gaps in the Digestion of Aerobic Granular Sludge

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Abstract

Full-scale wastewater treatment plants utilizing aerobic granular sludge technology are being built in many countries worldwide. As with all biological wastewater treatment plants, the produced waste biomass must be stabilized to protect the population, wildlife, and the environment. Digestion is usually used to break down the complex organics in the waste sludge; however, the digestibility of aerobic granular sludge still needs to be fully understood compared to the conventional activated sludge. This research reviews the studies published on the digestibility of waste aerobic granular sludge to date. Studies comparing aerobic granular sludge and activated sludge in terms of composition, properties, and digestibility are highlighted. The impact of bio-logical composition and physical properties on the digestibility of sludge was reviewed in terms of biomethane production and biodegradability. The effect of pre-treatment was also covered. It was found that limited research was done in investigating the appropriate pre-treatment needed for the granular sludge. Additionally, there is a lack of digestion or fermentation kinetic analyses, as well as any full-scale studies. Areas for future research were identified.

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1. Hamza, R.; Rabii, A.; Ezzahraoui, F.Z.; Morgan, G.; Iorhemen, O.T. A review of the state of development of aerobic granular sludge technology over the last 20 years: Full-scale applications and resource recovery. Case Stud. Chem. Environ. Eng. 2022, 5, 100173. https://doi.org/10.1016/j.cscee.2021.100173.
2. Kazimierowicz, J.; Dębowski, M. Aerobic Granular Sludge as a Substrate in Anaerobic Digestion—Current Status and Perspectives. Sustainability 2022, 14, 10904. https://doi.org/10.3390/su141710904.

Keywords:
Aerobic granular sludge, Wastewater treatment, Digestibility, Pre-treatment, Biomethane production, Research gaps.

Abstract #: IW003

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Abstract

Membrane distillation (MD) is a promising technology for desalination of highly saline industrial wastewater. The development of omniphobic (i.e., non-wetting) membranes is essential to sustainable MD operation treating industrial wastewater containing low-surface-tension organic contaminants (e.g., surfactants). However, the most omniphobic membranes are currently fabricated using fluorinated substances, which pose substantial health and environmental concerns. In this study, we propose a facile and scalable approach to fabricate fluorine-free omniphobic membranes for MD. We first attached silica nanoparticles (SiNPs) to a quartz fiber substrate to create multilevel re-entrant structures. Subsequently, the membrane substrate was coated with polydimethylsiloxane (PDMS) as fluorine-free, low surface energy molecules, to reduce the surface energy of the substrate. The multilevel re-entrant structures and successful modification by PDMS were characterized by scanning electron microscopy and attenuated total reflectance−Fourier-transform infrared spectroscopy, respectively. The fabricated membrane showed excellent omniphobicity, resisting its wetting against liquids with surface tension as low as 28.0 mN/m. Finally, the fabricated omniphobic membrane exhibited stable desalination performance with nearly perfect salt rejection. Our work highlights the potential of omniphobic membranes fabricated using non-fluorinated chemicals, promising to reclaiming water from challenging industrial wastewaters through MD.

Abstract #: WS016

Contribución de las comunidades microbianas de agregados microalga-bacteria en la resistencia a antibióticos para el tratamiento de aguas residuales

Lizeth Guisa Morales

UNAM

Abstract

Antibiotic-resistant bacteria (ARB) carry antibiotic-resistance genes (ARG) and are commonly present in wastewater, which represents a risk to human health if they prevail after conventional wastewater treatment (CWT). Due to the energy limitation of CWT, alternatives based on microalgae-bacteria aggregates emerged as an efficient strategy for improving biomass harvesting. In such technology, it has been proposed that eukaryotic microalgae are playing a negative role in ARG transferring between symbiotic bacteria; but the role played by other microbial groups is still unknown. This project aimed to elucidate the specific contribution of photosynthetic and heterotrophic communities on the removal of ARG and ARB in a microalgal-bacterial system treating domestic wastewater and determine the reaction time's effect. First, the microbial communities were separated, and the removal of ARB and ARG related to tetracycline, ciprofloxacin, and ampicillin were determined. Afterward, the microorganisms playing significant roles and metabolic changes associated with the process were identified.

The removal of COD, N-NH4+, and P-PO4- was up to 70%, 86.56%, and 74.91%, respectively. Tetracycline ARBs increased (4.09 logCFU/mL to 4.23 logCFU/mL). Ciprofloxacin ARBs showed no change over time. Ampicillin ARBs increased (4.11-5.01 logCFU/mL to 4.44-5.36 logCFU/mL). The qPCR results showed a decrease in the tetQ gene (5.44-5.66 logCopies/mL to 4.36-2.76 logCopies/mL) for photosynthetic and heterotrophic communities, respectively. The blaCTX-M gene showed an increased for heterotrophic and photosynthetic communities (2.44 logCopies/mL and 3.21 logCopies/mL, respectively to 3.3 logCopies/mL and 8.5 logCopies/mL). In conclusion, photosynthetic community favors the horizontal transfer of blaCTX-M genes, significantly influenced by the reaction time.

Keywords: Antibiotic-resistance genes, Microalgal-bacterial aggregates and Wastewater treatment

Abstract #: IW005

Isolation of Heavy Metal Resistant Fungi and Response Surface Methodology for Biosorption Optimization

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Tecnologico de Monterrey, School of Engineering and Science

Abstract

The importance of high metal resistance as a trait for microorganisms in applied metal remediation processes is tightly related to the biosorption process in which biomass is able to concentrate metals into its cell structure, with highly resistant microorganisms being able to operate at higher metal concentrations (Fomina and Gadd, 2014). We have hypothesized that the Atoyac River, one of the most metal-polluted rivers in México, has the potential to contain such microorganisms and be used as tools for biosorption-based metal remediation. In this work, a total of 34 fungal strains were isolated from selected heavily polluted points of the river based on the report "Indicadores de calidad del agua superficial 2020" from CONAGUA. Heavy metal resistance screenings allowed the selection of 14 isolates with high heavy metal resistance to Fe, Cu, Cr, Ni, Mg, and Zn. The two highest metal-resistant yeasts were molecularly identified as Cyberlindnera jadinii (1000 ppm Fe, 3000 ppm Cu, 5000 ppm Cr, 1000 ppm Ni, 5000 ppm Mg, 750 ppm Zn) and Wickerhamomyces onychis (400 ppm Fe, 1500 ppm Cu, 4500 ppm Cr, 400 ppm Ni, 5000 ppm Mg, 750 Zn) and selected for metal biosorption optimization using response surface methodology evaluating pH, temperature, initial metal concentration, and initial inoculum size as the main variables involved.

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Fomina, M., & Gadd, G. M. (2014). Biosorption: current perspectives on concept, definition and application. Bioresource technology, 160, 3-14.

Keywords: Heavy-metal pollution, water bioremediation, biosorption.

Abstract #: IW008

Study of solar photocatalysis and using LED lighting for the treatment of real wastewater: Recovery and reuse of the TiO2

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Abstract

Challenge facing the photocatalysis with TiO2 is its application to real and complex wastewater samples. Of the total scientific publications on advanced oxidation processes, only about 10% correspond to research on actual wastewater treatment, and less than 1% have addressed the impact of the waster matrix [1]. So, this research focuses on the evaluation of the performance of photocatalysis with TiO2 using an artificial and a renewable lighting source. Complex wastewater samples were used, such as slaughterhouse effluents to evaluate the efficiency of removal of organic matter under real conditions.

Wastewater samples were collected from a slaughterhouse in central Mexico and were characterized using standardized methods. Due to the complexity of this type of samples [2], first a sedimentation was applied. Subsequently a coagulation-flocculation using 0.5 g/L ferric chloride was carried out. Then a photocatalytic treatment for 2 hours with 0.25 g/L TiO2 P25 (Evonik) was applied using light-emitting diode (LED) systems and using natural sunlight. The results indicate that at the end of the photocatalysis with LED lighting, a 96% of the chemical oxygen demand (COD) removal is achieved. Using sunlight 99% of COD removal was obtained. There was a mass recovery of TiO2 around 30%, analyzing this residual via Fourier-transform infrared spectroscopy the spectra with broad bands between 880 and 500 cm-1 was detected that are related to the stretching vibration of the Ti-O-Ti and Ti-O-C bonds, but with some absorption peaks related to remainder organic matter. Thus, it is recommended to purify the photocatalyst before reusing it.

Abstract #: NS001

Gestión del agua de lluvia en un Centro Escolar ubicado en una zona suburbana en el estado de Oaxaca, México

Tania Espinosa Fragoso, Susana Margarita Navarro Mendoza

Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional-Unidad Oaxaca

Abstract

En México, como en muchas del mundo, se refleja una crisis del agua debido a la escasez para las necesidades básicas (Sandoval, 2020), la cual se relaciona, entre otros aspectos, a una desigualdad económica y social (OXFAM, 2017). Por tal motivo, las comunidades han empleado diversas estrategias autogestivas para tener acceso al agua. Entre estas se encuentra la captación de lluvia, la cual se implementó en un Centro Escolar ubicado en una zona suburbana. Esta implementación se vio como solución no solo al problema de escasez hídrica, sino también al problema de inundación que sufre el plantel escolar en temporada de lluvia.

Sin embargo, no se aprovechan los volúmenes de lluvia disponibles para contribuir a satisfacer la demanda hídrica debido a que el sistema de captación implementado no tiene un funcionamiento óptimo, que es consecuencia, en gran medida, del insuficiente apoyo técnico y económico. Por tal motivo, este trabajo se centró en la adecuación del sistema mediante la integración de componentes de purificación y pretratamiento elaborados localmente mediante el fomento del trabajo colaborativo interinstitucional e interdisciplinario y el intercambio de conocimientos.

Se destaca que la captación de lluvia no solo tiene que ver con el desarrollo de mecanismos tecnológicos, sino también con el desarrollo de procesos sociales. Por lo tanto, es imprescindible conocer el contexto socioeconómico y cultural de las personas, dentro de estos: el conocimiento del manejo de sus recursos naturales, formas de organización, motivaciones culturales, saberes, soluciones tecnológicas y capacidades.

Abstract #: RR013

Resource recovery of value-added from slaughterhouse wastewater and purple phototrophic bacteria

Karla Estefanía Ibarra Munguia[1], Shinichi Akizuki[2], Germán Cuevas Rodríguez[1]

[1]Guanajuato University

[2]Soka University

Abstract

En México, como en muchas del mundo, se refleja una crisis del agua debido a la escasez para las necesidades básicas (Sandoval, 2020), la cual se relaciona, entre otros aspectos, a una desigualdad económica y social (OXFAM, 2017). Por tal motivo, las comunidades han empleado diversas estrategias autogestivas para tener acceso al agua. Entre estas se encuentra la captación de lluvia, la cual se implementó en un Centro Escolar ubicado en una zona suburbana. Esta implementación se vio como solución no solo al problema de escasez hídrica, sino también al problema de inundación que sufre el plantel escolar en temporada de lluvia.

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Emerging Technologies

Abstract #: [WS012]

Ensemble machine learning approach for examining critical process parameters and scale-up opportunities of bioelectrochemical systems for hydrogen peroxide production

Tae Hyun Chung

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Abstract

Hydrogen peroxide (H2O2) production in bioelectrochemical systems (BESs) is an attractive option for enabling a circular economy in the water/wastewater sector. However, several challenges remain regarding the systematic optimization of process parameters, system design, and scale-up for the field application of H2O2-producing BES. Furthermore, there is a lack of mechanistic models to understand the complex non-linear interactions between process operating and/or design parameters and H2O2 productivity, which forces us to rely heavily on very laborious and time-consuming experimental investigations/data. Alternatively, applying machine learning (ML) algorithms has become a more emerging area in research related to BES. Here, an ML algorithm was developed, using a meta-learning approach, to predict the H2O2 production rates in BES based on the seven input variables, including various design and operating parameters. The developed models were trained and cross-validated using the experimental data collected from 25 published reports. The final ensemble meta-learner model (combining 60 models) demonstrated a high prediction accuracy with very high R2 (0.983) and low RMSE (0.647 kg H2O2 m-3 d-1) values. The model identified the carbon felt anode, GDE cathode, and cathode-to-anode volume ratio as the top three most important input features. Further scale-up analysis for small-scale wastewater treatment plants indicated that proper design and operating conditions could increase the H2O2 production rate to as high as 9 kg m-3 d-1, and ultimately, applying the model could provide a systematic database of design and operating parameters and their corresponding predicted H2O2 production rates, which can be further investigated in future studies.

Abstract #: ET004

Electrochemical oxidation of toxic per- and poly-fluoroalkyl substances (PFAS) from water

Fatemeh Asadi Zeidabadi, Madjid Mohseni
The University of British Columbia

Abstract

Widespread detection of long-chain perfluorooctanoic acid (PFOA) in the environment and stringent regulations on their use have led to a shift towards fluorinated alternatives, including GenX. This transition has resulted in the widespread presence of GenX in aquatic and natural environments1. Yet, a thorough understanding of the degradability of such alternative compared to the legacy PFAS is limited. This study investigates the use of electrochemical treatment with boron doped diamond and stainless steel as anode and cathode for the treatment of PFOA and GenX, examining degradability, extent of mineralization, and transformation pathway along with contributions from generated radicals (•OH and SO4•). The decomposition efficiencies of PFOA and GenX were 97.9±0.1% and 84.9±3.3% within 120 min of electrolysis. Compared to PFOA, GenX showed a lower extent of degradation which could be due to the presence of –CF3 branching, which hinders the electron transfer from the carboxyl head to the anode surface2. Initially, defluorination efficiencies followed the same trend as those of degradation, while as time went on, the efficiency of GenX (71.2±0.1%) surpassed the one for PFOA (68.6±1.3%) within 120 min of electrolysis. Formation of fewer number of intermediates in GenX could be the main reason for this observation. SO4•- played a significant role in the decomposition of PFOA and GenX, while •OH did not contribute to the degradation of these molecules. Detailed decomposition pathways were proposed through identifying the generated intermediates along with analyzing the fluorine recovery. 19F NMR results further assessed the structural differences and decomposition pathways of PFOA and GenX.

Abstract #: ET005

Photodegradation of legacy and emerging per- and poly-fluoroalkyl substances (PFAS) using VUV/sulfite process

Ehsan Banayan Esfahani, Madjid Mohseni

The University of British Columbia

Abstract

The ubiquitous detection, toxicity, and recalcitrant nature of per- and poly-fluoroalkyl substances (PFAS) pose serious environmental and human health challenges. Photochemical processes, combining mediators and UV radiations, are viable technologies that have shown promising potential for the effective decomposition of PFAS1. Among them, owing to the high standard reduction potential of hydrated electrons (eaq–, –2.9 V2), photo-reductive processes have been able to effectively degrade different structures of PFAS1,3. The present study proposed a comprehensive kinetic modeling to describe the decomposition of well-known PFOA, PFOS, and their common alternatives (PFBS, PFHxS, 6:2 FTSA, PFBA, and GenX) upon the attack of eaq–, verifying the experimental results, predicting radical concentrations, and determining the photochemical parameters (e.g., quantum yields and intrinsic rate constants) of species involved in the process. The model successfully predicted the decomposition of studied PFAS under different conditions, e.g., different UV wavelengths and fluences. The photochemical experiments were carried out using a well-controlled quasi-collimated beam of UV (254 nm) and UV/VUV (254/185 nm) radiations to measure the extent of degradation based on fluence (or actual UV energy delivered to the system). Degradation and defluorination of the studied PFAS were 13.4–97.9% and 4.2–66.2%, respectively, within 15.7 J/cm2 in the VUV/sulfite process. The intrinsic kinetics rate constants of the studied PFAS with eaq– were in the range of 1.8×106 to 8.3×107 M–1 s–1, where shorter chain fluorinated alkyl chain and inclusion of C–H and C–O bonds led to slower decomposition efficiencies of the PFAS in VUV/sulfite process.

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Jun 1-3, 2023 - Vancouver, BC

Abstract # ET001

Ozonation intensification by an integrated multiphase system.

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Ozone is an effective water disinfectant that has significantly reduced the spread of disease and improved public health. Its high reactivity can oxidize a wide range of contaminants, including persistent organic compounds (e.g., pharmaceuticals), not entirely removed by conventional wastewater treatments. The low solubility of ozone molecules and the formation of potential carcinogen by-products, however, have redirected the study of Advanced Oxidation Processes towards mixing intensification and the control of disinfection by-products. A promising technology that promotes vigorous mixing and simultaneous injection of different reagents is MITO3X®. This technology allows the integration of tertiary processes in a compact multifunctional system through simultaneous injections of different reagents that are quickly mixed, leading to parallel reactions. This study is divided into two sections: first, a series of hydraulic tests in which the system was configurated in multiple ways to find the highest-pressure point and thus achieve an optimized process; and second, the performance of the MITO3X® technology (Figure 1), which was evaluated at different pump rates, flow rates, ozone concentrations, and carbon and $NaNO_2$ concentrations in the media for pharmaceutical compound control. The results (Figure 2), in terms of response surfaces, reveal (a) an optimal pump rate of 30Hz and (b) O_3 and $NaNO_2$ correlation for pharmaceutical compounds removal efficiency. In summary, we successfully validated the performance of a novel technology showing efficient pharmaceutical compound removal (>90%), a clear scavenging effect of $NaNO_2$ and total organic carbon on system efficiency, and the impact of water flow rate and mixing on micropollutant oxidation.

Key words: Ozone, pressure intensification, disinfection, advanced oxidation treatment.

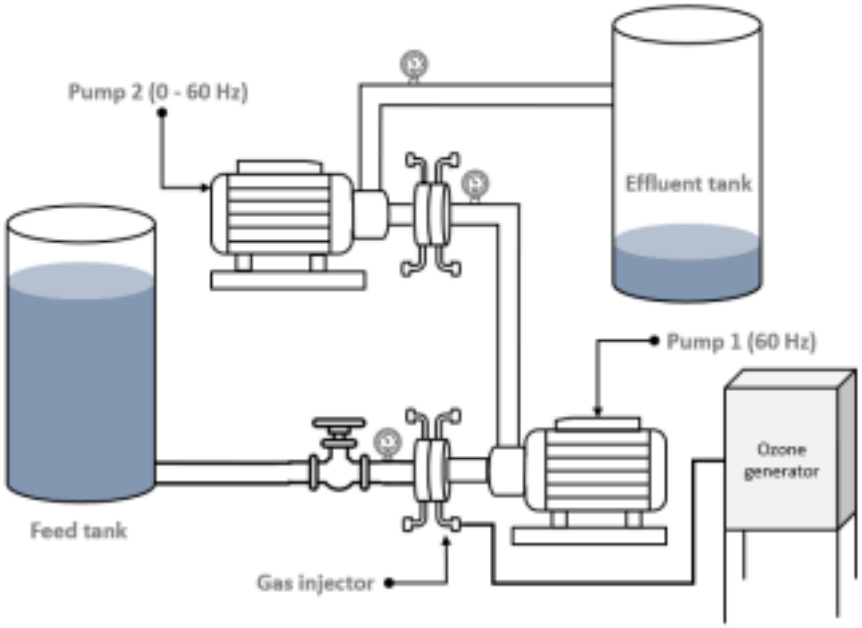

Figure 1. MITO3X® technology scheme.

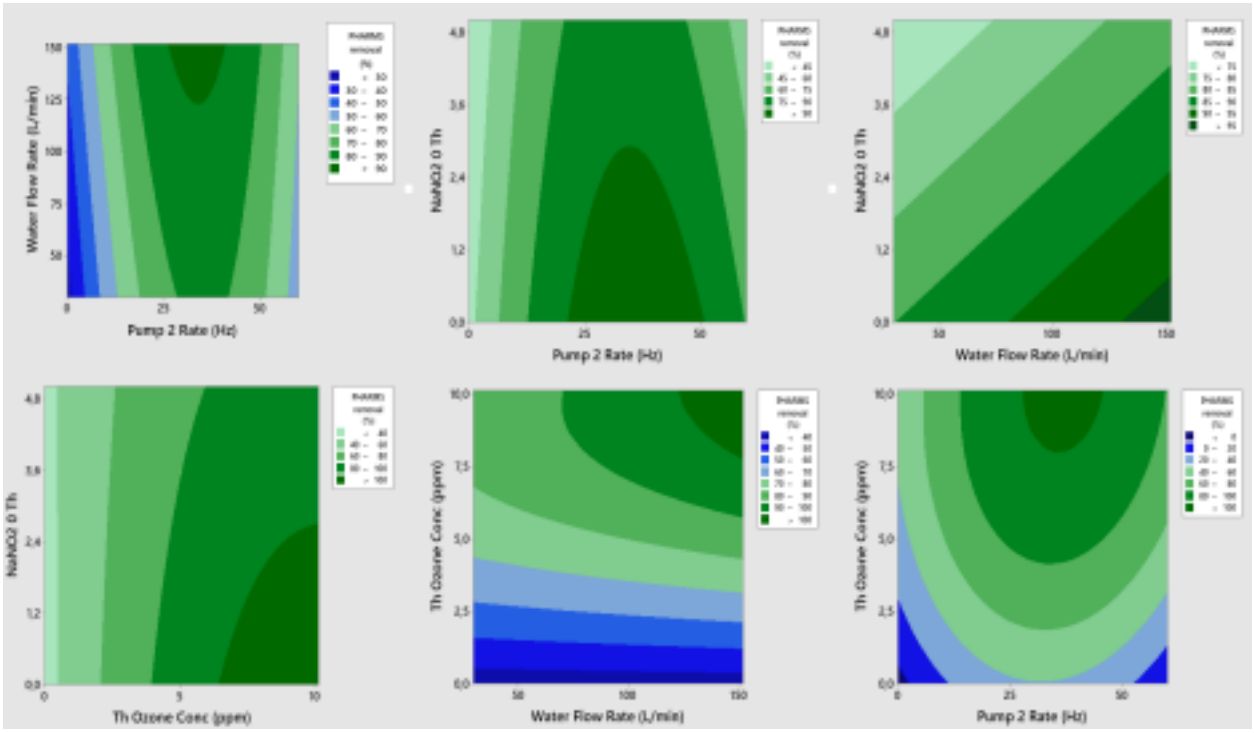

Figure 2. Pharmaceutical compounds removal in response to variables. Multilinear regression developed by B. Cantoni.

Acknowledgement: The authors would like to thank the Water Research Center of Lambton College and their coordinator Carlos Diaz Rangel for their valuable technical support during system evaluation and analysis.

Reference:

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Wastewater Respirometry for data-hungry WRRF digital twins

M Karen Mesta Ortega
Université Laval

Abstract

Abstract # ET003

Optimising the ultrasound assisted electrocoagulation process applied for the treatment and reuse of slaughterhouse wastewater

Saif Ullah Khan, Izharul Haq Farooqi, Farrukh Basheer
Aligarh Muslim University

Abstract

The applicability of combined approaches, such as physiochemical processes, in the treatment of wastewater has garnered much attention worldwide. The aim of the present study was to explore the performance of ultrasound assisted electrocoagulation for the possibility of Slaughterhouse wastewater using iron-aluminum electrodes. The process was optimized using Central composite design based on response surface methodology. The effect of applied current initial PH and reaction time were evaluated to know the best possible combination for the response variables in terms of COD removal along with nitrates and phosphates being removed. The optimized conditions obtained showed an efficiency in removing 78% total nitrogen, 98% total phosphorus and 77.5% COD at an applied current intensity of 1.5 ampere, initial pH 7 and reaction time of 22 minutes.

Abstract #: [ET006]

Accuracy of weather prediction with Machine Learning and Decision Trees

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Universidad Autonoma de Yucatan, Facultad de ingeniería

Abstract

"This paper presents a different approach to predicting weather using machine learning and decision trees in Python. The goal of the study was to develop a highly accurate and reliable model for weather prediction, considering previous labeled of data temperature and precipitation. The decision tree algorithm was chosen due to its ability to handle non-linear relationships between variables and to make clear and interpretable predictions. Python was used for the implementation of the model, making use of popular machine learning libraries such as scikit-learn.

To train the model, a medium dataset of manually measured weather data was used, including information such as minimum, maximum, and ambient temperature as well as precipitation. The decision tree algorithm was then used to learn the relationships between these variables and the target variable of interest, such as precipitation and temperature of the desired day. The resulting model was evaluated using several metrics, such as R2-score, and was found to perform well on the test dataset, achieving high levels of accuracy and consistency.

The results of this study demonstrate the feasibility of using decision trees and machine learning in Python for weather prediction. The model developed in this study can be used as a tool for meteorologists and weather forecasters, providing a simple and effective way to make weather predictions with considerably high accuracy. The implementation of this approach can also be easily extended to include additional meteorological factors or to be applied to different regions, making it a versatile and valuable tool for weather prediction."

Abstract #: [DW001]

Biological Ion Exchange: new insights on the contribution of biodegradation vs. ion exchange mechanisms

Karl Zimmermann

University of British Columbia

Abstract

"In Canada, three-quarters of drinking water advisories affect communities with less than 5,000 inhabitants. Small towns face unique challenges: infrequent service, intermittent power and internet, a single water operator and difficulty procuring consumables.

Dissolved organic carbon (DOC) in surface waters creates treatment challenges: i) adds colour, taste and odour, ii) fouls filters and interferes with UV disinfection, iii) provides substrate for biofilm growth and iv) reacts with chlorine. Conventional treatment or pre-oxidation and filtration removes DOC but is expensive and requires frequent operator intervention. Ion exchange (IEX) can remove 90% of DOC, but a high concentration brine is produced which must be managed.

Biological ion exchange (BIEX) offers the high DOC removal of IEX with decreased maintenance needs of BAC filters, and removes 50% of DOC for two years without regeneration. After five years of lab and field research, we better understand this technology. Biodegradation was thought to provide substantial DOC removal (~30%) from increased metabolic activity due to high DOC concentrations on the resin surface. However, we now understand that biodegradation contributes to a lesser extent, around 10% total DOC removal. Instead, two consecutive ion exchange mechanisms account for the majority of DOC removal.

Primary ion exchange involves releasing chloride and removing DOC, nitrate and sulphate. Following primary IEX exhaustion, secondary ion exchange begins, releasing sulphate and removing DOC and nitrate. Beyond secondary IEX exhaustion, DOC removal is dominated by biodegradation, which continues unaffected throughout the process.

With our informed understanding of these three DOC removal mechanisms, we are pursuing opportunities to tailor this technology. Long-term performance depends on secondary IEX which we have dramatically prolonged using higher-capacity resins with a small trade-off in DOC removal. Understanding anionic resin affinity enables predicting DOC removal from the inlet DOC-to-sulphate ratio and informs operations and maintenance."

Abstract #: [WS019]

Photoreactors with purple phototrophic bacteria to produce protein biomass from slaughterhouse wastewater

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Abstract

Slaughterhouse wastewater has a negative impact on the environment at being disposed without adequate treatment, it contains high loads of organic matter, nitrogen and phosphorus generated during the processing of animals. Purple phototrophic bacteria (PPB) can assimilate high concentrations of organic matter and nutrients and is possible to recover biomass rich in protein with added value. Photoreactors with infrared light are being used to produce protein-rich biomass from agro-industrial wastewater with organic loading rates from 0.8 to 7.8 kg CODs /m3 day and mostly with PPB mixed culture inoculum, obtaining concentrations among 40- 60% protein in dry biomass. On this work, we evaluate the performance of continuous photoreactors with mixed culture of PPB for the generation of protein-rich biomass from raw slaughterhouse wastewater. The principal operating parameter volumetric organic loads (VOC), the production of protein in the biomass (% in dry mass), the assimilation of nutrients and organic matter from wastewater were evaluated through the analysis of CODs, NT, P-PO43- , NH4+. In this work, the protein percentages in dry biomass of 40.4% ± 6.2, 43.4% ± 6.8 and 41.2% ± 4.4 have been achieved with organic loading rates of 0.9 ± 0.4, 1.9 ± 0.7 and 7.2 ± 1.7 kg CODs / m3 day, respectively. Photoreactors with PPB can generate biomass rich in protein greater than 40% even under a high VOC of 7.2 ± 1.7 kg CODs/m3 day, this represents an economic and environmental benefit taking advantage of this wastewater and the biomass generated in the treatment.

Arsenic removal with biofilters using groundwater-native iron from different wells in Bangladesh

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Abstract

Passive groundwater treatment for iron, ammonium, and manganese removal consists of aeration followed by single or multiple filtration steps without using chemicals. However, this passive method is not appropriate for arsenic (As) removal, since its removal efficacy can vary between 15-90%, depending on groundwater composition. However, As removal with precipitating iron (Fe) is found to be effective. Consequently, As co-removal with groundwater native-iron is reported to be only possible if As concentrations are low (<50 µg/L) despite having sufficient iron to As ratio in the source water. The commonly practiced aeration prior to storage facilitates rapid and complete Fe2+ oxidation before As(III) oxidation, which hampers the overall As removal efficacy. Thus, the conventional aeration-filtration processes require additional chemical oxidants/adsorbents to remove As. Equilibrium adsorption studies of As on Fe oxides show that, although both As(III) and As(V) have an affinity for Fe oxides, the removal capacity for As(V) by freshly forming Hydrous Ferric Oxides (HFO) is much higher than for As(III). Therefore, it was hypothesized that the step-wise/delayed oxidation of groundwater native-Fe2+ by introducing anoxic (pre-)storage could promote As(III) oxidation and removal of As(V) to meet the WHO and regional standards. In addition this research also aimed to study the interaction between Fe, As, phosphate and manganese during anoxic storage followed by sand filtration, using natural groundwater, containing low to high concentrations of As (<60->300 µg/L), Fe2+ (2.4-5.4 mg/L), phosphate (2-4 mg/L) and manganese (280-600 µg/L), in the As-affected areas in Bangladesh. The field trial consists groundwater anoxic storage followed by aeration-filtration using natural groundwater, locally available materials and crafts but without external chemicals. This study proved that independent of locations or source (ground)water composition, the use of anoxic storage before aeration followed by aeration-filtration produces in-situ HFO flocs by delayed/step-wise Fe2+ oxidation and contributed to high (>94%) As removal without compromising phosphate and manganese removal with no use of (external) oxidants or chemicals. Therefore, it is proved that the use of anoxic storage of groundwater could facilitate the delayed/step-wise Fe2+ oxidation through surface-related and/or biological processes, which would be beneficial in the subsequent aeration-(sand) filtration steps for better As removal. Thus this anoxic storage of Fe and As contaminated groundwater followed by aeration and sand

filtration could be used as a cost-effective and chemical-free alternative for removing As from groundwater under field-relevant conditions and can be considered for large scale application to provide As-safe drinking water in affected communities.

Keywords:
Arsenic removal, Native iron, Groundwater, Sand filter, Drinking water treatment

Integrating Genome-Resolved Metagenomics with Trait-Based Process Modeling to Determine Biokinetics of Distinct Nitrifying Communities within Activated Sludge

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Abstract

Conventional bioprocess models for wastewater treatment are based on aggregated bulk biomass concentrations and do not incorporate microbial physiological diversity. Such a broad aggregation of microbial functional groups can fail to predict ecosystem dynamics when high levels of physiological diversity exist within trophic guilds. For instance, functional diversity among nitrite-oxidizing bacteria (NOB) can obfuscate engineering strategies for their out-selection in activated sludge (AS), which is desirable to promote energy-efficient nitrogen removal. Here, we hypothesized that different NOB populations within AS can have different physiological traits that drive process performance, which we tested by estimating biokinetic growth parameters using a combination of highly replicated respirometry, genome-resolved metagenomics, and process modeling. A lab-scale AS reactor subjected to a selective pressure for over 90 days experienced resilience of NOB activity. We recovered three coexisting Nitrospira population genomes belonging to two sublineages, which exhibited distinct growth strategies and underwent a compositional shift following the selective pressure. A trait-based process model calibrated at the NOB genus level better predicted nitrite accumulation than a conventional process model calibrated at the NOB guild level. This work demonstrates that trait-based modeling can be leveraged to improve our prediction, control, and design of functionally diverse microbiomes driving key environmental biotechnologies.

Abstract #: [WR005]

Determination of the best hydrogeological target for improving the success rate and productivity of boreholes in basement environments

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Abstract

Access to water is not yet universal in Burkina because 30% of Burkinabes do not have access to drinking water. The objective is difficult to achieve in the context of climate change and population growth. 80% of the surface of Burkina Faso is occupied by basement rocks. These formations contain groundwater resources that constitute the only source of drinking water for many populations.

However, 40% of the boreholes drilled in the Burkina Faso basement do not deliver enough water (Q < 700l/s) and are abandoned. This study focuses on the determinitation of the hyfrogeophysical target (alteration versus fracturation).we've collected 2150 data of boreholes drilled in basement areas. The dataset is constituted of (a lineament map, geophysical survey, boreholes log, and pumping test). On the 2150 data,60% have a flow rate higher than 700l/s and 40% have a flow rate lower than 700/s. A sensitivity analysis was done to see the relationship between the parameters concerning the geometry(weathering thickness), the drilling, and the productivity. This analysis was done in 2 steps: first analysis between the productivity of the borehole and its geometry, and on the other hand between productivity and fracturation.

We found out that the success rate at 700l/s is 62% at the end of drilling against 54% at the end of development; the first water occurrences are more productive than the following ones; the flow rates of the water occurrences are stable (or slightly decreasing) with the depth; beyond 60m of depth, it is rare (only 15% of cases) to find water occurrences.

There is a good relation between the geometry of the borehole and its productivity.

A deeper borehole can be more productive if it reaches a geological structure that is favorable for groundwater flow.

Keywords: Geophysical, survey, basement, lineament

Abstract #: [WR010]

Evaluation of groundwater quality for irrigation purposes using multiple graphical and indexing approaches supported with machine learning models and GIS techniques; representative case study

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Abstract

Irrigation has made a significant contribution to supporting the population's expanding food demands, as well as promoting economic growth in irrigated regions. The current investigation was carried out to assess the groundwater quality for agricultural viability in semi-arid region using different irrigation water quality indices (IWQIs) and geographic information systems (GIS). In addition, the machine learning models (ML) such as, support vector machine regression (SVMR) was applied to forecast the eight IWQIs such as irrigation water quality index (IWQI), sodium adsorption ratio (SAR), sodium percentage (Na %) soluble sodium percentage (SSP), Kelley index (KI), permeability index (PI), potential salinity (PS), permeability Index (PI), and residual sodium carbonate index (RSC). Physicochemical parameters such as To, pH, EC, TDS, K+, Na2+, Mg2+, Ca2+, Cl-, SO42-, HCO3-, CO32-, and NO3- were measured at 45 deep groundwater wells. The hydrochemical facies of the groundwater resources were Ca–Mg–Cl/SO4 and Na–Cl, which revealed evaporation, dissolution of gypsum, and reverse ion exchange processes. The IWQI, SAR, KI, and PS showed that groundwater samples were categorized for irrigation purposes into high restriction (93.6%), permissible (64.4%), unsuitable (91.2%), and injurious to unsatisfactory (100%), respectively. While, Na %, SSP, PI, and RSC revealed that all groundwater was excellent, safe, and good-class II for irrigation. The SVMR model produced robust estimates for eight IWQIs in calibration (Cal.) datasets, with R 2 ranging from 0.90 to 0.97. Furthermore, in validation (Val.) datasets, the SVMR model produced robust estimates for eight IWQIs, with R2 ranging from 0.88to 0.95. The values of the saturated index (SI) calculated by PHREEQC indicated that the groundwater is undersaturated with halite, anhydrite, and gypsum but saturated to oversaturated by calcite, aragonite, and dolomite.

Abstract #: [DW014]

EVALUATION OF SCALING AND FOULING IN LOW-PRESSURE UV AND UV LED SYSTEMS FOR USE IN RURAL COMMUNITIES

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Abstract

The presence of water that is safe is essential for human survival. United Nations Sustainable Development Goal 6.1 outlines the need for universal and equitable access to safe and affordable drinking water for all by 2030. However, drinking water sources worldwide are heavily contaminated with microbial contaminants, leading to waterborne diseases. Many efforts are being made to reduce these diseases through efficient water treatment and adequate water supply. One of the water treatment methods employed is ultraviolet disinfection. Ultraviolet (UV) disinfection has been used for pathogen inactivation for many years. According to various studies, one of the limitations of low-pressure UV systems is scaling and fouling of the quartz sleeve of UV lamps due to the presence of organic and inorganic contaminants in the source water, which leads to low efficacy1,2. However, there are limited studies on scaling and fouling in UV LEDs3. This research compares the decline in disinfection efficacy of two UV systems, a traditional commercial low-pressure UV reactor and a UVC LED flow-through reactor, resulting from scaling and fouling. Comparison of the effectiveness of these systems will be achieved by measuring the transmittance before and after exposure to source water with varying hardness concentrations. Furthermore, the reversal of scaling and fouling in these UV systems using lime and lemon juice, which are available in low-resource settings, will be investigated. This research is ongoing on a laboratory-scale; however, the results will be available before the conference and will have applications in rural communities in the future.

Keywords: Ultraviolet disinfection of water, UV LEDs, small-scale systems, low-resource context.

Climate Change and Sustainability

Abstract #: [SU002]

Strengthening Coastal Aquifer Resilience and Groundwater use against Climate Change Effects in the Caribbean Coast of Colombia: case of the Arroyo Grande aquifer

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Abstract

Humans, tend to take advantage of resources that are readily available and economically exploitable. However, this is not the case with groundwater resources in Colombia, with a potential supply up to 5,848 km3 and a deficit in the resource management especially in the coastal regions. Strategies to protect coastal aquifers are not developed yet and consequently, the coastal communities continue decreasing their strength and ability to improve living conditions.

This study develops a hydrogeological and environmental profile of the Arroyo Grande Coastal aquifer as a strategy to strengthen the aquifers resilience and groundwater use. The profile includes the delimitation of the aquifer, hydrogeological dynamics, water quality, and an assessment of climate change and anthropogenic activities, through experimental and numerical simulations. It was found that the aquifer serves five municipalities and has the potential to serve the City of Cartagena, it has an approximate area of 30 km2 and 100 m depth. Solid waste disposal and rock mineralization are some of the main factors contributing to water quality deterioration. In addition, exploitation rates (10-40 L/s) and relative sea-level rise rates (7.02 ± 0.06 mm/yr) [1] threaten to enhance salinity intrusion.

This profile sets a precedent that can be replicated at the 30 aquifer systems distributed in the Colombian Coast, that possess low sustainability index for the groundwater (0.47) [2]. The importance of strengthening the social awareness about groundwater use, training qualified specialists and the development of studies to reduce uncertainties related to the dynamics of the subterranean resource are discussed.Keywords: Ultraviolet disinfection of water, UV LEDs, small-scale systems, low-resource context.

Abstract #: [SU004]

HOW TO DEAL WITH THE CONSEQUENCES OF THE OVEREXPLOITATION OF GROUNDWATER ON THE CARIBBEAN COAST: Case study in the Arroyo Grande coastal aquifer, Colombia

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Abstract

Management plans, strategies, and good practices to increase the resilience and sustainability of coastal aquifers in Latin America are scarce. The aquifers lack of continuous monitoring and appropriate management, it creates a strain to the access to accurate data and makes the study of aquifers more difficult for professionals and technicians. The consequences of overexploitation of the resource are increasingly evident, which enhances the need to identify and apply strategies focused on the needs and characteristics of each coastal aquifer. In contribution to this need, this research proposes the development of an integrated framework for the identification, design and application of sustainability strategies that can be adapted to the Arroyo Grande coastal aquifer of Colombia. This presents a bibliographical review of public, private and academic strategies that have been implemented in Latin America. Favorable results were identified, such as in Argentina and Brazil, and other unfavorable ones, such as the Barú aquifer in Colombia, which is undergoing a process of contamination by salinization; and it is our purpose to prevent it from happening in Arroyo Grande. Likewise, the guidelines of the book Local Groundwater Protection were considered. The studies similars in the hydrogeological and hydrological characteristics of the Arroyo Grande coastal aquifer were filtered and analyzed for identify their applicability. The conclusions of this research show that the protection, sustainability and governance of the resource, should include collaborative efforts between the public and private sectors, the industry, communities and academia, who directly or indirectly benefit from the aquifer.

Abstract #: [WG002]

Fortalecimiento de la cultura hídrica para la gobernanza en la gestión comunitaria del agua

Laura Lourdes Gomez Hernandez

Jóvenes profesionales y estudiantes del agua

Abstract

Resumen

La cultura hídrica que poseen los pueblos indígenas destaca por su sensibilidad hacia el medio ambiente, capacidad de adaptación y resiliencia. Características que evidencian las acciones que realizan frente a los problemas ambientales. En este trabajo se analiza como la cultura hídrica para la gobernanza del agua ha generado estrategias de manejo y conservación del recurso, llevadas a cabo a través de la gestión comunitaria del agua, en una comunidad del Estado de Oaxaca, México. Una de las preguntas centrales abordadas en este trabajo es: ¿cómo puede organizarse la comunidad para fortalecer la cultura hídrica mediante un proceso de sensibilización colectiva para la gobernanza en la gestión comunitaria del agua? La organización que mantienen las comunidades es eje central para contribuir a una sostenibilidad ambiental y son capaces de satisfacer sus propias necesidades de suministro de agua (Sandoval Moreno & Günther, 2015). Se utilizó el método etnográfico apoyado de la observación participante y recorridos de campo como estrategias metodológicas. Los resultados muestran que, en el contexto de la crisis actual del agua, el fortalecimiento de la cultura hídrica promueve una organización y gestión comunitaria que permite la reproducción de la sociedad con prácticas más respetuosas con el medio ambiente. Estos aspectos han generado cambios para la creación de procesos cooperativos que lleven a la gobernanza en la gestión comunitaria del agua.

Palabras clave: Comunidad, Agua, Sensibilización colectiva

Referencia

Sandoval Moreno, A., & Günther, M. G. (2015). Organización social y autogestión del agua. Comunidades de la Ciénega de Chapala, Michoacán. Política y Cultura, 44, 107–135. http://www.redalyc.org/articulo.oa?id=26743130006

Abstract #: [DW012]

MATRIZ DE GESTIÓN PARA EL ABASTECIMIENTO ANTE ESCENARIOS DE CAMBIO CLIMÁTICO

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Autonomous University of Yucatán

Abstract

En acuíferos de poblaciones costera se tiene un fenómeno en común, “Intrusión Salina”, esta amenaza la calidad del agua desde el punto de vista de consumo humano. La presente investigación realizó un estudio preliminar de los efectos a futuro que se tendrá la intrusión salina sobre el sistema de abastecimiento de Sisal Yucatán, el punto de partida es el estudio realizado por Canul-Macario, donde evaluó los efectos físicos del aumento el nivel del mar en la salinidad el acuífero cárstico costero del noroeste de Yucatán, para el cual proyectó el avance que tendrá la cuña salina en el acuífero para los años 2040 y 2100, los cuales corresponden al escenario de aumento del nivel del mar (SLR por sus siglas en ingles). El estudió de la intrusión salina es a futuro, por ello se realizó la proyección de población para los mismos escenarios, puesto que implica un aumento en la demanda de agua. Para validar y seleccionar un modelo preciso de proyección se elaboró una matriz de comparación en las cuales se evaluaron los criterios de Error Absoluto, RMSE, Coeficiente de Correlación de Pearson y Coeficiente de Eficiencia de Nash-Sutcliffe. Los resultados preliminares del análisis permite proponer una matriz de gestión que servirá como base para aquellos encargados de la toma de decisiones, al presentar un panorama de los efectos que la intrusión salina junto al cambio en la demanda de agua tendrán para la población de Sisal y con ello tomar las medidas de mitigación adecuadas.

Characterisation of faecal material from rural school sanitation systems, for its optimal valorisation and safe disposal

Yuri Ramruthan

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Abstract

Poor sanitation facilities in South African rural schools are barricading youth from their education, due to an unsafe learning environment. This leading to severe health risks and derails from the 4th and 6th SDG. This study guides engineers and regulators in establishing safe, equitable and sustainable sanitation, by promoting sustainable energy mechanisms such as; bio-char, and biogas.

This research evaluated the optimal valorisation of faecal sludge from school sanitation facilities (ventilated improved pit latrines (VIPs), portable toilets (PTs) and septic tanks (STs)), through characterising their physico-chemical, thermal, thermodynamic and mechanical properties. These data informs the treatability and reusability of organic and inorganic products in terms of energy and nutrient yield in the context of rural schools in SA.

All containment systems contained comparable energy and nutrient potential to fuel woods and chemical fertilisers respectively. Particularly, fresher faeces from PTs exhibited the highest solids concentration (~18% TS), organic fraction (~78,37% VS) and therefore calorific value (23,24 MJ/kg dry solids). The opposite was observed for VIPs (~45,47% VS). Portable toilets also illustrated the highest mean nutrient composition and demonstrated improved treatability - a lower shear yield stress at the same solid's concentration to the more degraded faecal sludge from VIPs and STs. Inadvertently improving flowability and reduces pump head for emptying technologies and treatment processes.

Overall PTs show more appreciable levels of nutrients, making it more applicable for fertilizers and agricultural use. They exhibited the highest calorific value and COD concentration making it best for biofuel and biogas production. Practically, PTs demonstrated the greatest potential to enable circular economy opportunities. However, they currently act as a temporary containment solution, with limited maintenance and negative user perception. Therefore, consideration to improve user experience and safety is as critical to the final treatment, by maintaining a high standard of hygiene through providing amenities like toilet paper, handwashing water and soap, menstruation bins and frequent cleaning.

Abstract #: [DW005]

Degradation of Efavirenz and Nevirapine using chlorination - Kinetics and effect of operational parameters

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Durban University of Technology

Abstract

The prevalence of antiretroviral (ARV) drugs as recurrent emerging contaminants (ECs) in chlorination process is not thoroughly studied. The effect of operational parameters (pH, ARV initial concentration, initial chlorine concentration, and temperature) was investigated during the removal of Nevirapine (NVP) and Efavirenz (EFV) by chlorination. Comprehensive degradation kinetics of NVP and EFV in chlorination was also carried out. When the estimated apparent second order rate constant values (Kapp) were plotted against measured apparent second order rate constant (Kapp) values, a good agreement was observed, indicating the validation of the probable chlorination reactions. The half-life times and oxidant exposures contact time (CT) were calculated, for 95% and 99% removal of the two ARV. The maximum Kapp obtained for NVP was 109.67 x 10 -2M-1. S-1, under the following experimental conditions at pH 7.5 and 25°C, and the highest Kapp for EFV rate was 95.47 x 10 -2) M-1. S-1, under the same conditions.

Abstract #: [WH001]

Tools for sustainable safe water partnerships

Karl Zimmermann

University of British Columbia, Canada

Abstract

The UN's sixth Sustainable Development Goal envisions safe water and sanitation for all. To achieve SDG6 by 2030, we propose a partnership approach where local voices are empowered to contribute opinions like water needs and local capacity, that come only from a lifetime of experiences in their village.

In this presentation, we share tools to foster water partnerships built on collaboration and trust. Specifically, we consider: 1.Who are the necessary stakeholders. 2.What are the roles of each stakeholder, and 3.What tools empower everyone to share their opinions and experiences? The findings are informed by hundreds of discussions with community-level actors in Madagascar, Uganda, Canada, India, Peru and Nepal. While these areas represent diverse water challenges and cultures, a (non-surprising!) common story emerged around how to build respectful and collaborative partnerships.

These recommendations are shared through photographs and case studies, exemplifying how a partnership approach can help accelerate towards SDG6.

Abstract #: [CC001]

Navigating a Challenging a Future with Strategic Water Distribution Design and Construction

Sam Ghosn

Ductile Iron Pipe Research Association

Abstract

Climate change, population growth, tight municipal budgets, and energy cost, are posing sustainability challenges to our water management system. Standard engineering practices aim to provide a reliable engineering design that allows water and wastewater pipeline tolerate standard loading conditions.

Reliability threats such as construction and maintenance errors, cyclic fatigue, transient pressures, corrosion control, and extreme loading conditions, remain a challenge for pipeline owners. If not taken into consideration during the design and construction phase of new construction projects, those threats could cause premature failure of pipelines, thereby reducing their anticipated service life significantly.

On the other hand, it is becoming increasingly apparent that unavoidable failures are occurring due to the magnitude and intensity of wildfires, earthquakes, hurricanes, floods, and extreme weather conditions; thereby, emphasizing the need for a resilient and sustainable performance-based engineering practice to ensure that impacts are minimized on pipelines, recovery is quick, and functionality is maintained in the long term while considering the consequences for society, the economy, and the environment.

In this presentation, we will discuss threats on municipal water and wastewater pipelines. In addition, we will present long-term strategies for balancing the engineering design practices between reliability, resilience, and sustainability. Ultimately, those approaches allow current and future pipelines to respond and quickly recover from extreme events, thereby maintaining essential services such as water and wastewater.

Waste Reduction versus Waste Recovery; A Worldwide Future Concept

Reza Malekzadeh-Viayeh, Elsayed Elbeshbishy

Department of Civil Engineering, Toronto Metropolitan University

Abstract

Several sectors of human life have been benefited from the advances in biological sciences and biotechnological approaches. The traditional agriculture practices adversely impact the environment by considerable land and water exploitation, water pollution through the release of fertilizers and nutrients, e.g. nitrates and phosphates, pesticides, herbicides and biological contaminants, and lower shelf life of the products. However, improved knowledge of biological manipulation, selective breeding and hybridization has helped with considerable reduction in the required land, water, fertilizers and pesticides, as well as the production of the crops which have faster growth rate while have longer shelf life. As a consequence of such advancements, natural land and water resources are less impacted, and wastewater and solid wastes from agricultural activities are reduced considerably. In addition, a great deal of work in the wastewater management facilities are being done by microorganisms in both aerobic and anaerobic systems. Biological and environmental manipulation of the system, e.g. selection and proliferation of the specific bacterial communities for certain waste groups, can substantially increase the efficiency of the system and the recovery process. Collaborative attempts by biologist, environmental experts and engineers are required to minimize the land and water use, waste products and to develop the technologies to recover the waste at most and produce more value-added products.

Urban Water Systems

Abstract #: [UM001]

Dynamic Model Development for Management of Water Distribution System

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Abstract

Optimized management of water distribution systems using a hydraulic model enables to a reduction of demand deficit by up to 40%. A digital twin of a water distribution system is a model having an exchange of data between physical infrastructure in both directions which facilitates the operator/engineer with real-time monitoring, anomaly detection, emergency planning, maintenance scheduling, operational optimization, and predictive maintenance. All of these require a robust model which is well-calibrated and validated. A framework is proposed and showcased for the development of a dynamic model using a CAD of the physical infrastructure. A model was developed for EPANET using CAD of the network which was fed with baseline data. A zone of the network was calibrated for hydraulic parameters using real-time data from sensors and chemical parameters from field tests for an established interval of time. The simulation of the end model shows areas more affected during emergencies, pipes prone to leakages as well as deposition, fairly sharing water resources between usages, following the priorities.

Abstract #: [DW009]

Micro-Management: Insights from In-Line Bacterial Monitoring of a Drinking Water Treatment System

Fiona Webber, Claire Thom, Paul Weir

Scottish Water

Abstract

Central Message

Scottish Water use flow cytometry (FCM) for microbial risk management to reduce bacteriological water quality (WQ) failures. However, current microbiological monitoring methods have limitations:

• One sample is taken per day (drinking water is produced 24-hours per day, so representation is limited);

• Water is collected by a sampler, transported to the laboratory and analyzed within 48-hours (potential handling issues, WQ changes);

• Limited ability to understand how other conditions (e.g., temperature, flow rates, other WQ parameters) affect cell counts.

Keywords: Flow Cytometry, Drinking Water, Water Quality

Materials and Methods:

Scottish Water aimed to determine whether increasing sampling frequency; and analyzing samples on-site (automatically) could advance our understanding of cell count dynamics in relation to other observed WQ conditions, and consequently enhance our risk management capabilities.

The Bactosense is an in-line, automatic flow cytometer, that was installed at a Water Treatment Works in central Scotland for a 12-month period. Two devices, located at different treatment stages, were set to take sample every 2 hours via a direct sampling line.

Results and Discussion:

Water temperatures below 8 Deg. C (Figure 1) were associated with higher Total Cell Counts (TCCs), while increasing flow rates above 2 m3-1 (Figure 2) caused a linear increase in TCC well above 100,000 cells ml-1. Raw water turbidity also showed a close relationship with Final Water TCCs.

The Bactosense can advance our understanding microbial water quality in the context of drinking water

treatment. Further trials of this technology are being carried out to test the versatility of the device, and risk management practices developed to help manage future microbial risks.

Abstract #: [UM004]

Capillary-Driven Artificial Trees for Extreme Weather-Resistant Urban Infrastructure: Feasibility and Scalability

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Abstract

The ever-more frequent, extreme weather events have necessitated the development of effective technologies to manage the greater amount of stormwater and urban heating during the events. Recent progresses in capillary-driven dewatering processes have shown the potential to transform urban buildings into artificial trees that can transport water up the sides of buildings and evaporate off the buildings. In this work, we demonstrate the feasibility and scalability of a bench-scale dewatering device that mimics three different water transport functions in trees: solute rejection at the root, water conduction through the stem, and evaporation through leaves. First, we examine the dewatering performance of this artificial tree under varying environmental conditions, including humidity, temperature, and air stream velocity. We show a stable dewatering performance of the artificial tree device even under large negative capillary pressure (-20 bar) without cavitation, making it suitable for building-scale applications. Molecular dynamics simulations are also presented to illustrate the impact of the surface wetting and structural properties of the water conduits of the device. Finally, we construct a device with a 3D-printed nanocellulose stem with a hydrogel leaf to demonstrate the scalability of the device and the stable dewatering operation in harsh conditions. Our work demonstrates the feasibility of capillary-driven, tree-mimicking dewatering technology that can effectively remove stormwater and provide passive cooling in urban environments.

Abstract #: [UM005]

Coding Water Efficiency

Rachel McBrien, Ayo Tijani

Mott MacDonald

Abstract

Many Engineering projects involve the authoring of repetitive documentation. On one key project that aimed to track clean water leakage from pipelines across a major city, this was the case. This project involved constructing chambers around clean water mains that enabled a tracking device to be inserted into the main. The tracking device travelled with the water flow along the main and identified any leaks, enabling the leak to be fixed and a reduction in clean water loss. An automation process was developed to speed up the method and create the required designer documents faster and with a lower opportunity for human error.

A lot of similar hazards arise for each site making it simple to develop a checklist to mark yes/no against these repetitive issues. Along with a checklist, a table enabling user inputs was created for any more detailed research findings, such as where a list or description of a specific hazard is required. A VBA code was written using the find and replace function on word, that could populate the necessary templates using data from a table. The input required from the author was reduced to doing the research and in putting the findings in a table, saving time formatting, and typing out repetitive inputs.

The time saved using this automation process enables a larger volume of packs to be developed in a set time, allowing additional chambers to be built, more leaks to be identified, and ultimately less water from being lost. The automation facilitates good design and risk identification, but the output will still only be as good as the input. This automation has begun with a simple 'home-made' approach to coding and has the potential to develop a user-friendly tool accessible across multiple projects and sectors within the industry.

Abstract #: [WS001]

Assessment of effectiveness on current sewerage/ Septic tanks maintenance guidelines

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Abstract

SDG6 goals of ensuring safe water and sanitation and hygiene is incomplete without ensuring hygiene for sanitation workers. Among multiple profiles of sanitation workers in India e.g., Toilets cleaners, Open drains cleaners, STP operators etc. Sewerage maintenance workers are at highest risk due to multiple reasons including but not limited to exposure to hazardous gases, drowning, accidents, infections, etc. Absence of basic requirements like PPE, trainings, SOP multiplies this problem to manifold. Due to these multiple risks, avg. life of sanitation workers in India is less than 50 years as compared to national avg of 65 years.

Though India has legal acts framed to ensure protection of the divers called 'The Prohibition of Employment of Manual Scavengers and their Rehabilitation Act, 2013' by Ministry of Law. Further, SOP for Cleaning of Sewers and Septic Tanks is published in 2018 and advisory also rolled out in 2021 for creating ERSU (Emergency response sanitation unit) which focuses on ensuring safety during sewer and septic tank cleaning. However, all directives focus on giving proper training , proper PPE and improving life conditions for sewerage workers, but a proper training module and set of PPE gears, acc. to Indian sewerage system is absent at National level. Despite having all rules and regulations usage of PPE gears and implementation of trainings for workers is almost negligible. In order to undertake in-depth analysis of current sewage maintenance practices (including measures for occupational safety, prevention from diseases) with the aim of understanding resultant safety and health hazards for SEP along with to understand the relevance and sufficiency of legally-mandated PPE and to understand challenges in usage a primary research has been conducted in multiple cities in India on 200+ sewerage workers.

Poster Session

Land use, important parameter for aquifer protection

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ABSTRACT

Groundwater is the main source of supply in many counties; however, the high permeability of some geologic materials makes aquifers vulnerable to contamination. Therefore, there is a need for implementing practical actions to protect the natural quality of groundwater. Because groundwater contamination varies spatially, it is necessary to focus efforts, technologies and strategies on the most threatened areas. Modeling and mapping the vulnerability to pollution is a first-step in implementing groundwater management and protection programs.

Groundwater pollution vulnerability was estimated by means of a modified DRASTIC model. The DRSTIL model (D = depth-to-water table; R = recharge; S = soil media; T = topography; I = impact of the vadose zone; L = land use) was applied in the karstic aquifer of Yucatan, Mexico. Each factor was developed using databases and shapefiles available in governmental web portals. Those factors, its maps and the groundwater vulnerability map were developed using Geographic Information System (GIS).

This work presents a methodology proposed for groundwater pollution risk assessment that will provide information about hazards and analyze groundwater pollution vulnerability under climate change scenarios and the effects of future land use and change.

Nanomaterial-Amended Anaerobic Digestion: Effect of pH as a Game Changer

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Abstract

This study explores the pH-dependent role of nanomaterials, such as graphene oxide, magnetite, magnetic graphene oxide, and magnetic reduced graphene oxide, in anaerobic digestion (AD). Using batch biochemical methane potential assays, we show that the AD system is sensitive to pH, and nanomaterial effects vary under optimal (≈ 7.5) and elevated (≈ 9) initial pH. At neutral pH, magnetic reduced graphene oxide notably boosts methane production rates by 51%, while the rate decreases by 14% at elevated pH. These findings underscore the need for standardized procedures in nanomaterial-amended AD studies, highlighting pH as a crucial factor.

Keywords: pH dependence; Anaerobic digestion; Wastewater sludge treatment; BMPs; Nanomaterials; Instability.

Abstract #: RR014

Modeling of Gasification Process for Energy Recovery from Organic Waste

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Abstract

Due to the world population explosion, the production of waste has experienced a dramatic increase. Many research projects have demonstrated the possibility of converting organic waste into energy. An in-depth literature review was carried out to investigate energy conversion methods for organic waste streams. These methods are developed from two approaches, namely biological conversion (i.e., anaerobic digestion) and thermochemical conversion (i.e., pyrolysis, gasification, hydrothermal carbonization). This review focused on their concepts, selection, and the effect of varying parameters on their production and efficiency. Hydrothermal carbonization appears to be the most energy-efficient process, for it has the lowest feedstock and operation condition requirement. Additional to the literature review, a simulation model was developed for the gasification process using Aspen Plus. The model was validated and can be used to predict gasification performance. The gasifier was modeled in two stages. The feedstock is decomposed into its conventional fractions in the first stage by calculating elemental yield. In the second stage, gasification reactions were modeled from a minimizing Gibbs free energy approach. Sensitivity analysis was conducted to study the effect of varying temperature, gasifying agent, steam ratio, and equivalence ratio on syngas composition and syngas higher heating value (HHV). Higher temperature increases the production of carbon monoxide and hydrogen, thus the syngas HHV. Steam as gasifying agent favors hydrogen production, while oxygen and carbon dioxide gasification favors carbon monoxide production. A lower steam ratio and equivalence ratio of 0.1-0.3 is optimal for hydrogen, carbon monoxide production and syngas HHV. The performance of three feedstocks used in gasification was analyzed, including livestock manure, food waste, and wastewater sludge. Wastewater sludge is the ideal feedstock for gasification, for it can generate syngas with the highest energy content (HHV).

Abstract #: IW007

Performance prediction of anaerobic co-digestion of pulp & paper and municipal sludge with food waste using machine learning algorithms

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1. PhD student
2. Assistant Professor

Abstract

Effluents from pulp and paper (P&P) mills as well as primary and secondary sludge from wastewater treatment plants contain a large amount of organics. The high organic load of these waste streams makes them suitable for anaerobic digestion (AD) treatment. A limitation to the anaerobic digestion of P&P is the carbon to nutrient ratio (C/N). A high C/N ratio of P&P sludge prevents the AD process from having optimum results. High C/N ratio inhibits methanogenesis through the rapid nitrogen consumption by methanogens. To overcome this issue, digesting two substrates, each rich in carbon and nutrients, enhances the anaerobic digestibility of the feedstock. Balancing carbon and nutrient content by mixing materials with a high C/N ratio with a low C/N ratio feedstock improves the process's stability and performance, leading to higher energy recovery. Finding the optimum operating conditions or including at least a logical and practical range of conditions at which the process of anaerobic co-digestion (AnCoD) is efficient is important to save time, cost and energy. Reviewing the published literature has revealed that the use of AD technology for the P&P industry is limited to a few studies and, therefore, insufficient data is available with respect to the co-digestion of sludge generated from these facilities. The closest substrate to P&P sludge is waste-activated sludge, for which the feasibility of co-digestion application has been well demonstrated in the literature. This project aims to model the results of previously published works on co-digestion of waste activated sludge and P&P sludge with food waste to determine the optimum conditions and produce a predictive model that can forecast the result of various scenarios. Three machine learning algorithms, namely random forest, extreme gradient boosting, and deep learning are assessed for their feasibility of predicting co-digestion performance on the operating parameters collected in published articles on waste-activated sludge and P&P sludge. The accuracy in predicting model outputs, such as methane production, is evaluated for each method by calculating the root mean squared error (RMSE) and R squared methods. This study demonstrates the potential of using machine learning algorithms to model AnCoD.

Abstract #: WS008

Biofiltration combinée du méthane et des lixiviats de sites d'enfouissement

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Abstract:

Les sites d'enfouissement produisent des biogaz chargés en méthane (CH4) et dioxyde de carbone (CO2) et des lixiviats chargés en matière organique, azote et métaux. Les lixiviats sont traités et le biogaz peut être valorisé, brûlé, ou rejeté directement dans l'atmosphère. La biofiltration du biogaz est étudiée pour limiter les rejets de CH4 (Cabral et al., 2010; Nikiema et al., 2007). Cette biofiltration utilise des microorganismes méthanotrophes qui oxydent le CH4 en CO2 (réaction exothermique). Pour se développer, ces microorganismes ont besoin de nutriments qui pourraient provenir des lixiviats. L'objectif de cette recherche est d'étudier les performances d'une biofiltration combinée. Des biofiltres pilotes (44L) sont installés avec des supports organiques (tourbe, copeau) et inorganiques (béton recyclé) pour traiter un biogaz avec 2% de CH4 (Figure 1). Les nutriments provenaient des lixiviats ou d'une solution synthétique. Les performances épuratoires du CH4 (biogaz) et de l'azote (lixiviats) ont été suivies sur 215 jours. L'abattement du méthane a atteint en moyenne 65% sur support inorganique avec un maximum à 82% alors qu'il a varié, entre 35 et 45% avec des maximums d'environ 85% sur support organique. L'enlèvement moyen du nitrate a été de 40 % pour tous les biofiltres. On remarque une carence en phosphore dans les lixiviats utilisés. La température interne, produite au cours du traitement, apparait comme un bon indicateur de performances (Figure 2). Ces performances n'ont pas atteint un niveau de traitement stable et élevé tel qu'attendu. Une recherche sur des éléments limitants et inhibiteurs dans les biofiltres serait nécessaire. (Cabral, A.R., Moreira, J. and Jugnia, L. 2010. Biocover Performance of Landfill Methane Oxidation: Experimental Results. Journal of Environmental Engineering 136(8), 785-793), (Nikiema, J., Brzezinski, R. and Heitz, M. 2007. Elimination of methane generated from landfills by biofiltration: a review. Reviews in Environmental Science and Bio/Technology 6(4), 261-284) Biofiltre, Méthanotrophe, Lixiviats.

Phosphorus removal from wastewaters: increase in adsorption capacity and characterization of 3 activated wood species

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Abstract

"The Quebec Government is tightening phosphorus discharge requirements. Conventional phosphorus removal processes require maintenance and are expensive. There are only two passive phosphorus removal technologies certified in Quebec by the Bureau de Normalisation du Québec (BNQ). Therefore, it is necessary to target a robust and low-cost phosphorus removal process based on natural material. Research conducted at Investissement Québec-CRIQ focused on the development of a passive phosphorus capture process (Techno-P) characterized by biofilters with active wood-based media impregnated with iron hydroxide. These studies have shown that anaerobic columns were able to maintain phosphorus concentration in the effluent below 0.3 mg P/L through adsorption, ion exchange and precipitation by reductive dissolution. However, the phosphorus adsorption capacity of the media is limited to 4.4 mg P/g. The objective of the study is to increase the dephosphatation capacity of Techno-P technology. Three wood by-products (yellow birch, red oak, and softwood mixture) were harvested from a sawmill. Two types of treatment were applied to obtain activated wood media. Different concentrations of ferric chloride ($FeCl_3$), contact times and liquid/wood ratios were tested during the impregnation process. Results indicate that the maximum phosphorus adsorption capacity differs according to the wood species tested and a greater phosphorus adsorption capacity is achieved with a higher $FeCl_3$ dose and liquid/wood ratio. Langmuir and Freundlich isotherms fit the data and were suitable to describe phosphorus adsorption capacity of activated media impregnated with $FeCl_3$. The next stage is to conduct an experimental set-up of 6 biofilters filled with activated yellow birch and fed with a synthetic solution containing phosphorus and nitrate."

Venue Map

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