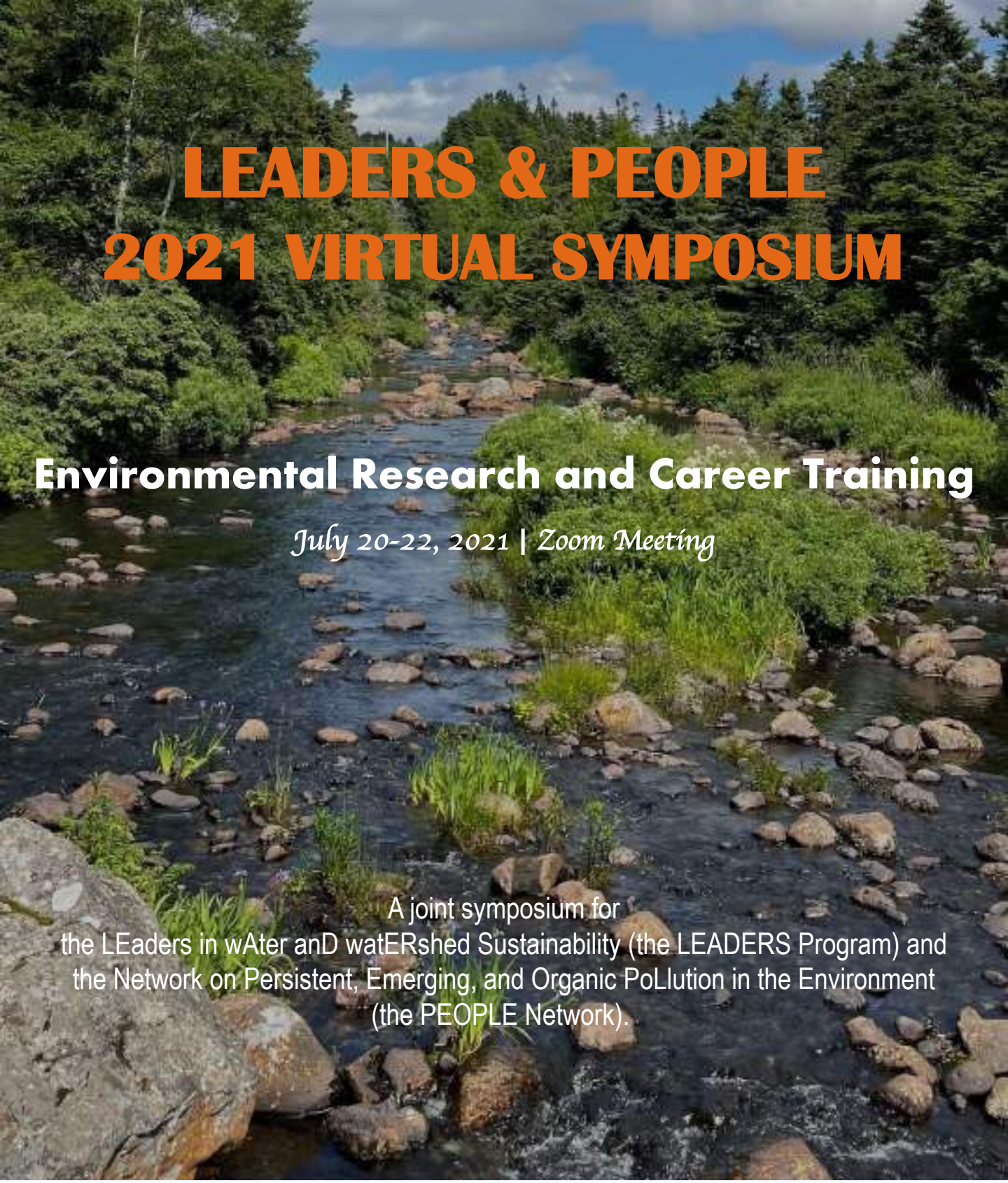

LEADERS & PEOPLE 2021 VIRTUAL SYMPOSIUM

Environmental Research and Career Training

July 20-22, 2021 | Zoom Meeting

A joint symposium for
the LEaders in wAter anD watERshed Sustainability (the LEADERS Program) and
the Network on Persistent, Emerging, and Organic PoLlution in the Environment
(the PEOPLE Network).

LEADERS CREATE

PEOPLE Network
Persistent, Emerging, and Organic Pollution in Environments

Two programs funded by

NSERC CRSNG

Welcome Message

We invite you to join us for the second LEADERS & PEOPLE Virtual Symposium: **Environmental Research and Career Training**, July 20-22, 2021! This symposium is co-hosted by the Leaders in wAter anD watershed Sustainability (the LEADERS Program, led by Queens University) and the Network on Persistent, Emerging, and Organic PoLlution in the Environment (the PEOPLE Network, led by Memorial University) for Highly Qualified Personnel (HQP) training. Both are funded by the Collaborative Research and Training Experience (CREATE) Program of the Natural Sciences and Engineering Research Council (NSERC) of Canada.

Persistent, emerging, and organic pollutants pose ecological and health risks due to their persistent, toxic, carcinogenic, and/or bio-accumulative properties and associated long-term ecological and health risks. Many are not regulated or legislated, mainly due to the lack of in-depth knowledge about their fate, transport, impact, or corresponding lack of effective management and mitigation. These emerging pollutants are found in air, surface water, groundwater, ice caps, oceans, soils, and sediments, and there is increasing evidence of their toxicity at all trophic levels, highlighting an urgent need for effective management and mitigation approaches globally. The topic becomes ever challenging in the context of climate change and important for science and policy.

This symposium will bring in a variety of keynote speeches, technical presentations, workshops, and career panels on the above topic and more. We welcome you all to join us for an exciting three days of learning, sharing ideas, and virtual networking!

Regards from your symposium chairs,

Dr. Stephen Brown
Director, the LEADERS Program
Associate Professor
Department of Chemistry &
School of Environmental Studies
Queen's University
Kingston, ON, Canada

Dr. Chen, Bing
Director, the PEOPLE Network
Professor & Head
Department of Civil Engineering
Faculty of Engineering and Applied Science,
Memorial University
St. John's, NL, Canada

Both programs
funded by

Symposium Co-Chairs

Dr. Stephen Brown
Director, the LEADERS Program

Dr. Stephen Brown is an Associate Professor in the School of Environmental Studies and the Department of Chemistry at Queen's University. He is the Principal Investigator and Program Director for the LEaders in wAter anD watERshed Sustainability (the LEADERS CREATE Program), which brings students from a variety of schools and departments to the forefront of water research through an interdisciplinary approach to develop future leaders in water related science and policy. Dr. Brown's research group focuses on the development of new methods of environmental analysis, with emphasis on detecting small organic compounds in aqueous samples. This requires development of instruments and chemical/biochemical assays to provide sensitive and selective measurement of a particular contaminant. Dr. Brown has an extensive track record in the commercialization of water sensor technology and is also the principal inventor of IP and co-founder of TECTA PDS Inc which markets automated microbiological water quality monitoring systems. TECTA PDS was originally formed in 2003 as a direct result of the Walkerton disaster in Ontario to revolutionize microbiological monitoring methods.

Symposium Co-Chairs

Dr. Bing Chen
Director, the PEOPLE Network

Dr. Bing Chen is a Professor and Head of Department of Civil Engineering and Director of Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory at Memorial University. He is also the founding Director of the global Network on Persistent, Emerging and Organic PoLlution in the Environment (PEOPLE Network). He is an elected Fellow of Engineering Institute of Canada (EIC), Fellow of Canadian Society for Civil Engineering (CSCE), and Member of Royal Society of Canada (RSC) College. He is an internationally respected leader in environmental engineering research and application with exemplary achievements in water and wastewater treatment, environmental emergency responses, persistent and emerging contaminants, AI-aided decision making, marine and coastal protection, environmental sustainability, cold region and climate change studies. He has produced over 400 technical publications and trained over 70 thesis-based graduate students and postdocs. He has served as VP of CSCE, VP of Canadian Association on Water Quality (CAWQ), VP of Sigma Xi Avalon Chapter, Senior Advisor of United Nations Development Programme, Member of RSC Expert Panel, Editor-in-Chief of Environmental Systems Research, and adjunct/visiting professor of 6 institutions worldwide. He has given over 70 invited keynotes and guest lectures worldwide. He has received over 40 awards and honours such as WEF A.S. Bedell Award, Terra Nova Innovator Award, FEAS award for Research Excellence and various conference/paper awards. As a registered Professional Engineer, he has provided consulting service to government, industry, NGOs and communities globally.

PEOPLE Network
Persistent, Emerging, and Organic Pollution in Environments

NRPOP LAB
Northern Region Persistent Organic Pollution Control Laboratory

MEMORIAL UNIVERSITY

Topics and Awards

All current students and postdoctoral fellows under the LEADERS and PEOPLE CREATE programs will present their research related to, but not limited to the following topics:

- Persistent, emerging, and oil pollutants (PEOPs) monitoring, analysis, fate, and transport
- PEOPs prevention, treatment, and remediation
- Ecological impact, toxicological analysis, and risk management
- Community health effects and technology transfer

Student awards:

All undergraduate, masters, and Ph.D. presenters are competing for the student awards. Presentations will be evaluated by faculty, postdoctoral fellows, and student judges. A First and a Runner-up will be selected for each program. Student awards will be announced at the closing ceremony.

Student award evaluation criteria:

Each student presentation will be rated by two sessional co-chairs (faculty - 50% weight; postdoctoral fellow - 30% weight) and a student judge (20% weight) on the following categories:

- Organization and Appearance (10 points)
- Presentation (10 points)
- Research Concept and Methodology (10 points)
- Research Analysis and Discussion (10 points)
- Answering Questions (5 points)

Symposium Organizers

Dr. Weiyun Lin
Coordinator
PEOPLE Network
Memorial University

Sophie Felleiter
Coordinator
LEADERS Program
Queen's University

Program Book Design

Yunwen Tao

Technical Support

Sophie Felleiter
Xudong Ye

Social Media Coordinators

Fei Wu
Xixi Li
Yunwen Tao
Zachary Lehman

Student Judges

Faisal Fahd
Jeffrey Cederwall
Lauren Halliwell
Mengfan Cai
Paisley Thomson
Sayed Nasiruddin
Yiqi Cao

(Alphabetical Order)

Keynote Speaker

Dr. Jayadev Raju

Vice President of Society of Toxicology of Canada
Research Scientist
Regulatory Toxicology Research Division
Bureau of Chemical Safety, Food Directorate,
Health Products and Food Branch, Health Canada,
Ottawa, Ontario, Canada

Dr. Raju will give a keynote speech on:

Food toxicology – A vital interphase of biology and chemistry research influencing food chemical safety and regulation

The identification and investigation of foods and food constituents, including additives, natural contaminants, and processing-induced/packaging-migration chemicals for their potential hazard to human health are key factors in providing food safety advice by Canadian food regulators. The Food Directorate's Regulatory Toxicology Research Division (RTRD) within Health Canada uses a multidisciplinary toxicological approach to identify and characterize food-based human health hazards of priority food chemicals. Harmonized and standardized testing to characterize chemical hazard characterization are conducted according to testing guidelines set by Organization Economic Cooperation and Development. Furthermore, well-established experimental protocols using rodent species are utilized to understand exposure-related toxicological and/or carcinogenic mode of action, and influences on apical end points and toxico-genomic/proteomic/metabolomic targets. Current projects in the laboratory include the toxicology of the process-induced food contaminants: acrylamide and chloropropanols. Overall, our studies emphasize the inter-disciplinary aspects of food regulatory process by combining toxicology, pathology, nutrition, food chemistry, biochemistry and aims to deliver refinement of the hazard characterization for toxicological evaluation, regulation and policy governing the use/occurrence of chemicals as/in foods.

Career Session Panelists

(Alphabetical Order)

Government panelist

Dr. Charles W. Greer
Principal Research Officer and the Group Leader
National Research Council Canada

Charles Greer is a Principal Research Officer and the Group Leader of the Genomics and Microbiomes Group in the Energy, Mining and Environment Research Centre (EME) of the National Research Council Canada, where he has been since 1987. He served as the Director of Research and Development at EME-Montreal from April 2011 to May 2013 and again from Nov. 2014 to June 2015. He is an adjunct professor in the Department of Natural Resource Sciences of McGill University since 1992 and the Biology Department of the University of Sherbrooke since September 2014, and an Editor for the Canadian Journal of Microbiology.

He is a microbiologist/microbial ecologist working on the biodegradation of organic pollutants, bioremediation, phytoremediation and monitoring microbial community structural and functional diversity related to ecosystem processes using metagenomics and metatranscriptomics. He has worked extensively in the Arctic on bioremediation projects and the effects of climate change, and in the marine environment examining natural attenuation as a remediation strategy to address oil spills. He has authored or co-authored more than 250 peer-reviewed publications and currently serves on the science technical advisory committees of the Prince William Sound Oil Spill Recovery Institute and the Environmental Science Research Funds.

Career Session Panelists

(Alphabetical Order)

Academia panelist

Dr. Lelia M. Harris
Professor
Institute for Resources Environment and Sustainability (IRES)
Institute for Gender, Race, Sexuality and Social Justice (GRSJ)
University of British Columbia

Dr. Leila M. Harris is a Professor at IRES Institute on Resources Environment and Sustainability and with the Institute for Gender, Race, Sexuality and Social Justice at the University of British Columbia. Dr. Harris's work examines social, cultural, political-economic, institutional and equity dimensions of environmental and resource issues, particularly issues related to water politics, infrastructures, and governance.

Earlier work focused on water related development and change in the upper Tigris-Euphrates basin of southeastern Turkey, connecting issues of irrigation use, management and agro-ecological transformation to ongoing socio-political and economic changes (at household, village, and regional scales). This work particularly emphasized gender, ethnicity, and state formation as key to the negotiations of ongoing water related changes. Her current research focuses on the intersection of environmental issues and inequality / social difference, water governance shifts (e.g., marketization, participatory governance, and transformative governance for equity and sustainability), as well as a range of water governance challenges important for the Canadian context (e.g., First Nations water governance in British Columbia).

Career Session Panelists

(Alphabetical Order)

NGO panelist

Michael Dakin
Water Resources Manager/Planner
Cataraqui Conservation Authority

Michael Dakin is a Resource Planner with the Cataraqui Conservation (CRCA) based out of Kingston, Ontario. As a Resource Planner, Michael's primary role is development review with a focus on environmental features and natural hazards. CRCA reviews Planning Act applications and provides technical comments for 11 member municipalities in eastern Ontario. Michael has been with the CRCA since 2008. He is a Registered Professional Planner and has an undergraduate degree from Queen's University and a Master's of Planning degree from the School of Urban and Regional Planning (SURP) at Queen's.

Career Session Panelists

(Alphabetical Order)

Industry panelist

Dr. Vanessa Mann
Lead
Research and Development, Teck Resources Limited

Dr. Vanessa Mann is a professional engineer with over 12 years of experience, including a broad background in chemistry and hydrogeology. Vanessa is currently a Lead in the Applied Research and Development group at Teck Coal (Teck) based out of Sparwood, British Columbia. In her role at Teck, she leads a variety of research programs aimed at reducing the impacts of mining on water quality in the Elk Valley of Southeastern B.C. Vanessa previously worked as a Hydrogeological Engineer at BGC Engineering, where her role included groundwater modelling and related site investigations, developing experimental methods for reclamation and remediation technologies, mine closure planning, water supply analyses and more. She is a Professional Engineer and has two undergraduate degrees from Queen's University, a Master's from the University of Guelph and a PhD from Queen's in Civil Engineering (Hydrogeology), where she researched flow and transport in fractured rock, with an emphasis on the influences of increasing velocity on estimates of flow and transport parameters, and the effects of biobarrier technology on contaminant transport. When she's not working, you'll find her hiking, mountain biking, cross-country skiing and enjoying the mountain lifestyle.

PhD Seminar

Jeffrey Cederwall
PhD student
Biology Department, Queen's University
Queen's Experimental Ecology & Ecotoxicology (QE3) Research Group

Jeffrey Cederwall is a PhD student in the Biology Department at Queen's University in the Queen's Experimental Ecology & Ecotoxicology (QE3) Research Group, directed by Dr. Diane Orihel, and was supported by the NSERC CREATE program for LEaders in wAter anD watERshed Sustainability (LEADERS-CREATE). Through large-scale field experiments, he investigates how crude oil spills of diluted bitumen affect the structure and function of the lower aquatic food-web, by focusing on phytoplankton and microbial communities, within Canadian boreal lakes. Jeffrey is a Métis citizen from the traditional territory of Treaty 3 in Northwestern Ontario. He grew up in the town of Kenora, ON, spending most of his free-time in the "bush" and on the water. Growing up surrounded by abundant freshwater lakes, rivers, and streams, he has focused his formal education and work around aquatic ecosystems. He has worked a diverse range of research and monitoring programs including: the assessment of threatened populations of lake sturgeon in the Winnipeg River system; whole fisheries population assessments on Lake of the Woods including targeted studies on walleye, lake trout, and invasive species; whole ecosystem research on aquatic mercury contamination, harmful algal blooms from excessive nutrients, water diversions, and climate change; pesticide residues including neonicotinoids on pollen and nectar, fungicide soil runoff, and safe levels in harvested crops; and surface water phosphorus monitoring in Ontario for both citizen and government science. Jeffrey actively supports his local community by participating in environmental assessments and consultations with industry proponents as well as with the Canadian federal and the Ontario provincial governments. He is working towards a world of sustainable development where local communities can see the social-economic benefits of resource development while protecting both the ecosystem and Indigenous way-of-life through respectful consultations, and applying evidence-based mitigations.

Abstract

Symposium Agenda

LEADERS & PEOPLE 2021 Virtual Symposium: Environmental Research and Career Training

July 20th-22nd, 2021

Zoom Meeting | **Location:** Zoom Room 1 / Zoom Room 2

All time marked as Eastern Time

Tuesday, July 20th	
12:00 – 12:15	Introduction / Zoom Room 1 **Dr. Stephen Brown** (LEADERS) and **Dr. Bing Chen** (PEOPLE)
12:15 – 13:00	Keynote: **Dr. Jayadev Raju** / Zoom Room 1 Research Scientist, Regulatory Toxicology Research Division, Bureau of Chemical Safety, Food Directorate, Health Products and Food Branch, Health Canada, Ottawa, Ontario, Canada *"Food toxicology – A vital interphase of biology and chemistry research influencing food chemical safety and regulation"*
13:00 – 14:30	Workshop #1: Innovation/Entrepreneurship / Zoom Room 1 Instructor: **Dr. James McLellan**, Professor of the Department of Chemical Engineering, Queen's University; Academic Director of the Dunin-Deshpande Queen's Innovation Centre
14:30 – 14:40	Break
14:40 – 16:10	Student Presentation Session 1/ Zoom Room 1 Student Presentation Session 2/ Zoom Room 2
16:10 – 16:20	Break
16:20 – 17:35	Continued Student Presentation Session 1/ Zoom Room 1 Continued Student Presentation Session 2/ Zoom Room 2

Symposium Agenda

Zoom Meeting | **Location:** Zoom Room 1 / Zoom Room 2 *All time marked as Eastern Time*

Wednesday, July 21st	
12:00 – 13:30	Student Presentation Session 3/ Zoom Room 1 Student Presentation Session 4/ Zoom Room 2
13:30 – 13:45	Break
13:45 – 15:15	Student Presentation Session 5/ Zoom Room 1 Student Presentation Session 6/ Zoom Room 2
15:15 – 15:30	Break
15:30 – 17:00	Workshop #2: Seeking and Securing Opportunities / Zoom Room 1 Instructor: **Carli Fink**, Career Counsellor, Career Services, Queen's University

Thursday, July 22nd	
12:00 – 12:50	**Jeffrey Cederwall**, PhD Seminar, Department of Biology, Queen's University, *"The good, the bad, and the green: Phytoplankton and microbial responses to experimental diluted bitumen spills in a freshwater lake."* / Zoom Room 1
12:50 – 12:55	Break
12:55 – 14:25	Student Presentation Session 7/ Zoom Room 1 Student Presentation Session 8/ Zoom Room 2
14:25 – 14:35	Break
14:35 – 15:35	Career Panel: Explore your best career fit – things you want to know about different sectors / Zoom Room 1 Career Panel # 1: NGO and Industry Panelists: **Michael Dakin**, Water Resources Manager/Planner, Cataraqui Conservation Authority & **Dr. Vanessa Mann**, Lead of Research and Development at Teck Resources Limited
15:35 – 15:45	Break
15:45 – 16:45	Career Panel # 2: Government and Academia/ Zoom Room 1 Panelists: **Dr. Charles Greer**, Principal Research Officer and Group Leader, National Research Council (NRC) Canada & **Dr. Leila Harris**, Professor, University of British Columbia
16:45 – 17:00	Closing Remarks and Award Announcements/ Zoom Room 1

Meeting Location

Topic: LEADERS & PEOPLE 2021 Virtual Symposium (Room 1)

Time: Jul 20, 2021 12:00 PM Eastern Time (US and Canada)

Every day, until Jul 22, 2021, 3 occurrence(s)
Jul 20, 2021 12:00 PM
Jul 21, 2021 12:00 PM
Jul 22, 2021 12:00 PM

Please download and import the following iCalendar (.ics) files to your calendar system.
Daily: https://queensu.zoom.us/meeting/tJYpdO-qqD0tEte-2dpBi2kWl4HzWEFEjp3Q/ics?icsToken=98tyKuCqqjgsGNKTtxGERowQBojCM-rwpiFaj7dY0U3hEwJaMAjBOrZqKIVaNv3a

Join Zoom Meeting:
https://queensu.zoom.us/j/92436266783

Meeting ID: 924 3626 6783
Passcode: LEADERS
One tap mobile
+12042727920,,92436266783#,,,,*4660603# Canada
+14388097799,,92436266783#,,,,*4660603# Canada

Join by SIP
92436266783@zoomcrc.com

Join by H.323
162.255.37.11 (US West)
162.255.36.11 (US East)
115.114.131.7 (India Mumbai)
115.114.115.7 (India Hyderabad)
213.19.144.110 (Amsterdam Netherlands)
213.244.140.110 (Germany)
103.122.166.55 (Australia Sydney)
103.122.167.55 (Australia Melbourne)
64.211.144.160 (Brazil)
149.137.68.253 (Mexico)
69.174.57.160 (Canada Toronto)
65.39.152.160 (Canada Vancouver)
207.226.132.110 (Japan Tokyo)
149.137.24.110 (Japan Osaka)

Meeting ID: 924 3626 6783
Passcode: 4660603

Dial by your location

+1 204 272 7920 Canada
+1 438 809 7799 Canada
+1 587 328 1099 Canada
+1 613 209 3054 Canada
+1 647 374 4685 Canada
+1 647 558 0588 Canada
+1 778 907 2071 Canada
+1 470 250 9358 US (Atlanta)
+1 470 381 2552 US (Atlanta)
+1 602 753 0140 US (Phoenix)
+1 646 518 9805 US (New York)
+1 651 372 8299 US (Minnesota)
+1 669 219 2599 US (San Jose)
+1 669 900 6833 US (San Jose)
+1 720 928 9299 US (Denver)
+1 786 635 1003 US (Miami)
+1 929 436 2866 US (New York)
+1 971 247 1195 US (Portland)
+1 206 337 9723 US (Seattle)
+1 213 338 8477 US (Los Angeles)
+1 253 215 8782 US (Tacoma)
+1 267 831 0333 US (Philadelphia)
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)
+1 346 248 7799 US (Houston)

Meeting ID: 924 3626 6783
Passcode: 4660603
Find your local number:
https://queensu.zoom.us/u/avOdRDJSP

Meeting Location

Topic: LEADERS & PEOPLE 2021 Virtual Symposium (Room 2)

Time: Jul 20, 2021 12:00 PM Eastern Time (US and Canada)

Every day, until Jul 22, 2021, 3 occurrence(s)
Jul 20, 2021 12:00 PM
Jul 21, 2021 12:00 PM
Jul 22, 2021 12:00 PM

Please download and import the following iCalendar (.ics) files to your calendar system.
Daily: https://us06web.zoom.us/meeting/tZwvdO2rrzsuGNYTYM8UJUSRmwBRAOMULER2/ics?icsToken=98tyKuGgrDguGdWVtBuFRpw-AIjCLOnzmGJbjY1kqCbIWxV5VzDEO_VgAJNQPe38

Join Zoom Meeting

https://us06web.zoom.us/j/88234310422
Meeting ID: 882 3431 0422
Passcode: PEOPLE
One tap mobile
+13126266799,,88234310422#,,,,*755497# US (Chicago)
+13462487799,,88234310422#,,,,*755497# US (Houston)

Dial by your location

+1 312 626 6799 US (Chicago)
+1 346 248 7799 US (Houston)
+1 669 900 6833 US (San Jose)
+1 929 205 6099 US (New York)
+1 253 215 8782 US (Tacoma)
+1 301 715 8592 US (Washington DC)
+1 587 328 1099 Canada
+1 647 374 4685 Canada
+1 647 558 0588 Canada
+1 778 907 2071 Canada
+1 204 272 7920 Canada
+1 438 809 7799 Canada

Meeting ID: 882 3431 0422
Passcode: 755497
Find your local number: https://us06web.zoom.us/u/kcrY5c0TvZ

Presentation Schedule

Tuesday, July 20th (Day 1)

All time marked as Eastern Time

Session 1 (14:40 – 17:20): Toxicology & Ecotoxicology

Zoom Meeting | **Location:** Zoom Room 1

Co-chair (Faculty)	Dr. Geof Hall	Adjunct Professor, Queen's University	LEADERS
Co-chair (Postdoctoral Fellow)	Dr. Xiaying Xin	Postdoctoral Fellow, Memorial University	PEOPLE
Student Judge	Jeffrey Cederwall	PhD student, Queen's University	LEADERS

Time	Presenter	Institution	CREATE Program	Title
14:40	Olivia Dillon	Memorial University	PEOPLE	Presence of microplastics in Placentia Bay, Newfoundland
14:55	Xixi Li	Memorial University	PEOPLE	Molecular modelling of synthetic musks for obtaining environmentally friendly derivatives
15:10	Jiawen Yang	North China Electric Power University	PEOPLE	Human health risk control of organophosphorus fire retardants and molecular design of environmentally friendly derivatives
15:25	Yuanyuan Zhao	North China Electric Power University	PEOPLE	Green substitutes of neonicotinoid insecticides: molecular design and multi-directional selective toxicity effects
15:40	Xiaying Xin *	Memorial University	PEOPLE	Biochemical alteration of green alga and trophic transfer interactively affected by $nTiO_2$, nZnO, and Triclosan
15:55	Verena Kalter	Memorial University	PEOPLE	Effects of marine oil snow uptake on blue mussels (*Mytilus edulis*)
16:10	**Break**			
16:20	Stephanie Graves *	Queen's University	LEADERS	Tracing microplastic derived carbon in an aquatic food web
16:35	Isaac Armstrong	Queen's University	LEADERS	Using paleolimnology to disentangle multiple stressors in the severely impacted St. Lawrence River at Cornwall, ON
16:50	Zheng Wang	Concordia University	PEOPLE	Disposable face masks: A new source of microplastics in the aqueous environment
17:05	Paisley Thomson	National Institute of Scientific Research (INRS)	LEADERS	Exposure to agricultural runoff disrupts metamorphic timing and hepatic gene expression in American toad tadpoles

* Postdoctoral fellows are excluded from the student competition

Presentation Schedule

Tuesday, July 20th (Day 1)

All time marked as Eastern Time

Session 2 (14:40 – 17:35): Water & Wastewater

Zoom Meeting | **Location:** Zoom Room 2

Co-chair (Faculty)	Dr. Yves Filion	Professor, Queen's University	LEADERS
Co-chair (Postdoctoral Fellow)	Dr. Sarah Jane Payne	Assistant Professor, Queen's University	LEADERS
Student Judge	Faisal Fahd	PhD student, Memorial University	PEOPLE

Time	Presenter	Institution	CREATE Program	Title
14:40	Guihua Dong	Memorial University	PEOPLE	Persulfate based advanced oxidation for onsite wastewater treatment in marine oil spill
14:55	Lauren Halliwell	Queen's University	LEADERS	Wastewater treatment ponds in the face of climate change
15:10	Abhishek Dutta	University of British Columbia	PEOPLE	Elucidating the inherent fouling tolerance of membrane contactors in ammonia recovery from wastewater
15:25	Pengxiao Zhou	McMaster University	PEOPLE	Analysis of Bisphenol A at wastewater treatment plants by multitask learning models
15:40	Max Robinson	Queen's University	LEADERS	Formation of alternate bars in ice-covered rivers and streams
15:55	Negin B. Ficzkowski	McMaster University	PEOPLE	Nature-oriented paradigms for urban water security
16:10	**Break**			
16:20	Cynthia Compaore	Université Laval	PEOPLE	Climate variability and drinking water quality: impacts and adaptation
16:35	Christian Ortiz-Lopez	Université Laval	PEOPLE	Machine learning models for forecasting raw water quality during weather events
16:50	Andres Ardila	Université Laval	PEOPLE	Spatiotemporal optimization of routine monitoring of drinking water quality in distribution networks
17:05	Hiroki Fukuda	University of British Columbia	PEOPLE	Harvesting medium-chain fatty acids from organic waste stream using supported liquid membrane
17:20	Archita Borah	University of British Columbia	PEOPLE	Impact of intermittent flow on DOC removal by BIEX systems

Presentation Schedule

Wednesday, July 21st (Day 2)

All time marked as Eastern Time

Session 3 (12:00 – 13:30): Environmental Impact and Community Health from A Global Perspective

Zoom Meeting | **Location:** Zoom Room 1

Co-chair (Faculty)	Jyoti Kotecha	Director Research Operations, Contaminants of Emerging Concern-Research Excellence Network, Queen's University	LEADERS
Co-chair (Postdoctoral Fellow)	Dr. Hongjing Wu	Postdoctoral Fellow, Memorial University	PEOPLE
Student Judge	Lauren Halliwell	PhD student, Queen's University	LEADERS

Time	Presenter	Institution	CREATE Program	Title
12:00	Priyam Saxena	Memorial University	PEOPLE	Assessment of pharmaceuticals in Danube River basin: A review
12:15	Rashmi Hazarika	Memorial University	PEOPLE	Spatio-temporal distribution of Persistent Organic Pollutants and its concentration in the Danube River catchment area
12:30	Qiao Kang	Memorial University	PEOPLE	How should we interpret links between COVID-19 cases and environmental factors: A machine learning-aided causal inference case study
12:45	Mengfan Cai	Concordia University	PEOPLE	The impact of successive COVID-19 lockdowns on people's mobility, lockdown efficiency, and municipal solid waste
13:00	Baris Uzel	Queen's University	LEADERS	Seasonal responses of nitrogen to cold season warming in a High Arctic Wet Sedge Tundra
13:15	Alexandra Cassivi *	Université Laval	PEOPLE	Access to safe drinking water in Northern Canada: Arctic perspectives and challenges

* Postdoctoral fellows are excluded from the student competition

Presentation Schedule

Wednesday, July 21st (Day 2)

All time marked as Eastern Time

Session 4 (12:00 – 13:30): Microbial Remediation

Zoom Meeting | **Location:** Zoom Room 2

Co-chair (Faculty)	Dr. Pascale Champagne	Professor, Queen's University	LEADERS PEOPLE
Co-chair (Postdoctoral Fellow)	Dr. Xing Song	Postdoctoral Fellow, Memorial University	PEOPLE
Student Judge	Sayed Nasiruddin	PhD student, University of Northern British Columbia	PEOPLE

Time	Presenter	Institution	CREATE Program	Title
12:00	Zhe Wang	Memorial University & Shangdong University	PEOPLE	Biochar-based phosphorus solubilizing bacterial inoculants for soil remediation
12:15	Xing Song *	Memorial University	PEOPLE	Profiling microbial communities for identification of microbiologically induced corrosion in submarine environments
12:30	Jiheng Hu	Memorial University	PEOPLE	Multi-scale demonstrations of surfactin synthesis from fishery waste
12:45	Emma Wells	Memorial University	PEOPLE	Genomic and metabolic characterization, and hydrocarbon-degrading potential of the marine bacterium *Pseudomonas sp.* Oil-1
13:00	Yiqi Cao	Memorial University	PEOPLE	Magnetic nanoparticles decorated bacteria for enhanced mitigation of heavy crude oil pollution
13:15	Matthew Fyfe	Queen's University	LEADERS	Heterologous cytochrome P450 expression for emerging contaminant treatment by microalgae

* Postdoctoral fellows are excluded from the student competition

Presentation Schedule

Wednesday, July 21st (Day 2)

All time marked as Eastern Time

Session 5 (13:45 – 15:15): Monitoring & Fate of Contaminants

Zoom Meeting | **Location:** Zoom Room 1

Co-chair (Faculty)	Dr. Laurence Yang	Assistsnt Professor, Queen's University	LEADERS
Co-chair (Postdoctoral Fellow)	Dr. Bo Liu	Postdoctoral Fellow, Memorial University	PEOPLE
Student Judge	Paisley Thomson	PhD candidate, Institut national de la recherche scientifique (INRS)	LEADERS

Time	Presenter	Institution	CREATE Program	Title
13:45	David Patch	Royal Military College of Canada	LEADERS	Irradiation-based degradation of per-and-polyfluorylalkyl substances (PFAS): Isomer-dependence, pH, and transformation
14:00	Anbareen Farooq	Royal Military College of Canada	LEADERS	Fate of silver nanomaterials in treatment wetland mesocosms
14:15	Fereshteh Shahhoseini	Memorial University	PEOPLE	Standardization of a simple and reliable method for analyzing 16 priority PAHs using porous selective polymers (PSP) extraction devices
14:30	Masoumeh Rostami	Memorial University	PEOPLE	Selective detection of nitenpyram by a Carbon dots-based fluorescence sensor
14:45	Roya Sadat Neisan	Memorial University	PEOPLE	Removal of arsenic in aqueous solutions by developing a 5-stage drinking water filtration system
15:00	Lantian Chang	Memorial University	PEOPLE	Novel fluorescent N and S co-doped carbon quantum dots prepared through hydrothermal method

Presentation Schedule

Wednesday, July 21st (Day 2)

All time marked as Eastern Time

Session 6 (13:45 – 15:15): Oil Pollution, Response &Treatment #1

Zoom Meeting | **Location:** Zoom Room 2

Co-chair (Faculty)	Dr. Helen Zhang	Professor, Memorial University	PEOPLE
Co-chair (Postdoctoral Fellow)	Dr. Zhiwen Zhu	Postdoctoral Fellow, Memorial University	PEOPLE
Student Judge	Shams Anwar	PhD student, Memorial University	PEOPLE

Time	Presenter	Institution	CREATE Program	Title
13:45	Min Yang	Memorial University	PEOPLE	Effects of microplastics on oil droplet size distribution in the marine environment
14:00	Fei Wu	Memorial University	PEOPLE	Chemical demulsifiers enhanced gravity separation for mechanical recovery during marine oil spill responses
14:15	Parisa Keyvan Hosseini	Dalhousie University	PEOPLE	The study of pilot-scale membrane filtration system for decanted oily seawater treatment generated from marine oil spill response
14:30	Mahsa Keyvan Hosseini	Dalhousie University	PEOPLE	The Investigation of an environmentally viable approach for online chemical cleaning of pilot-scale membrane filtration technology during in-situ treatment of decanted oily seawater
14:45	Yifu Chen	Memorial University	PEOPLE	A general-purpose deep learning framework for classifying weathered microplastic-oil-dispersant agglomerates
15:00	Narimene Zoghbi	Memorial University	PEOPLE	Comparative tests of dispersant effectiveness in the presence of organic matter using different quantification methods

Presentation Schedule

Thursday, July 22nd (Day 3)

All time marked as Eastern Time

Session 7 (12:55 – 14:25): Microbiology & AMR

Zoom Meeting | **Location:** Zoom Room 1

Co-chair (Faculty)	Dr. Manuel Rodriguez-Pinzon	Professor, Université Laval	PEOPLE
Co-chair (Postdoctoral Fellow)	Dr. Abdul Asharaf	Postdoctoral Fellow, Queen's University	LEADERS
Student Judge	Yiqi Cao	PhD student, Memorial University	PEOPLE

Time	Presenter	Institution	CREATE Program	Title
12:55	Tessa Latchmore	Queen's University	LEADERS	Estimating the burden of illness attributable to shiga-toxin producing *E. coli* (STEC), Giardia and norovirus associated with private wells in Ontario
13:10	Madeleine Kelly	Queen's University	LEADERS	The spatiotemporal distribution, phylogenetic profile and antimicrobial resistance profiles associated with *E. coli* contaminated groundwater sources in southeastern Ontario
13:25	Ioan Petculescu	Queen's University	LEADERS	Total coliforms: Towards a better understanding of this microbial water quality indicator using statistical analysis and a large Ontario water quality dataset
13:40	Leah Vignale	Queen's University	LEADERS	The development of heavy-metal mediated antimicrobial resistance in bench-scale pipe-loop system
13:55	Victoria Rilstone	Queen's University	LEADERS	Examining the impacts of antibiotics on the promotion of antimicrobial resistance (AMR) and antibiotic resistance genes (ARGs) in biofilms of drinking water systems
14:10	Sarah Lavallee	Queen's University	LEADERS	Classification of private well users in Ontario for quantitative risk assessment and socio-epidemiological modelling: A cross-sectional population study

Presentation Schedule

Thursday, July 22nd (Day 3)

All time marked as Eastern Time

Session 8 (12:55 – 14:25): Microbial Remediation

Zoom Meeting | **Location:** Zoom Room 2

Co-chair (Faculty)	Dr. Carlos Bazan	Assistant Professor, Memorial University	PEOPLE
Co-chair (Postdoctoral Fellow)	Dr. Xiujuan Chen	Postdoctoral Fellow, University of Calgary	PEOPLE
Student Judge	Mengfan Cai	PhD student, Concordia University	PEOPLE

Time	Presenter	Institution	CREATE Program	Title
12:55	Jessica Ollinik	Environment and Climate Change Canada	PEOPLE	The importance of using high resolution gas chromatography quadrupole time-of-flight mass spectrometry for analysis of polycyclic aromatic sulfur heterocycles in oil spill forensics
13:10	Taylor Filewood	Environment and Climate Change Canada	PEOPLE	Determining the presence and concentration of polycyclic aromatic sulfur heterocycles in non-weathered oil samples
13:25	Christopher Cote	Environment and Climate Change Canada	PEOPLE	Statistics and oil forensics: how performing a multi-tiered statistical analysis of non-weathered and weathered crude oils can allow us to identify source oils
13:40	Xudong Ye	Memorial University	PEOPLE	A marine oil spill response support system by Bayesian Network and agent-based modeling
13:55	Jingjing Ling *	Memorial University	PEOPLE	Performance evaluation of chemical demulsifiers for marine oil spill response
14:10	Anisha Bhattacharyya	Dalhousie University	PEOPLE	The use of membrane bioreactors to clean-up marine oil spills

*Research associates are excluded from the student competition

Abstracts

Abstracts

PhD Seminar

The Boreal Oil Release Experiment by Additions to Limnocorrals (BOREAL) project: Phytoplankton and microbial responses to diluted bitumen spills in freshwater

Jeffrey Cederwall[1], Jules M. Blais[2], Mark L. Hanson[3], Bruce P. Hollebone[4], Vince P. Palace[5], Jose Luis Rodriguez-Gil[2], Tyler A. Black[3], Charles W. Greer[6], Scott N. Higgins[5], Christine Maynard[6], Alice C. Ortmann[7], Rebecca C. Rooney[8], Sawyer S. Stoyanovich[2], Arthur Zastepa[9], Diane M. Orihel[1,10]

1. Department of Biology, Queen's University
2. Department of Biology, University of Ottawa
3. Department of Environment and Geography, University of Manitoba
4. Emergencies Science and Technology Section, Environment and Climate Change Canada
5. IISD-Experimental Lakes Area
6. Energy, Mining and Environment Research Centre, National Research Council Canada
7. Bedford Institute of Oceanography, Fisheries and Oceans Canada
8. Department of Biology, University of Waterloo
9. Environment and Climate Change Canada, Canada Centre for Inland Waters
10. School of Environmental Studies, Queen's University

The ecological effects of diluted bitumen (dilbit) spills in freshwater remain unclear. To address this gap, we experimentally spilled dilbit at the IISD-Experimental Lake Area to study the fate and effects of this unconventional heavy oil in freshwater. We conducted a land-based experiment in 2018 and an in-lake limnocorral experiment in 2019. This talk will focus on the ecological responses of the lower aquatic web to dilbit spills, particularly the phytoplankton and microbial communities. For the pilot study we simulated two dilbit spills in 1400-L land-based mesocosms containing lake water and sediments. Most species of phytoplankton and zooplankton were sensitive to oil and declined in response to the dilbit. In contrast, oil spills stimulated bacteria known to degrade hydrocarbons. For the limnocorral study we simulated seven dilbit spills—over a range of environmentally realistic spill volumes—in 10 m diameter, in-lake limnocorrals, containing >100 m^3 of water and natural lake sediment. In the limnocorral study, chlorophyll-a, and photosynthetic efficiency increased with the volume of oil by two weeks post-spill. Prokaryote abundance initially declined with increased dilbit and bacterial virus abundance. However, by six weeks post-spill, prokaryote abundance was increased but only in the largest dilbit spill. The microbial communities became more diverse and better able to metabolize a diversity of substrates following dilbit addition. Dilbit triggered regime shifts in the phytoplankton and microbial communities; large changes to the lower food web may trigger trophic cascades impacting zooplankton and fish. This research confirms phytoplankton are a reliable indicator of aquatic pollution, including freshwater oil spills. Freshwater microbial communities, similar to marine environments, can increase in abundance and metabolize petroleum hydrocarbons but in this low-nutrient, low-mixing energy lake, microbes responded less aggressively to dilbit than is typical of marine oil spills.

Abstracts

Session 1
Toxicology & Ecotoxicology

Presence of microplastics in Placentia Bay, Newfoundland

Olivia Dillon & Uta Passow

Memorial University

Microplastics are a growing concern of global significance, as they are becoming present from the Antarctic Peninsula to the placentas of unborn babies. It is important to understand how microplastics are entering our oceans and the effects they are causing on the marine ecosystem as a whole. Within the Placentia Bay research project, I will be looking for and understanding the spatial distribution of microplastics present in one of Newfoundland's most prominent fishing regions (Placentia Bay). This project measures different types of microplastics, and their abundance at various locations, both nearshore and in the central Bay. If we can determine where in the Bay microplastics accumulate, we improve our understanding of its origins, e.g., from fishery activities or from pollution from the mainland. Data collection is performed by plankton net tows at various dock, river, and open water locations. Once collected, the majority of organic matter is digested, plastic particles and fibers are isolated. Fourier-transform infrared spectroscopy (FTIR) is used to determine the type of plastic.

Abstracts

Session 1
Toxicology & Ecotoxicology

Molecular modelling of synthetic musks for obtaining environmentally friendly derivatives

Xixi Li, Bing Chen, Zhiwen Zhu, Baiyu Zhang

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

Galaxolide (HHCB) is one of the most widely used synthetic musks that has been extensively utilized in personal care products. To overcome its adverse effects as an emerging contaminant, a promising design and screening system was developed for obtaining environmentally friendly HHCB derivatives with long lasting odor. Among the 90 designed HHCB derivatives, 15 were screened with improved functional properties (i.e., odor stability and intensity) and less environmental impacts (i.e., lower bio-toxicity, bio-accumulation ability, and mobility) using 3D-QSAR models and density functional theory methods. Then four derivatives with lower risk to human were identified by toxicokinetic analysis. Among them, Derivative 7 demonstrated the lowest human health risk. Additives (i.e., anti-photosensitivity materials and moisturizer) reduced toxicity of HHCB and Derivative 7 to human was further evaluated using molecular docking and molecular dynamic simulation. The transformation mechanism (i.e., photodegradation, biotransformation and chlorination) of Derivative 7 in the environment was also tackled. Results proved that biotransformation and chlorination were the optimum methods to remove SM and its derivatives. This study provides a comprehensive system for molecular designing of functionally improved and environmentally friendly HHCB alternatives, assists a better understanding of their environmental behaviors and health risks, and facilitates their treatment after usage.

Abstracts

Session 1
Toxicology & Ecotoxicology

Human health risk control of organophosphorus fire retardants and molecular design of environmentally friendly derivatives

Jiawen Yang[1], Bing Chen[2], Baiyu Zhang[2], Zhiwen Zhu[2], Yu Li[1] *

1. The Moe Key Laboratory of Resources and Environmental Systems Optimization, College of Environmental Science and Engineering, North China Electric Power University, China
2. Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University, Canada

The wide existence of hard-to-degrade organophosphorus fire retardants (OPFRs) in the environment as well as their joint toxicity to humans call for technologies to reduce their adverse impacts. The advancement in computational molecular design have attracted increasing attention for designing chemical molecules with desired properties and less environmental footprint. Keeping healthy diary plans has been considered as an effective tool to reduce the adverse impacts of existing environmental toxins. Therefore, these tools were firstly introduced in this study to control the joint toxicity of OPFRs to humans. Designing of environmentally friendly OPFRs derivatives with lower toxicity, better performance (i.e., high flame retardancy) and higher degradability (i.e., biodegradation/photodegradation) were applied as a cradle-to-grave approach to reduce the ecological toxicity of OPFRs. Diary plans were also assessed to decrease the toxicity of currently available OPRFs taken by humans. The OPFRs derivatives were firstly designed by a comprehensive effect 3D quantitative structure-activity relationship pharmacophore model. The molecular modification results indicated an improved electronic parameter (q+) and reduced toxicity of OPFRs. The OPFR derivatives had higher steric parameters (i.e., longer bond length and wider bond angle of the molecular side chain) exhibited better molecular flame retardancy. Comparing to TCPP, modeling results also indicated a 75.52% increase on the biodegradation efficiency of the generated derivative molecule TCPP-OH and a 44.23% decrease of its required UV spectral transition energy (44.23%) under the influence of hydrogen peroxide solvation effect. Thanks to the competition for the target joint toxic receptor (JTR) between nutrients and OPFRs, diary plans was designed to win nutrients the binding spot on JTR and reduce the OPFRs toxicity.

The combination of β-lactoglobulin, α-lactoalbumin, milk fat globule membrane protein, ovalbumin, ovotransferrin, vitamin, plant pigment, apple polyphenols, and malic acid led to a sharp decrease (91.18%) of the joint toxicity of OPFRs to pregnant women.

Abstracts

Session 1
Toxicology & Ecotoxicology

Green substitutes of neonicotinoid insecticides: molecular design and multi-directional selective toxicity effects

Yuanyuan Zhao[1], Baiyu Zhang[2], Bing Chen[2], Zhiwen Zhu[2], Yu Li[1] *

1. The Moe Key Laboratory of Resources and Environmental Systems Optimization, College of Environmental Science and Engineering, North China Electric Power University, China
2. Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University, Canada

The wide existence of hard-to-degrade organophosphorus fire retardants (OPFRs) in the environment as well as their joint toxicity to humans call for technologies to reduce their adverse impacts. The advancement in computational molecular design have attracted increasing attention for designing chemical molecules with desired properties and less environmental footprint. Keeping healthy diary plans has been considered as an effective tool to reduce the adverse impacts of existing environmental toxins. Therefore, these tools were firstly introduced in this study to control the joint toxicity of OPFRs to humans. Designing of environmentally friendly OPFRs derivatives with lower toxicity, better performance (i.e., high flame retardancy) and higher degradability (i.e., biodegradation/photodegradation) were applied as a cradle-to-grave approach to reduce the ecological toxicity of OPFRs. Diary plans were also assessed to decrease the toxicity of currently available OPRFs taken by humans. The OPFRs derivatives were firstly designed by a comprehensive effect 3D quantitative structure-activity relationship pharmacophore model. The molecular modification results indicated an improved electronic parameter (q+) and reduced toxicity of OPFRs. The OPFR derivatives had higher steric parameters (i.e., longer bond length and wider bond angle of the molecular side chain) exhibited better molecular flame retardancy. Comparing to TCPP, modeling results also indicated a 75.52% increase on the biodegradation efficiency of the generated derivative molecule TCPP-OH and a 44.23% decrease of its required UV spectral transition energy (44.23%) under the influence of hydrogen peroxide solvation effect. Thanks to the competition for the target joint toxic receptor (JTR) between nutrients and OPFRs, diary plans was designed to win nutrients the binding spot on JTR and reduce the OPFRs toxicity.
The combination of β-lactoglobulin, α-lactoalbumin, milk fat globule membrane protein, ovalbumin, ovotransferrin, vitamin, plant pigment, apple polyphenols, and malic acid led to a sharp decrease (91.18%) of the joint toxicity of OPFRs to pregnant women.

Abstracts

Session 1
Toxicology & Ecotoxicology

Biochemical alteration of green alga and trophic transfer interactively affected by $nTiO_2$, nZnO, and triclosan

Xiaying Xin, Baiyu Zhang

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

This study applied a full factorial design (2×2×2×3) to explore interactive effects of $nTiO_2$, nZnO and triclosan (TCS) on green alga Asterococcus superbus, and to identify significant factors. The bioaccumulation of $nTiO_2$, nZnO, and TCS in different combinations was also explored through green alga to fish, Gyrinocheilus aymonieri. The results showed TCS considerably affects cell viability, photosynthesis activity, lipid peroxidation and protein structure of the alga. The $nTiO_2$ shows significant effects on oxidative stress, antioxidant enzyme, and lipid peroxidation of the alga. The $nTiO_2$ * nZnO is the only significant interaction of the targeting pollutants, affecting macromolecules, lipid peroxidation, and photosynthesis activity of the alga. Two groups of endpoints are best to reflect alga responses to interactively effects by $nTiO_2$, nZnO, and TCS. One group is ROS, chlorophyll pigments, TBARS, area, MTT, and MMP, and the other one is chlorophyll pigments, ROS, TBARS, CAT, MTT and SOD. The bioaccumulation of TCS changed with algal biomass, while the bioaccumulation of Ti and Zn varied with the amount of lipids and proteins in algal cells. In alga, Ti was in the form of $nTiO_2$ and Zn in the form of zinc ion. Due to dietary exposure, Ti and Zn quantity in fish was closely related to that in algae. The quantity of Ti and Zn in algae and fish exposed to $nTiO_2$ * nZnO* TCS was higher than other treatments. The uptake of Ti and Zn in algae exposed to $nTiO_2$ * nZnO had been inhibited, and correspondingly less Ti and Zn was observed in fish tissues. No observation of TCS in fish in all treatments suggested the removal and metabolism of TCS might be induced by tissue recovery and acclimation. Our findings can be instructive for comprehensive evaluations on the impact of nanoparticles and personal care products on aquatic organisms.

Abstracts

Session 1
Toxicology & Ecotoxicology

Effects of marine oil snow uptake on blue mussels (*Mytilus edulis*)

Verena Kalter[1], Benjamin de Jourdan[2], Uta Passow[1]

1. Department of Ocean Sciences, Memorial University
2. Huntsman Marine Science Centre

Marine snow is defined as aggregates larger than 0.5 mm consisting of organisms, organic detritus and clays. These aggregates sink and represent the main transport pathway by which surface-derived organic matter reaches deep waters, and constitute a vital food source for various marine organisms.

When contaminated with oil droplets, as seen during the Deepwater Horizon oil spill in the Gulf of Mexico in 2010, marine snow is referred to as "marine oil snow" (MOS) and may expose animals to oil via their diet. However, despite the known potential toxicity of oil to organisms, the effects of MOS uptake are largely unknown.

Therefore, this study aimed to assess i) the effects of MOS uptake on the condition index and clearance rate and ii) the potential of MOS to induce DNA damage in blue mussels (*Mytilus edulis*).

First results indicate a higher clearance rate and a lower condition index after MOS uptake. A greater proportion of DNA damage was found after exposure to MOS, but this effect was reversed after the mussels had time to recover in clean seawater.

By learning about the impacts of MOS on organisms, we hope to broaden our understanding of the potential consequences of oil spills for marine ecosystems.

Abstracts

Session 1
Toxicology & Ecotoxicology

Tracing microplastic derived carbon in an aquatic food web

Stephanie Graves[1], Brian Hayden[2], Chelsea Rochman[3], Jennifer Provencher[4],

Michael Paterson[5], Daniel Layton-Matthews[1], Diane Orihel[1]

1. Queen's University
2. University of New Brunswick
3. University of Toronto
4. Environment and Climate Change Canada
5. International Institute for Sustainable Development – Experimental Lakes Area

Microplastics are a diverse suite of carbon-based contaminants of concern due to their ubiquity and persistence in the environment. Slowly over time, carbon (C)-containing compounds are released during microplastic degradation, some of which are biolabile and can be utilized by microbes. The ultimate fate of microplastics in the environment is difficult to study because we cannot differentiate between microplastic-derived carbon and natural carbon using traditional analytical techniques. The objective of our research is to determine whether microplastics in a boreal lake ecosystem will leach carbon over time that will subsequently be incorporated into the aquatic food web. We hypothesize that 1) microplastics in a lake will leach C over time due to both abiotic (photo-oxidative) and biotic (microbial) degradation, and 2) dissolved organic and inorganic carbon (DOC and DIC) derived from microplastics will be bioavailable and incorporated into the food web through utilization by microbes. To study the fate of microplastic-derived carbon, we set up two ~1100 L limnocorrals (in situ enclosures) in the littoral zone of Lake 378 at the International Institute for Sustainable Development - Experimental Lakes Area in Northwestern Ontario, Canada. In one limnocorral, 3268 particles/L (or 0.05 mg/L) of 99% 13C-labelled polystyrene was added in May 2021, while the second limnocorral will serve as a control. δ13C-DIC and δ13C-DOC in filtered water will be measured monthly to determine leaching of C from the plastic. Compound specific isotope analysis of amino acids will be used to measure enrichment of 13C in zooplankton and benthic invertebrates collected monthly from each limnocorral. It is well known that microplastics are ubiquitous and abundant in the environment, but the ultimate fate of microplastics remains poorly understood. This project will give insight into the potential for microplastic degradation in freshwater lake ecosystems and the fate of microplastic-derived carbon in aquatic environments.

Abstracts

Session 1
Toxicology & Ecotoxicology

Using paleolimnology to disentangle multiple stressors in the severely impacted St. Lawrence River at Cornwall, ON

I. Armstrong, JJ Ridal, BF Cumming

Queen's University (ZA, BFC, JJR), St. Lawrence River Institute of Environmental Sciences (JJR)

Twentieth century industrial activity in Cornwall, ON loaded high amounts of heavy metals (including mercury (Hg), zinc (Zn), copper (Cu), and lead (Pb)) and organic matter to the St. Lawrence River. Previous research has shown that benthic invertebrate chironomid larvae (order: Diptera) were functionally absent from a waterfront site which received both organic and Hg pollution during the height of industrial activity, however due to the co-occurring nature of these stressors the precise mechanism of the absence is unknown. Regional climate warming also affects the waterfront, complicating interpretations of impact and recovery. My research uses paleolimnology to disentangle multiple stressor impacts, as understanding the respective effects of heavy metals, organic pollution, and climate warming is crucial to appropriate ecosystem management and the development of remediation strategies. To parse out stressor effects, I will take a sediment core from Zone 1, a waterfront area impacted by both metals and organic pollution, and from Zone 2, a waterfront area which primarily experienced heavy metal loading. A reference core was taken from Grenadier Basin in fluvial Lake St. Francis for the purpose of identifying a regional warming signal. I have identified and enumerated chironomid subfossils from the first 20 cm of the reference core, which corresponds to roughly 1890. A shift to warm water, organic-associated taxa post-1984 is consistent with expected effects of climate warming. A less interpretable assemblage shift is seen at ~1936 and possible explanations will be discussed in the presentation.

Abstracts

Session 1
Toxicology & Ecotoxicology

Disposable face masks: A new source of microplastics in the aqueous environment

Zheng Wang[1,*], Chunjiang An[1], Xiujuan Chen[2], Kenneth Lee[3], Baiyu Zhang[4], Qi Feng[1]

1. Department of Building, Civil and Environmental Engineering, Concordia University
2. Institute for Energy, Environment and Sustainable Communities, University of Regina
3. Fisheries and Oceans Canada, Ecosystem Science
4. Northern Region Persistent Organic Pollutant Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University

The COVID-19 pandemic has driven explosive growth in the use of masks has resulted in many issues related to the disposal and management of waste masks. As improperly disposed masks enter the ocean, the risk to the marine ecological system is further aggravated, especially in the shoreline environment. The objective of this study is to explore the changing characteristics and environmental behaviors of disposable masks when exposed to the shoreline environment. The transformation of chain structure and chemical composition of masks as well as the decreased mechanical strength of masks after UV weathering were observed. The melt-blown cloth in the middle layer of masks was found to be particularly sensitive to UV irradiation. A single weathered mask can release more than 1.5 million microplastics to the aqueous environment. The physical abrasion caused by sand further exacerbated the release of microplastic particles from masks, with more than 16 million particles released from just one weathered mask in the presence of sand. The study results indicate that shorelines are not only the main receptor of discarded masks from oceans and lands, but also play host to further transformation of masks to plastic particles.

Abstracts

Session 1
Toxicology & Ecotoxicology

Exposure to agricultural runoff disrupts metamorphic timing and hepatic gene expression in American toad tadpoles

Thomson P[1], Robinson SA[2], Veilleux É[3], Gruyer N[3], Deblois C[3], Thériault G[4], Langlois VS[1]

1. Institut national de la recherche scientifique (INRS) Centre Eau Terre et Environnement
2. Environment and Climate Change Canada (ECCC)
3. Centre d'expertise en analyse environnementale du Québec (CEAEQ), Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC)
4. Agriculture and Agri-Food Canada (AAFC)

Retention ponds are a management strategy implemented in the agroecosystem as to reduce the ecological impacts of runoff entering surface waters. However, these constructed wetlands also provide habitat for wildlife (e.g., serving as breeding grounds for amphibians) despite the concentrated burden of agrochemical contaminants. The main objective of this research project is to study the effects of water from an agricultural retention pond on native larval amphibians. At a field site adjacent to traited corn cultivation, water quality was assessed for three summers, and chemical analyses revealed a complex and dynamic mixture of agrochemicals, including herbicides (e.g., glyphosate, S-metolachlor), insecticides (e.g., neonicotinoids), and a fungicide (azoxystrobin). Chronic exposures to this retention pond water were performed on the American toad (Anaxyrus americanus) from the free-feeding stage throughout metamorphosis. Endpoints related to, survival, growth, and morphology were assessed throughout the experiment. At larval stages, treated toads were significantly smaller in morphometric indices compared to control animals and that rate of metamorphosis was altered by exposure. However, this effect was not observed at the 2-weeks post-metamorphosis timepoint, suggesting that the morphological impacts of agrochemical exposure are transient in nature. Exposed organisms exhibited significant alterations of hepatic gene expression related to the hypothalamus-pituitary-thyroid axis. Ongoing analyses aim to assess these genes of interest in tadpole tail tissue and to evaluate the implications of this perturbation of hormone signalling. This work provides ecologically relevant information of the potential endocrine disrupting effects of agricultural activities on a North American amphibian species.

Abstracts

Session 2
Water & Wastewater

Persulfate based advanced oxidation for onsite wastewater treatment in marine oil spill

Guihua Dong[1], Bing Chen[1*], Bo Liu[1], Xing Song[1], Stanislav Stoyanov[2], Kenneth Lee[3], Baiyu Zhang[1]

1. Northern Region Persistent Pollution Control (NRPOP) Laboratory, Memorial University
2. Natural Resources Canada, CanmetENERGY Devon
3. National Senior Scientific Advisor, Fisheries and Oceans Canada (DFO)

In conventional decanting practice for an oil spill response, mechanical recovered oily fluids, which is a mixture of oil and water, are usually temporarily stored in response vessels and shipped to shore for disposal/treatment. The high content of water in oily fluids occupies large space in the temporary storage vessels, putting pressure on the limited storage space and prolonged time for logistics, thus could significantly reduce the efficiency and the capacity of mechanical recovery. An onsite treatment and discharge of decanted water could help address this critical issue. The physical separation technologies have been widely used in offshore oil and water separation but are not effective in handling the soluble petroleum compounds in decanted water. The presence of these compounds may lead to the elevation of ecotoxicity in decanted water. As one of the powerful advanced oxidation processes (AOPs), the UV/O_3 process has been proven to have a huge ability to treat oily wastewater. Persulfate (PS) based AOPs have drawn considerable attention in recent years due to their high efficiency for generating sulfate radical, which has more positive redox potential (2.6–3.1 V) than hydroxyl radical (1.9–2.7 V), to degrade recalcitrant organic pollutants. In this study, a bench-top continuous-flow photo-ozonation system was developed to further reduce oil contents from the decanting water (after physical separations) and remove petroleum hydrocarbons of concern (e.g., total petroleum hydrocarbon [TPH] and polycyclic aromatic hydrocarbon [PAHs]). Seawater samples containing crude oil (around 100 ppm) were tested under various pre-defined operational conditions. The preliminary results showed that the developed system was capable of cutting the TPH to less than 15 ppm in 50 min. In comparison with UV/O_3 system, the addition of PS could improve the removal efficiency of both TPH and PAH impressively. These indicated that the UV/O_3/PS system had a robust potential for onsite decanting water treatment during marine oil spills.

Abstracts

Session 2
Water & Wastewater

Wastewater treatment ponds in the face of climate change

Lauren Halliwell, Pascale Champagne, Geoffrey Hall,

Hamidreza Shirkhani, Alexander Rey, Leon Boegman

Queen's University

Wastewater Stabilization Ponds (WSPs) are an example of a conventional wastewater treatment system that is sustainable for human health and the surrounding environments of smaller-scale communities. This research promotes the WSP design adaptability to climate change, specifically in the summer and winter months in Amherstview, Ontario. In collaboration with Loyalist Township's municipal wastewater treatment facility and the National Research Council of Canada, the goal of this research is to advance our understanding of the pond processes and interactions that pertain to the efficiency of the WSP in evolving climate changing events. This research uses the numerical modelling tool Delft3D and MATLAB, to compare applied hydrodynamic and water quality assessments from the Amherstview. Ultimately this doctoral research uses the Amherstview, Ontario wastewater treatment ponds to demonstrate real WSP data for numerical modelling calibration and validation which is used to predict the process outputs for WSP systems. Since WSPs are known as greener wastewater treatment technology, for its environmental and social components, understanding these ponds through increased knowledge, judgement and proficiency, will strongly influence public and private engineering initiatives to ensure the seriousness for future growth in wastewater infrastructure.

The novel component of this research includes:

1. It is the first to supply extensive data collection of the AWPCP WSPs (hydrodynamic and water quality components) in the summer season to calibrate and validate the developed coupled 3D numerical model for Amherstview WSPs. This novel component can be referenced for other Ontario WSP ponds.
2. It is the first to develop a coupled 3D numerical model using Delft-3D software to advance designing WSPs, while incorporating all synergistic components hydrodynamic and water quality parameters.
3. Provide short- and long-term predictions of WSPs performance in the face of climate change that is pertinent to wastewater treatment in municipalities.

Abstracts

Session 2
Water & Wastewater

Elucidating the inherent fouling tolerance of membrane contactors in ammonia recovery from wastewater

Abhishek Dutta, Sifat Kalam and Jongho Lee

University of British Columbia

Recovery of ammonia (NH_3) from wastewater has garnered interest due to its potential as a fertilizer, refrigerant, and hydrogen carrier. Membrane contactors (MCs) are an effective process for NH_3 recovery from diverse wastewater streams, but the impact of fouling on the process has seldom been explored. Here, we examine the dependency of membrane fouling on process conditions and elucidate the inherent system tolerance to fouling in NH_3 recovery using MCs. In our isothermal MC system, a hydrophobic PVDF membrane was employed between NH_3-rich anaerobically digested food wastewater at pH 10.2 (feed) and sulfuric acid stream (draw). While demonstrating >90% recovery of NH_3, our experiments indicated minimal membrane fouling despite the high organic foulant loading in feed. We then performed a membrane distillation (MD) experiment to investigate the impact of transmembrane water vapor flows and feed pH on fouling. The membranes from MD tests were severely fouled, suggesting the acceleration of fouling in presence of water vapor flows across the membrane. Despite the severe fouling, when these membranes were employed back in the isothermal MC, >70% NH_3 recovery from the wastewater was observed. This markedly high NH_3 recovery from the fouled membranes was explained using our mass transfer model. Our study shows that (1) isothermal MC processes possess an inherent tolerance to membrane fouling due to the absence of transmembrane water vapor flows and high feed pH; and (2) even in the event of severe membrane fouling, high NH_3 recovery is attainable, showing an excellent applicability of the MC process for NH_3 extraction from diverse wastewaters of high fouling potential.

Abstracts

Session 2
Water & Wastewater

Analysis of bisphenol A at wastewater treatment plants by multitask learning models

Pengxiao Zhou, Zhong Li

McMaster University

Contaminants of emerging concern (CECs) such as pharmaceuticals and personal care products (PPCPs) are considered as a growing threat to the aqueous environment and public health. Previous studies show that wastewater treatment plants (WWTPs) are the major source for these contaminants to enter the aqueous environment. However, WWTPs were originally designed for the removal of organic and bacteriological, not emerging contaminants. Thus, comprehensive studies on the fate of these chemical contaminants at wastewater treatment plants are desired. This study focus on Bisphenol A (BPA), which has been widely used in industrial production and is considered to have an impact on human health. The BPA data are collected by the Canada's Chemical Management Plan from a total of 12 anonymous WWTPs across Canada. The treatment efficiency of BPA at different types of WWTPs are firstly analyzed. Then the data from different WWTPs are integrated and used to build a multitask learning model for prediction. Multi-task learning exploits useful information from related learning tasks to help alleviate the data sparsity problem. The results show that the multitask learning model is able to generate proper prediction for effluent BPA concentration at WWTPs across Canada. The proposed multitask learning model can help WWTPs with a data sparsity problem to produce reliable predictions, and therefore benefit public health as well as the operation and management of WWTPs.

Abstracts

Session 2
Water & Wastewater

Formation of alternate bars in ice-covered rivers and streams

Max Robinson, Cristopher Gamboa-Monge

Queen's University

Alternate bars are very large-scale migrating bed forms that occur in rivers and streams and are particularly prominent in gravel rivers. They occur in both subcritical and supercritical flows, and are characterized by diagonal crests with gentle upstream slopes and with scour holes at the banks alternating from left to right. The length of alternate bars is typically of the order of several channel widths, and the near-bank scour depth due to these bed forms can reach values of the order of a few channel depths. The riffle-pool pattern associated with alternate bars constitutes a prime habitat for several fish species including salmon and trout. While the bars contribute significantly to the health of the river ecosystem, they can also be a source of stream destabilization as they direct the flow to the banks and cause bank erosion.

Owing to these reasons, various aspects related to alternate bars have been investigated for many years. However, the mechanism of their formation in ice-covered rivers as well as their geometry in such streams remain poorly understood. This research seeks to contribute to a better understanding of the formation of alternate bars under ice-covers, through a special series of laboratory experiments.

The experiments were carried out in an 11 m long, 0.38 m wide, and 0.41 m deep tilting flume located at the Coastal Engineering Lab at Queen's University. The gravel used was pea stone gravel with an average grain size of 5 mm. Extruded polystyrene boards were used to simulate ice covers. Different ice surface roughnesses were achieved using the polystyrene boards by themselves or with a mesh attached to their bottom surfaces. In the tests, stream discharge and flow depth were varied. Geometric characteristics of the bars were measured using a point-gauge as well as a Micro-Epsilon scanControl line laser system.

Nature-oriented paradigms for urban water security

Negin B. Ficzkowski, Nidhi Nagabhatla, Tariq A. Deen

McMaster University, The United Nations Institute on Comparative Regional Integration Studies (UNU-CRIS)

Water security in urban areas is threatened by a multitude of direct and indirect drivers. On the one hand, the demand for water is increasing on a daily basis as the urban population and lifestyle needs increase; on the other hand, events such as floods, tropical cyclones, and other natural hazards result in disruption of water provisioning systems and processes. Additionally, climate change impacts such as heat waves and sea-level rise affect the sustainability of water supplies in urban areas. Conventionally, hard engineering structures and strategies have been implemented around the world to address water needs in urban areas and solutions that are often costly and intrusive to the natural environment. Nature-based solutions (NBS) in the past years emerged as a framework for exploring the potential of soft engineering solutions—as an alternative for managing urban planning, building climate resilience, and sustaining water needs of the urban communities. In this chapter, the following points are explained: (a) review of selected nature-oriented conceptual framings and practical options that apply to urban water systems, (b) illustration of existing NBS practices such as permeable pavements, green roofs, and bioretention ponds in urban landscape architecture planning, and (c) future of urban landscapes with comparative context of traditional versus nature-based water management practices. The conclusion draws attention to the UN Decade on Ecosystem Restoration (2021–2030) that is aiming to prevent, halt, and reverse the degradation of ecosystems globally. The aim is to present a synthesis that can steer integrated development planning while addressing basic water needs, climate resilience, and ecosystems protection in all settings and particularly in urban landscapes.

Abstracts

Session 2
Water & Wastewater

Climate variability and drinking water quality: impacts and adaptation

S. M. Cynthia Compaore, Manuel Rodriguez, Sonja Behmel

WaterShed Monitoring, Université Laval

Adaption to climate changes is an important issue for drinking water systems (DWS) to maintain safe drinking water and protect human health. Some authors have been interested in the perceptions of municipal DWS officers concerning adaptation to climate changes with the purpose of protecting drinking water quality. They put on light the fact that awareness to climate change consequences can be very low for some DWS officers and some of those that are aware do not adopt adaptation strategies. In this context, the use of decision support tools (DSS) can be helpful to municipal DWS officers for climate changes adaptation.

This project examines the factors that determine DWS adaptation to climate changes to assure adequate levels of drinking water quality. The first objective is to understand the perceptions, attitudes and behavior of DWS officers to climate changes and adaptation. The study will then, focus on the interest and capacity to use DSS about climate change adaptation. These two objectives are reached through a critical review of the literature and a participatory research including a questionnaire-based survey, focus groups and serious games with the participation of municipal DWS officers.

The participatory approach aims to define to what extent the human and organizational contexts can influence the DWS managers and operators, in climate changes adaptation. This research project will identify human and social challenges linked to climate changes adaptation and shared by DWS officers. It will unveil certain levers to be operated to promote DWS adaptation to climate change, with the willing to preserve drinking water quality. The research will also result in the elaboration of a structural framework providing the conditions and indications to be followed in the implementation and application of DSS in order to facilitate the use and appropriation of these tools by DWS managers and operators.

Abstracts

Session 2
Water & Wastewater

Machine learning models for forecasting raw water quality during weather events

Christian Ortiz-Lopez, Christian Bouchard, Manuel Rodriguez

Université Laval, École Supérieure d'Aménagement du Territoire et de Développement Régional (ÉSAD), Chaire de recherche en gestion et surveillance de la qualité de l'eau potable

Surface waters are the source water of most medium and large municipalities in order to provide safe drinking water to the population. A multi-barrier approach has been implemented in North America to assure a safe drinking water supply. Such an approach consists of an integrated system of procedures and tools that avoid or reduce the contamination of drinking water in order to reduce the risks to public health. Monitoring and surveillance of the source water is critical since it constitutes the first barrier. The rising of natural and anthropogenic pressures on water quality requires increasing efforts to fulfill the needs for water treatment and monitoring. For instance, some river water quality parameters could be impacted during weather events, such as rainfall, leading to sudden changes in source water quality. When these events occur, adjustments of coagulant doses could be required during water treatment operations to control turbidity and natural organic matter. According to a critical literature review we recently conducted, various machine learning-based methods have been applied to model and predict source water quality indicators for multiple purposes. Those methods comprise artificial neural networks, decision trees, neuro-fuzzy inference systems and support vector machines, among others. For this research, the study case is a water treatment facility supplied by a river for which water quality is impacted by spring and fall runoff and frequent rain events. We propose to undertake a retrospective analysis of changes in source water quality by means of time series analysis of both hydrological variables such as rainfall, temperature and flow, and water quality variables such as turbidity and UV absorbance at the water intake. Furthermore, sampling campaigns will be carried out between March and October (spring, summer and fall) during two years in order to acquire complementary water quality data at high frequency.

Abstracts

Session 2
Water & Wastewater

Spatiotemporal optimization of routine monitoring of drinking water quality in distribution networks

Andres Ardila, Manuel Rodriguez, Geneviève Pelletier

Chaire de recherche en eau potable de l'Université Laval

Water quality varies spatially and temporally in distribution networks due to the complex relationships between various physicochemical, structural, and operational variables specific to each system. Likewise, exogenous socio-economical, demographic and land use variables can increase the risk and vulnerability of the population associated with the consumption of contaminated water. An adequate monitoring of water quality in the distribution network is essential to correctly represent its potential degradation, improve the management of the operation and minimize the impact on the population. However, there is no regulated methodology for the optimal selection of monitoring points, considering the spatiotemporal variability of water quality. The objective of this project is to develop a methodology for the spatio-temporal optimization of routine monitoring in distribution networks (location and frequency of sampling sites), considering the variability of microbiological and chemical parameters of water quality and their influencing variables. The methodology is based on the following steps: i) the evaluation of the seasonal portrait of water quality variability, ii) the modelling of the spatio-temporal variability of chemical and microbiological parameters, iii) the creation of a water quality index in order to establish the spatial representativeness of sample sites, iv) the generation of a risk indicator, v) the construction of an optimization model for the number, location and frequency of the sampling points, and vi) the definition and comparison between different scenarios for routine monitoring. The methodology is applied to the distribution network of Quebec City, Canada, for which robust databases have been generated in the last ten years to characterize seasonal and spatial variations of water quality from source to tap, including microbiological indicators, residual chlorine, regulated disinfection-by products, etc., as well as the hydraulic conditions that impact these variabilities. A critical discussion will be provided on the benefits and limitations of optimized monitoring frameworks for routine purposes.

Abstracts

Session 2
Water & Wastewater

Harvesting medium-chain fatty acids from organic waste stream using supported liquid membrane

Hiroki Fukuda, Jongho Lee

University of British Columbia

Medium-chain fatty acids (MCFAs) derived from organic waste, with 30-50 times higher market values than methane, have recently been recognized as a promising source for biofuels, pharmaceuticals and cosmetics. In this work, we develop a supported liquid membrane (SLM) for selective MCFA recovery from organic waste streams. The SLM is a porous and hydrophobic membrane filled with 3% trioctylphosphine oxide (TOPO) in dodecane. An aqueous solution containing ethanol, short-chain fatty acids (SCFAs) and MCFAs was used as feed to mimic the effluent of MCFA-producing anaerobic bioreactors. Placed between the feed stream and a base draw stream, the SLM transfers MCFAs by the pH gradient as the driving force. We demonstrated >90% recovery of MCFAs in the draw solution while ethanol and SCFAs were effectively rejected. We then investigated the effect of temperature and TOPO concentration on the recovery and selectivity of MCFAs. By measuring the partition coefficients of SCFAs and MCFAs between aqueous and organic phase, we found that the selectivity of MCFAs increases at a lower temperature due to the enhanced complexation of MCFAs by the SLM-impregnating liquid. The MCFA selectivity was increased with a higher concentration of TOPO, likely due to the higher affinity contrast between the hydrophobic MCFAs and SCFAs. Our study shows the potential of SLMs for MCFA production in building a new production stream for biochemicals from organic wastes.

Impact of intermittent flow on DOC removal by BIEX systems

Archita Borah

University of British Columbia

Biological Ion Exchange (BIEX) is emerging as a promising approach for DOC removal from surface waters. Because of its simplicity, BIEX is particularly attractive for small/remote communities that require simple but effective NOM removal approaches with low chemical use, low effluent waste discharge, and high performance. Additionally, water demand, and therefore water treatment, in small communities, is often intermittent due to the changing demand for water usage from traditional work hours, seasonal migration of the community, or power cuts in remote communities. The intermittent operation could impact the ability of BIEX to effectively remove NOM. The present study investigates the impact of intermittent operation on the performance of BIEX.

Observations from the present study indicate that intermittent operation does not have a significant impact on DOC removal by BIEX systems. Intermittent systems with daily and weekly intermittent periods achieved about 22-45% DOC removal during the study periods. These results are quite optimistic and can alleviate concerns relating to water quality and ensure sustainable essential water services to small communities can be continued without boil water advisories.

Abstracts

Session 3
Environmental Impact & Community health from A Global Perspective

Assessment of pharmaceuticals in Danube River basin: A review

Priyam Saxena[1], Rashmi Hazarika[1], Om Prakash Yadav[1], Atanu Sarkar[1],

Gopal Achari[2] and Jaroslav Slobodnik[3]

1. Faculty of Medicine, Memorial University, Canada
2. Department of Civil Engineering, The University of Calgary, Canada
3. Environmental Institute, Kos, Slovakia

Pharmaceuticals are contaminants of emerging concerns (CECs) in different environmental systems air, water (terrestrial and marine), soil, and biota. Their presence in the environment is a severe issue due to its toxicological effects on humans and ecological health. A growing number of emerging contaminants are being discovered in surface river water.

This review aims to analyse the presence of twelve pharmaceuticals compounds such as Amoxycillin, Azithromycin, Sulfamethoxazole, Diclofenac, Ibuprofen, 17 α ethynylestradiol, 17 β estradiol, Estrone, Progesterone, Atenolol, Gemfibrozil, Carbamazepine in the surface river water, sediments and biota of the Danube River basin. The individual contaminants are being detected in concentrations that are typically thought to be too low to have acute effects. Nonetheless, with present understanding, health consequences from prolonged exposure to a mixture of low concentrations of all types of CECs cannot be ruled out. The available data on CECs is used to carry out this study (Source: Norma database). Herein, statistical, spatial and temporal analysis of distribution of CECs using GIS software of targeted drugs is presented. Moreover, the occurrence patterns of CECs in different countries of Danube River basin are compared and evaluated.

According to published research studies, the removal of antibiotics and associated residues is challenging, which raises the risk of antibiotic resistance and, therefore, the sustainability of global water sources. The findings of this work may be utilized to assess the health and environmental hazards associated with the presence of CECs in Danube River basin to frame future policy.

Abstracts

Session 3
Environmental Impact & Community health from A Global Perspective

Spatio-temporal distribution of Persistent Organic Pollutants and its concentration in the Danube River catchment area

Rashmi Hazarika[1], Priyam Saxena[1], Om Prakash Yadav[1], Atanu Sarkar[1],

Gopal Achari[2], Jaroslav Slobodnik[3]

1. Faculty of Medicine, Memorial University
2. Department of Civil Engineering, The University of Calgary
3. Environmental Institute, Kos, Slovakia

Persistent Organic Pollutants are discharged in the rivers by various point and non-point sources, thereby degrading the functioning of ecosystem and threatening human health.

This study aims to assess the environmental occurrence and spatial distribution of POPs in the surface water, sediments, and biota of river Danube. The available POPs data of sampling stations are downloaded from the Norman database and consolidated into a single cohesive dataset. Concentration of BPA, Perfluorooctanoic acid, Perfluoro hexanoic acid, Perfluoro nonanoic acid are taken into consideration for this study.

The above-mentioned POPs, found in the countries along the catchment of Danube River are compared and evaluated under a geospatial framework. To interpret the spatial and temporal distribution patterns of POPs, data of various sampling stations are initially converted into point shapefiles and analysed in Arc GIS interface with results shown as maps and geostatistical models.

The findings of this study show that some of the POP contaminants are in below detection limits, while others are low or essentially constant, and some are subsequently high at different timeframe.

A systematic research is required to determine the spatial and temporal variations of POPs in the Danube River. Long term monitoring of POPs with consistent data quality is essential to evaluate the contaminant load and effectiveness of control efforts taken by countries worldwide.

Abstracts

Session 3
Environmental Impact & Community health from A Global Perspective

How should we interpret links between COVID-19 cases and environmental factors: A machine learning - aided causal inference case study

Qiao Kang, Xing Song, Xiaying Xin, Bing Chen*

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

A causal inference framework with the support of machine learning methods was proposed to investigate the potential causal relationships between environmental factors and COVID-19 transmission in 166 Chinese cities. Three city clusters were generated to enable investigations under various socio-economic conditions, and data in each cluster was analyzed based on pandemic phases. CO survived the refutation with an extremely low Average Treatment Effect (ATE) of 0.005. PM2.5 passed the refutation as well with an ATE of 0.162. The two potential relationships under specific circumstances cannot be ruled out from a statistical perspective. With no associated causal relationship passed the final refutation, NO_2's contributions in machine learning models were mostly negative with normalized feature importances from 0.1 to 0.2, indicating its capability of reflecting the degree of activeness. Besides provided evidence for identifying the potential causal relationships between the COVID-19 pandemic and environmental factors, the study proposed a feasible causal inference framework for environmental data analysis.

Abstracts

Session 3
Environmental Impact & Community health from A Global Perspective

The impact of successive COVID-19 lockdowns on people's mobility, lockdown efficiency, and municipal solid waste

Mengfan Cai[1], Christophe Guy[2], Martin Héroux[3], Eric Lichtfouse[4,5], Chunjiang An[1]

1. Department of Building, Civil and Environmental Engineering, Faculty of Engineering and Computer Science, Concordia University, Canada
2. Department of Chemical and Materials Engineering, Concordia University, Canada
3. Department of Environment, City of Montreal, Canada
4. Aix Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, France
5. State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, China

The COVID-19 pandemic has induced many issues for all societal sectors, in particular in the production and disposal of municipal solid waste (MSW). This is because successive easing and reimposing of lockdown measures have deeply changed people's movements, consumers' behaviors, and waste management. Previous studies have focused on the short-term effects of lockdowns on waste changes, yet there is little knowledge on waste variations during successive lockdowns and unlocking of various lockdown intensities. Moreover, the efficiency of lockdown and its relation to people's mobility in different countries are still not clear. Here we studied the variations of amounts and composition of MSW before the pandemic in 2019 and during the pandemic in 2020-2021 in the United States, Brazil, Canada, United Kingdom, France and Italy. We used a stringency index and a composite mobility index to assess the lockdown intensity and people's movements. Results show that the mobility index sharply decreased with lockdown intensity and enforcing measures were more efficient in France and Italy. Compared to 2019, prolonged lockdowns caused larger decreases in commercial and construction wastes than household waste. The initial implementation of lockdown or unlocking measures promoted consumption, generally leading to the increased waste amount, by about 9% for Trento and 12% for Montreal at the beginning of lockdown, respectively. Moreover, larger variations in the waste amount in Trento (-25.3–9.8%) were in line with higher lockdown intensity compared to those in Montreal (-9.5–12.7%), affected by people mobility, consumers' behaviors, and waste management.

Seasonal responses of nitrogen to cold season warming in a high arctic wet sedge tundra

Baris Uzel, Neal Scott

Queen's University

Nitrogen pools in the High Arctic are expected to increase due to permafrost thaw and elevated microbial activity stimulated by atmospheric warming and the consequent changes in moisture regimes. However, the how the variation in cold-season temperatures influence this release of nitrogen is still unknown. Cold season, the period between soil freeze-up in September and thaw in June, is warming relatively faster compared to the growing season, which drastically alters the insulating snow cover and microbial processing of soil organic matter. We conducted a laboratory incubation study to investigate the effects of different cold season temperatures (-10˚C, -15˚C, -20˚C, -25˚C) on spring and growing season. We measured inorganic nitrogen pools, net N cycling rates, and CO_2, CH_4, N_2O fluxes throughout the study. Our results are generally consistent with the High Arctic soil biogeochemistry literature. Interestingly, over the coldest period of the annum, warmest and coldest soils displayed greatest net N mineralization rates. During the thaw period, we found that soils treated with -10˚C produced a much greater spring NO_3^- flush while -15˚C, -20˚C, -25˚C treatments were relatively consistent with each other, suggesting a cold-temperature inhibition of nitrification. Although cold season fluxes of CH_4 and CO_2 differed with temperature, there was no treatment effect on flux rates during the growing season. We conclude that cold-season N transformations play a crucial role in soil N biogeochemistry in High Arctic wet-sedge communities and have a potential to disrupt surrounding downstream ecosystems.

Abstracts

Session 3
Environmental Impact & Community health from A Global Perspective

Access to safe drinking water in Northern Canada: Arctic perspectives and challenges

Cassivi Alexandra[1,2], Rodriguez Manuel[1], Guilherme Stéphanie[2]

1. Université Laval
2. University of Ottawa

Drinking water supply remains an important concern in Northern Canada, particularly in remote Indigenous communities. Drinking Water supply in remote communities in the Arctic is typically received supplied through water trucking due to, among other things, the presence of permafrost. Water trucking may compromise water quality as well as increasing risks of contamination from the point of entry into the distribution system to the point of use, i.e., households' cisterns. In addition, risk perceptions associated to water distribution along with water advisories intensify the rejection of chlorinated water by the communities and can lead some households to use alternative water sources to meet their needs in water, i.e., collecting water from natural sources or directly from a tap at the local the treatment plant, as purchasing water bottles. A sampling program was carried out in three Indigenous communities in Nunavik, Canada (summer and fall 2019) to study the microbiological and chemical quality of the water throughout the distribution process. In order to identify critical points in the supply system, water was collected from the source (i.e., surface water intake), the water treatment plant, the tanker truck, and several public and residential reservoirs. These results will be presented by taking based on a comparative approach using evidence drawn from a scoping review on access to safe drinking water and health that included the eight Arctic nations. Perspectives and challenges associated to with water supply in remote communities of the Arctic will be discussed.

Abstracts

Session 4
Microbial Remediation

Biochar-based phosphorus solubilizing bacterial inoculants for soil remediation

Zhe Wang[1,2], Bing Chen[1,*], Shuguang Wang[2,*], Hui Chen[2,*], Baiyu Zhang[1], Xing Song[1]

1. Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University, Canada
2. Shandong Key Laboratory of Water Pollution Control and Resource Reuse, School of Environmental Science and Engineering, Shandong University, China

Phosphorous solubilizing bacteria (PSB) can convert unavailable phosphorus into available phosphorus in the soil, improve soil nutrients content, and reduce the amount of phosphorus fertilizer applications. Inoculation of phosphate solubilizing bacteria in soil is a promising technology to increase the available phosphorus content for plant growth, but its application is limited by the low survival rate in the field. Inoculated bacteria with the porous-structured biochar, in which the PSB are immobilized, can effectively avoid PSB loss and improve the vitality of the PSB. However, the effects of feedstock and pyrolysis temperature of biochar on PSB survival and its activity have not been fully understood. This research thus proposed to inoculate *Bacillus. Megaterium* with 10 types of biochar and evaluated the survival rate and phosphate-solubilizing performance of *B. megaterium* in various inoculated biochar with distinct physicochemical properties. The soil culturing experiments were conducted to exam the phosphorus releasing performance by the biochar-based inoculants. In addition, the fluorescence protein labeling elucidated the abundance and spatial distribution of the bacteria in situ after application to emphasize the correlations between improved phosphorus content and PSB survival. Our results showed that the survival of *B. megaterium* in soil was significantly affected by pyrolysis temperature of biochar regardless of feedstock (wheat straw, maize straw, and corn straw), with a lower pyrolysis temperature of 300℃ conferring the higher survival rate. Among all the biochar, 300℃ maize straw biochar as the bacterial inoculum carrier performed the best in keeping PSB cells density with 2.048×10^{7} CFU g^{-1} soil after four weeks inoculation, compared with the 2.5×10^{8} CFU mL^{-1} initial bacterial inoculum population density.

Abstracts

Session 4
Microbial Remediation

Profiling microbial communities for identification of microbiologically induced corrosion in submarine environments

Xing Song, Baiyu Zhang*, Bing Chen

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University

Corrosion of infrastructure has generated massive costs (at least $3 billion) in the oil and gas industry each year. Microbiologically induced corrosion is a major issue to deteriorate assets associated with the offshore oil industry. Although many efforts have been undertaken to investigate the occurrences, mechanisms, and control strategies of MIC during oil production and transportation, limited studies focused on the characterization of possible survival of relevant bacteria in surrounding submarine environments, especially in North Atlantic Canada. In this study, the microbial community of subsurface seawater and sediments from offshore Newfoundland was examined using phospholipid-derived fatty acid analysis. Seawater samples and sediment samples were collected 10 m far from the corroded assets (92 m-95 m depths subsurface seawater). Phospholipids in samples were extracted, derivatized to fatty acid methyl esters, and analyzed through gas chromatography-mass spectrometry based on a developed analytical method in the NRPOP laboratory at Memorial University. The detected fatty acid methyl esters ranged from 0.131 to 24.0 μg/g in sediment and from 0.0787 to 9.01 μg/L in seawater. The analytical results profiled the presence of sulfate-reducing bacteria surrounding the corrosion location, such as Desulfobacter, implying the composition of the indigenous microbial community. The results can help to give a better understanding of the effects of MIC on submarine environments, and the prevention, monitoring and control of corrosion under such situations.

Abstracts

Session 4
Microbial Remediation

Multi-scale demonstrations of surfactin synthesis from fishery waste

Jiheng Hu[1], Jie Luo[2], Zhiwen Zhu[1], Bing Chen[1,*], Xudong Ye[1], Peng Zhu[3], Baiyu Zhang[1,*]

1. Faculty of Engineering and Applied Science, Memorial University, Canada
2. Faculty of Biotechnology, Jiangnan University, China
3. Faculty of Food and Pharmaceutical Science, Ningbo University, China

The surfactin biosurfactants have demonstrated their wide applicability in the field of environmental engineering and beyond. However, low yield and high production cost hindered the industrialization of surfactin, resulting in insufficient supply of this product with relatively high price in the market. Utilization of waste materials as low-cost substrates for the growth of biosurfactant producers has emerged as a feasible solution for economical biosurfactant production. In this study, fish peptone was generated through enzyme hydrolyzation (mainly PB05 basic protein and PB02 animal protein) of smashed tuna waste. Surfactin production by Bacillus subtilis ATCC 21332 was then evaluated and optimized using the generated fish peptone as a comprehensive substrate. To explore the possibility for a large-scale surfactin production, the optimized production conduction was continuously assessed in a 7 L batch-scale and a 100 L pilot-scale fermenter after the bench-scale production of biosurfactants. Electro Spray Ionization-Mass Spectrometry (ESI-MS) analysis demonstrated that the generated biosurfactant product belonged to surfactin. The results showed that Bacillus subtilis ATCC 21332 could effectively use the fish waste peptone for surfactin production. The highest surfactin productivity achieved in the pilot-scale experiments was 274 mg/L. The experimental results shed light on the further production of surfactin at scales using fish wastes as an economical substrate.

Abstracts

Session 4
Microbial Remediation

Genomic and metabolic characterization, and hydrocarbon-degrading potential of the marine bacterium *Pseudomonas sp.* Oil-1

Emma Wells[1], Javier Santander[2], Ignacio Vasquez[2], Cristopher Segovia[2], Uta Passow[1]

1. Ocean Sciences, Anthropogenic Effects on the Oceanography of Newfoundland Lab, Memorial University
2. Ocean Sciences, Marine Microbial Pathogenesis and Vaccinology Lab, Memorial University

An oil spill can be described as a release of hydrocarbons into the environment caused by anthropogenic activity. Oil spills in the ocean pose a direct threat to marine birds, mammals and fish due to the toxicity of the oil and the formation of oil slicks. Naturally occurring marine bacteria play a major role in the recycling of carbon in the ocean, including hydrocarbons. Many of these bacterial species are able to utilize hydrocarbons as an energy source. The purpose of this study is to investigate the biodegradation potential of the hydrocarbon-degrading marine bacterium *Pseudomonas sp*. Oil-1, which was isolated from surface waters in Logy Bay, Newfoundland in 2017. *Pseudomonas sp*. Oil-1 cells are Gram-negative, psychrophilic, motile, biofilm-producing marine bacterium. The *Pseudomonas sp*. Oil-1 genome is composed of one chromosome with a total genome size of 4.23 Mb with 58.3% G+C content. Phylogenetic and comparative analysis determined that *Pseudomonas sp*. Oil-1 is associated with the genus *Pseudomonas*, but is not closely related to well-studied pollutant-degrading species such as Pseudomonas putida. This study focuses on the species identification of *Pseudomonas sp*. Oil-1 and the hydrocarbon-degrading abilities of this bacterium.

Abstracts

Session 4
Microbial Remediation

Magnetic nanoparticles decorated bacteria for enhanced mitigation of heavy crude oil pollution

Yiqi Cao, Baiyu Zhang *, Zhiwen Zhu, Masoumeh Rostami, Bing Chen

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University

Global energy demand has increased the production, transportation, and usage of heavy crude oil (HCO), urging the need for effective HCO spill preparedness and responses. Biodegradation is an effective and environmentally friendly alternative for spilled oil mitigation. However, such effectiveness is limited for HCO pollution. Unlike conventional oils, an abundance of recalcitrant high-molecular-weight (HMW) aromatics, asphaltenes, and resins in HCO make them extremely dense and viscous. The low solubility and mobility of HCO limited their bioavailability to microbes. The dominant HMW aromatics, resins, and asphaltenes components are further resistant to biodegradation. Hence, increasing initial bacterial abundance toward HCO and recovering these recalcitrant components may enhance mitigation of HCO pollution. In this study, we developed magnetic nanoparticles decorated bacteria (MNPB) using an oil-degrading and biosurfactant-producing Rhodococcus erythropolis species and identified a novel access-dispersion-recovery strategy for enhanced HCO pollution mitigation. The strategy entails (1) magnetic navigation of the MNPB towards the HCO layer, (2) enhanced oil dispersion and formation of suspended oil-bacteria aggregates, and (3) magnetic recovery of these aggregates. The UV-spectrophotometer analysis showed that this strategy could enable up to 62% removal of HCO. The GC-MS analysis demonstrated that the MNPB enhanced the degradation of low-molecular-weight aromatics compared with the pure bacteria, and the recovery process further removed oil-bacteria aggregates and entrained HMW aromatics. The designed MNPB and novel bio-mitigating strategy can expand the biodegradation applicability for HCO pollution and shed light on the application of the emerging magnetically enhanced bioremediation technologies.

Abstracts

Session 4
Microbial Remediation

Heterologous cytochrome P450 expression for emerging contaminant treatment by microalgae

M. Fyfe, Petkovich, P. Champagne

Queen's University

Synthetic biology is expanding the repertoire of biocatalytic industries, and phytoplankton are emerging as sustainable alternatives to traditional non-photosynthetic hosts. This review investigates the opportunities to express recombinant catabolic enzymes to develop cultures capable of high efficiency phycoremediation of pollutants in wastewater streams. Biodegradation is responsible for most reported EC removal by phytoplankton but recombinant protein expression has the potential to improve the degree of removal and the range of compounds as it has in higher plants. By leveraging the unique electron-transfer infrastructure of the photosynthetic apparatus, the expression of heterologous cytochrome P450 enzymes known to metabolize xenobiotics may prove to be an elegant biocatalytic treatment option. The selection of an appropriate enzyme, additional transformations required, and opportunities to improve degradation efficiency are discussed.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Irradiation-based degradation of per-and-polyfluorylalkyl substances (PFAS): isomer-dependence, pH, and transformation

David Patch, Iris Koch, Tom Creswell, Cath Hughes, Justin B. Davis,

Dannis O'Carroll, Kela Weber

RMC, University of New South Wales, ANSTO

This study investigates degradation of fourteen different per- and polyfluoroalkyl substances (PFASs) in water following treatment with gamma irradiation. Perfluorooctanoic acid (PFOA), perfluorooc-tanesulfonic acid (PFOS), and 6:2 fluorotelomer sulfonate (6:2 FTS) were irradiated independently to investigate overall degradation, isomer-specific degradation, and transformation into shorter-chained PFAS. Independently PFOA was decreased by 81±5%, PFOS was decreased by 70±8%, and 6:2 FTS was decreased by 44±7%. Decrease in the initial PFAS present and corresponding transformation into smaller chained carboxylates were highest at pH 11, but transformation products were higher, indicating a pH-dependent transformation mechanism into shorter-chained PFAS including C2, C3, and H/F exchanged polyfluorinated alkyl substances. Thirteen different PFAS, including C4-C12 carboxylates, C4, C6, C8 sulfonates, and C8 sulfonamide were irradiated together to investigate any synergis-tic/antagonistic effects. In the PFAS mixture, carboxylate degradation did not depend on chain length or pH, with average total degradations of 978±3%. Sulfonate degradation was highly dependent on chain length, with degradation totals of 4±1% for PFBS (C4), 49±1% for PFHxS (C6) and 61±1% for PFOS (C8). Degradation of PFOSA was highly dependent on pH, with a total degradation of 99±1% at pH 7 compared to 70±3% at pH 11. Degradation rates for most PFAS were twice as high at pH 11 compared to pH 7. PFOS and PFHxS exhibited isomer-dependent degradations, with linear isomers being more resistant to degradation than their branched counterparts. These findings provide critical information for developing PFAS remediation technologies that can be applied to a wide range of PFAS including different chain lengths, functional groups, and isomers. These findings also suggest that further development of existing analytical methods is required to provide better insight into partial defluorination products.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Fate of silver nanomaterials in treatment wetland mesocosms

Anbareen Jan Farooq[1], Vincent Gagnon[1], David Patch[1], Denis O'Carroll[2], Kela Weber[1]

1. Environmental Sciences Group, Department of Chemistry and Chemical Engineering, Royal Military College of Canada
2. School of Civil and Environmental Engineering, UNSW Water Research Laboratory, The University of New South Wales Sydney

Recent research has shown that silver nanomaterials (AgNMs), often employed due to their antimicrobial properties, are released from textiles during use and are entering wastewater streams. However, the fate and effects of AgNMs release from these commercial products in the environment are largely unknown. Treatment wetlands (TWs) are a green technology that is passive, energy-efficient and cost-effective compared to conventional wastewater treatment methods. Microbial communities in TWs are responsible for much of the system's wastewater treatment potential. The focus of this research is to assess whether the TW systems can sequester the AgNMs released from textiles without impairing these crucial microbial communities. Twenty-four subsurface flow planted wetland mesocosms were developed for this study; twelve were intensified with artificial aeration and twelve were non-aerated. The experiment consisted of four mesocosm schemes: positive control, negative control, pristine AgNM, and artificially weathered AgNM (released from X-Static® fabric) exposures, all conducted in triplicate. Two separate in-situ exposures were conducted and monitored using an extensive characterization suite (total of 15 different metrics) to profile the impacts on water treatment performance and microbial function. Finally, the overall fate of silver within the mesocosms was determined through destructive sampling of the constructed wetland biofilm, plant roots, and aboveground plant biomass. Overall, there was no observable difference in microbial activity between the silver treatments and the controls, demonstrating the robustness of TWs. The TW systems were able to achieve removal efficiencies above 80% for both the pristine and weathered AgNMs. Furthermore, the silver mass balance revealed that the majority of silver had been sequestered in the gravel-associated biofilm; in particular in the lower half of the TWs. As the AgNMs sequester in the biofilm, it is likely to transform into less toxic silver species, such as silver sulfide, which would result in reduced toxicity to downstream environmental receptors.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Standardization of a simple and reliable method for analyzing 16 priority PAHs using porous selective polymers (PSP) extraction devices

Fereshteh Shahhoseini, Ali Azizi, Carlos A Bazan, Christina Bottaro

Memorial University

Thousands of water samples are being analyzed for determination of different organic pollutants in analytical labs all around the world every day. Accredited contract analytical labs mostly use liquid-liquid extraction (LLE) and solid phase extraction (SPE) as sample preparation techniques. LLE does not need any specific apparatus, but this method needs high volume of hazardous solvents, and it is very time-consuming and laborious technique. SPE was introduced as a replacement for LLE to minimize the manipulation in this technique and reduce the solvent consumption. However, the requirement of filtering the water samples with suspended solids and particulates, specific apparatus to adjust the flow rate through the SPE column, and the loss of the analytes are some of the disadvantages of SPE technique that hinder its widespread usage. Other techniques such as solid phase microextraction (SPME) in different formats of fiber and thin film have been reported as an alternative sample preparation for LLE and SPE. SPME has official methods published by regulatory agencies such as United States Environmental Protection Agency (US EPA), International Standard Organization (ISO), and American Standards for Testing and Materials (ASTM). Although this technique has been standardized by several studies and agencies, it has not been broadly adapted by labs which is mostly because of the possibility of carry over especially for trace analysis, expensive apparatus, and specific equipment (i.e., thermal desorption unit).

In this research, a simple and reliable technique is presented which has been developed and optimized based on the needs and problems that environmental analytical labs are facing today, and the process of standardization has been started to introduce the PSP extraction technique to the sample preparation market.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Selective detection of nitenpyram by a carbon dots-based fluorescence sensor

Masoumeh Rostami, Yan Zhang, Baiyu Zhang

Memorial University

In this study, a sensitive carbon quantum dots-based fluorescence sensor was developed for quantitative detection of nitenpyram, a toxic neonicotinoid pesticide from various water samples. A facile hydrothermal/solvothermal method was applied to prepare blue-emitting N-doped carbon quantum dots (N-CQDs) from citric acid as carbon source and dimethylamine as nitrogen source in a mixture of ethanol and water. The as-prepared N-CQDs demonstrate extremely high sensing selectivity to nitenpyram from other pesticides. By adding nitenpyram solution to N-CQDs, the fluorescence of N-CQDs was quenched significantly, whereas no quenching effect of N-CQDs was detected by the addition of imidacloprid, thiamethoxam and atrazine to N-CQD solution.

The results showed the fluorescence intensity of the N-CQDs keeps on decreasing with the increase of nitenpyram concentration and a very good linear correlation (R^2 = 0.997) between the ratios of F0/F and nitenpyram concentration was obtained within the concentration range of 5-75(or 100) ppm. This study confirms that CQDs-based fluorescence sensor can be applied for the detection of nitenpyram at low concentration with high accuracy and reproducibility.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Removal of arsenic in aqueous solutions by developing a 5-stage drinking water filtration system

Roya Sadat Neisan, Carlos Bazan, Noori M. Cata Saady, Tahir Husain

Memorial University

Due to the poor quality of water in rural areas, people living in small communities suffer from health problems and diseases caused by dangerous pollutants. Arsenic is one of the significant groundwater pollutants. As a toxic metal, it severely affects human health and the environment. Therefore, there is need for a small, simple, reliable household water treatment package system that remove Arsenic from the accessible water sources in rural and remote areas.

Recently, researchers have focused on converting waste materials into adsorbents for heavy metal removal from water due to these adsorbents' low cost and effectiveness. However, there is still a need for a drinking water filtration system targeting arsenic removal. This research proposes a five stages under-the-sink household water treatment system, including a 1-resin unit for softening of water; 2- clothing filter; 3-UV-assisted purification unit; and 4 and 5- adsorption units made of fly ash-based activated carbon and mussel shells powder as a potential solution. The UV-assisted purification unit disinfects the water and removes Arsenic simultaneously using titanium dioxide as a photocatalytic material. To develop this system, we investigate different methods and materials to find the best option for manipulating the surface area of the cloth filter, Mussel shells and fly ash adsorbents to customize them for arsenic removal. Additionally, Thermogravimetric Analysis (TGA), Scanning Electron Microscopy (SEM), Powder X-ray Diffraction (XRD), Infrared spectroscopy (IR), Solid-State NMR spectroscopy and Brunauer-Emmett-Teller (BET) surface area analysis are the analytical methods we use to characterize the adsorbents. The final stage of this research is finding the optimum conditions for maximum removal efficiency of Arsenic. Our team recommends establishing and developing a fully sustainable and environmentally friendly filtration system as well as driving benefits from waste material.

Abstracts

Session 5
Monitoring & Fate of Contaminants

Novel fluorescent N and S co-doped carbon quantum dots prepared through hydrothermal method

Lantian Chang, Yan Zhang

Memorial University

Carbon quantum dots (CQDS), a new family of fluorescence carbon nanomaterials, have received increasing attention in areas of biological imaging, sensing, photocatalysis and electrocatalysis by virtue of their excellent photoluminescence(PL) properties, photo-stability, low toxicity, and low cost. In this work, a facile hydrothermal method was applied to prepare green emitting N and S co-doped carbon quantum dots (N,SCQDs) from citric acid (1 mmol) and thiourea (3 mmol) at reaction temperature of 180 ^{o}C for 6h. The asprepared N,S-CQDs have shown significant optical absorbance in the visible light region (>400nm),demonstrating the potential as catalyst or co-catalyst for visible-light-driven photocatalysis. The PL property of the N,S-CQDs was studied using fluorescence spectroscopy at different excitation wavelengths ranging from 280 to 700 nm. The N,S-CQDs exhibit excitation-dependent PL behavior. When the excitation wavelength (λex) is less than 400nm, N,S-CQDs demonstrate the highest fluorescence emission peak at 450 nm. However, the highest fluorescence emission peak shifts from 345 nm to 450 nm at λex> 400 nm. The morphology and average particle size of N,S-CQDs were characterized by transmission electron microscopy (TEM). TEM results indicate that N.S-CQDs are well-dispersed spherical particles with the average particle size being around 10 nm.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

Effects of microplastics on oil droplet size distribution in the marine environment

Min Yang, Baiyu Zhang, Yifu Chen, Bing Chen

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University

Microplastics (MPs) and oil are marine pollutants with rising concerns in recent years, but their interactions are less tackled. In this study, we explored the effects of MPs on oil droplet size distribution during oil dispersion treatment in the marine environment. Corexit 9500A was used as the dispersant, Terra Nova crude oil was selected as the target oil, and polyethylene (PE) MPs were used as the tested MPs. Without the existence of MPs, the oil droplet size under a dispersant-to-oil volumetric ratio (DOR) of 1:25 reduced from 8.15±0.64 to 2.29±0.20 μm, while the oil droplet size under a DOR of 1:10 decreased from 3.67±0.21 to 2.31±0.01μm when the mixing energy increased. With the existence of MPs, the oil droplet size would decrease first then increase when MPs concentration increased. The maximum oil droplet size under a DOR of 1:10 and the mixing energy of 200 rpm was 9.96±0.64 μm which was reached at 533 mg/L MPs. The maximum oil droplet size under a DOR of 1:25 and the mixing energy of 120 rpm was 19.08±1.37 μm at 1083 mg/L MPs. This study would provide fundamental knowledge on oil spill response with MPs occurred in the marine environment.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

Chemical demulsifiers enhanced gravity separation for mechanical recovery during marine oil spill responses

Fei Wu, Jingjing Ling, Baiyu Zhang, Bo Liu, Yuming Zhao, and Bing Chen*

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

The mechanical recovery of spilled oil after an offshore oil spill can produce oil-water emulsions, which contain up to 70% seawater. Gravity separation is the most commonly applied technology for oil/water separation during a marine oil spill response; however, the low separation speed of oil-water emulsions limits the mechanical response efficacy. Therefore, it is necessary to accelerate the gravity demulsification process. The introduction of chemical demulsifiers to the gravity separation is a widely used enhancement method to break highly stable emulsions. Chemical demulsifiers are a class of surfactants used for emulsion separation that can reduce oil-water interfacial tension. Two different chemical demulsifiers, namely Brand A and B, were evaluated in this work. They belong to two different categories (ionic and nonionic, respectively). Control samples were set up without the addition of demulsifiers. Our emulsion samples were prepared by blending two different crude oils (light oil T and heavy oil D) with seawater at the same oil-water ratio using a homogenizer. Samples were subjected to gravity separation for 30 minutes at room temperature. The results showed that both demulsifiers could accelerate the oil and water separation. For the T-seawater emulsion, Brand A demulsifier led to more than 85% of recovery of seawater. Different results were observed for D-seawater emulsions. The highest water recovery rate of nearly 70% was achieved by using Brand B demulsifier. The free water resulting from the T-seawater emulsion was found to be more transparent than that from the D-seawater emulsion. Based on our studies, Brand A demulsifier is recommended for breaking T-seawater emulsions, and Brand B demulsifier for breaking D-seawater emulsion.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

The study of pilot-scale membrane filtration system for decanted oily seawater treatment generated from marine oil spill response

Parisa Keyvan Hosseini, Mahsa Keyvan Hosseini, Lei Liu

Dalhousie University

Increasing volume of oil exploration, production, and transportation activities have led to higher risks of oil spill incidents, leaving negative impacts on marine biota and human beings. Oil decanting technology is used all over the world to recover spilled oil. The release of decanted seawater back to the ocean is forbidden by the Canada Fisheries Act, due to regulatory barriers and the presence of persistent and toxic pollutants in decanted seawater. Decanted seawater must be barged to shore for disposal in Canada, which significantly limits the response capacity and efficiency of oil recovery by skimmers. This is due to limited temporary storage space in barges and the long time and high cost of transportation, which has become one of the major challenges confronting Canadian governments and oil spill response industries in Canada. The identification of the appropriate on-site treatment technologies has become essential in marine oil spill response operations. Membrane filtration technology has been proven to be a promising approach in treating hydrocarbon-containing wastewaters, particularly for the effluents containing emulsified and dissolved oils, which have fine droplet size and strong consistency. The objective of this study is to evaluate the feasibility and effectiveness of the pilot-scale membrane filtration system for treatment of decanted oily seawater and optimize the operating conditions of the system using response surface methodology (RSM). Various parameters, such as membrane flux, hydraulic retention time (HRT), and aeration flow rate using two types of membranes with different pore sizes (i.e., microfiltration and ultrafiltration) will be considered. Experiments will be conducted to analyze the concentrations of oil, chemical oxygen demand (COD), total organic carbon (TOC), total petroleum hydrocarbons (TPHs), and polycyclic aromatic hydrocarbons (PAHs). It is expected that oil concentration reaches less than 15 ppm in effluent and the concentration of toxic substances becomes less by implementing the proposed methodology.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

The investigation of an environmentally viable approach for online chemical cleaning of pilot-scale membrane filtration technology during in-situ treatment of decanted oily seawater

Mahsa Keyvan Hosseini, Parisa Keyvan Hosseini, Lei Liu

Dalhousie University

Membrane filtration technology after an oil spill response is a viable approach for the process of oil decanting compared to common decantation processes. Membrane filtration has many advantages, such as reducing trip cycles to the shore, increasing space in recovery ships, and fastening the oil recovery process, as well as high-quality effluent and small footprint. One of the major challenges of this technology is membrane fouling, which leads to the reduction of system efficiency, membrane permeability, and membrane lifespan. In oily wastewater treatment, the presence of oil results in the accumulation of oil droplets on the membrane surface and leads to the membrane fouling. To mitigate this issue, physical and chemical cleaning methods have been conventional and necessary approaches; on-line chemical cleaning with chlorine-based chemicals has been widely used as a potential solution to increase the performance of membrane filtration, moreover, maintaining membrane permeability and decreasing membrane fouling. However, common chlorine-based chemicals, such as sodium hypochlorite (NaClO) has presumably raised concerns for the environment, marine creatures such as fish and algae, and humans due to the generation of harmful halogenated-by-products and toxic substances after on-line chemical cleaning. Previous studies focused on a chlorine-free and thermodynamically strong oxidant including peroxymonosulfate (PMS) to decrease adhesion force of foulants to the membrane surface during water treatment, as an environmentally friendly agent for online chemical cleaning. However, the synergistic use of chlorine-free agents as chemical cleaning substances during treatment of decanted oily seawater through membrane filtration has rarely been reported. In this study, experiments are planned to investigate the efficiency of on-line chemical cleaning with chlorine-free agents such as PMS and analyze the toxicity of effluent after on-line chemical cleaning during the treatment of decanted oily seawater. It will help to enhance the application of membrane technology as a prospective approach for oil decanting in Canada.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

A general-purpose deep learning framework for classifying weathered microplastic-oil-dispersant agglomerates

Yifu Chen, Bing Chen*, XiaYing Xin, Qiao Kang, Xudong Ye, Baiyu Zhang

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

The classification of different weathering degree microplastic, oil, dispersant agglomerates (WMODAs) is a needed task to evaluate their impacts on oil spill and weathered microplastic. However, it is a difficult and time demanding task to perform manually since the subtle difference between them. In this paper, an interpretation-oriented framework based on deep learning neural networks was presented powered by deep convolutional generative adversarial networks (DCGANs) to classify scanning electron microscopy (SEM) images from different weathering degree WMODAs. The proposed framework comprises a first stage, implemented DCGANs to augment image datasets to optimize model performance from limitation of dataset size. After augmenting datasets, a second stage based on different convolutional neural networks (CNN) classified them into before/after 21 days WMODAs, including customized CNN, original and pre-trained CNN of Resnet50 and VGG16. A third stage was carried out to test the performance of five different CNN models followed by local interpretable model-agnostic explanations (LIME) to increase model reliability. A F score of 0.9192 was achieved from pre-trained Resnet50 in classifying before/after 21 days WMODAs. The proposed framework was proved its accuracy in classification from SEM images in WMODAs field and its application has potential in other SEM image-related classification fields.

Abstracts

Session 6
Oil Pollution, Response & Treatment #1

Comparative tests of dispersant effectiveness in the presence of organic matter using different quantification methods

Narimene Zoghbi, Massomeh Karimi, Uta Passow

Memorial University

Dispersant application is one response measure to marine oil spills. To assess their effectiveness in the open ocean, we investigated the impacts of microbial exudates on dispersant effectiveness using a modified version of the Baffled Flask Test (BFT): The laboratory dispersant testing protocol, developed by the U.S. Environmental Protection Agency (EPA). Before an hour of shaking at 150 rpm and 4°C, weathered oil, and COREXIT (at a DOR of 1:20) were added to baffle flasks containing artificial sea water. We then measured dispersant effectiveness in different types of organic matter (Xanthan Gum, phytoplankton exudates, and natural community exudates), each in the presence and absence of cells. Tests were conducted with three types of oil (Macondo crude, Cold Lake Dilbit and Conventional Crude). Dispersant effectiveness based on oil concentration in the water phase, was analyzed spectrophotometrically (EOC) and fluorometrically (EOE) according to the standard method prescribed by the BFT protocol. While this estimation of dispersant effectiveness is widespread, interference in the oil quantification in samples containing organic matter were observed. We defined the effectiveness of a dispersant as its ability to increase the number and total volume of oil microdroplets in the water. We estimated dispersant effectiveness via the quantification of the volumetric concentration of oil in the microdroplets phase using flow imaging microscopy. This method compares the total cumulative volume of oil droplets present in a chemically dispersed sample with the volume present in a physically dispersed sample, to estimate dispersant effectiveness.

Dispersant effectiveness varied greatly between treatments. For Macondo oil, the presence of exudates leads to a significant decrease in the volume of oil suspended in the microdroplets fraction. The treatments containing conventional crude oil and the Cold Lake Dilbit also displayed different dispersion behavior in presence of organic matter. Those results were more significant in samples containing cells.

Abstracts

Session 7
Microbiology & AMR

Estimating the burden of illness attributable to shiga-toxin producing *E. Coli* (STEC), giardia and norovirus associated with private wells in Ontario

Tessa Latchmore[1], Paul Hynds[2], Stephen Brown[3], Kevin McDermott[4], Anna Majury[5]

1. Queen's University
2. Technological University Dublin
3. Queen's University
4. Public Health Ontario
5. Public Health Ontario and Queen's University

Approximately 1.5 million individuals in Ontario are supplied by private wells. Individuals using private well water are at an elevated risk of acute gastrointestinal illness (AGI) compared to individuals who rely on municipal water supply. However, the true extent of AGI attributable to private well water remains relatively unknown, with cases frequently underreported or misdiagnosed. Unlike municipal water supplies private well water quality remains unregulated; therefore, owners are responsible for testing, treating, and maintaining their own systems. Using a large spatio-temporal groundwater quality dataset, a provincial-scale quantitative microbial risk assessment (QMRA) tool has been developed to estimate the burden of illness attributable to Shiga-toxin producing E. coli (STEC), Giardia and norovirus among consumers of contaminated private well water in Ontario. Recent research recommends that future human health risk estimation should be delineated based on significant contamination drivers. Thus, the current QMRA was delineated based on aquifer type (e.g., consolidated, and unconsolidated) and vulnerable sub-populations, namely adults (> 11 years old) and young children (< 10 years old). Model estimates predict an overall crude incidence rate of 55.2/100,00, 105.1/100,00 and 1,116.5/100,000 for STEC, Giardia and norovirus respectively; approximately 40 and 12 times higher than the Ontario estimated crude incidence rate for STEC and Giardia. An estimated 2,887 illness per year are due to the presence of the aforementioned pathogens in drinking water from private well water in adults with an estimated 718 illness per year in children. Study findings will provide a better understanding of the role private drinking water systems have on the human health burden in rural communities in Ontario and the developed model will ultimately aid in risk communication and management strategies for private well owners in Ontario.

Abstracts

Session 7
Microbiology & AMR

The spatiotemporal distribution, phylogenetic profile and antimicrobial resistance profiles associated with *E. coli* contaminated groundwater sources in southeastern Ontario

Madeleine Kelly, Anna Majury, Paul D. Hynds, Stephen Brown

1. Queen's University
2. Public Health Ontario
3. Technological University Dublin

Fecal contamination of drinking water represents a threat to public health in globally, and particularly in rural communities reliant on private well water. Private well water supplies in Canada are unregulated, with supplies frequently impacted by anthropogenic activities including agricultural runoff and septic system leakage. Consequently, these sources may be a potential reservoir for the transport of and human exposure to antimicrobial resistant organisms (AROs) and antimicrobial resistant genes (ARGs). The current study sought to assess private well water supplies across Ontario for the prevalence of fecal contamination based on the detection of *E. coli*, describe the phylogenetic profile and source of private well water *E. coli* isolates and assess levels of antimicrobial resistance using diffusion-based methods. The antimicrobial susceptibility panel was designed to ensure adequate representation of antimicrobials relevant to *E. coli*, across clinical, agricultural and veterinary usage. A total of 19 antibiotics from the aminoglycosides, carbapenems, 1st, 2nd, 3rd and 4th generation cephalosporins, monobactams, nitrofurantoin, penicillins, quinolones, sulfonamides and tetracyclines classes were included. Private well water convenience samples were collected over two full hydrological years and seasonally categorized, with the final data set comprising approximately 150 isolates from 50 wells, per season, i.e., approximately 200 wells per year. Year one of isolate collection yielded 491 isolates from 189 southeastern Ontario private wells which have been characterized by phylogenetic origin and antimicrobial resistance profile. The phylogroup distribution consists of 34% A, 35% B1, 25% B2, 2% C, 14% D, 1% E, and 2% G. Results of statistical analyses indicate an association between phylogroup type and 10-day cumulative antecedent rainfall ($p = 0.030$. Significant associations were also found between phylogroup and geological setting. Approximately 55% of year one isolates were resistant to ≥1 antibiotic, 13% were resistant to ≥3 antibiotics, 25% of all wells contained antibiotic resistant isolates. Study results will be used to further current understanding of the presence, frequency and concentration of antimicrobial resistant *E. coli* in southeastern Ontario groundwater. Determining the potential drivers of antimicrobial resistant *E. coli* in well water will better inform surveillance, modeling and predictions of human health risk. Furthermore, it will initiate discussion regarding the potential implications of antimicrobial resistant *E. coli* in private well water, such as water quality testing methodologies, regulation and policy.

Abstracts

Session 7
Microbiology & AMR

Total coliforms: towards A better understanding of this microbial water quality indicator using statistical analysis and A large Ontario water quality dataset

Ioan Petculescu

Queen's University

Faecal pollution continues to be a major contributor to outbreaks of infectious disease globally, making drinking water quality monitoring for contamination a high priority public health action. Testing for the presence of indicator organisms, such as total coliforms (TC) and Escherichia coli (*E. coli*), as a proxy for potential pathogen contamination is a frequently used method for monitoring water quality. The relationship between *E. coli* contamination (i.e., detection rates and concentrations) and source susceptibility of private wells has been studied thoroughly; however, few studies have analysed the relationship between TC contamination and source susceptibility in the context of multiple concurrent drivers of contamination.

This study examined a large (more than 790,000 samples from approximately 250,000 wells), multi-year (2010-2017) water quality (microbial) and well descriptor (e.g. location, construction, geologic setting) dataset for private drinking water wells in Ontario to determine TC and *E. coli* contamination trends (detection rates), the relative distributions of TC:E. coli concentration ratios, and the relationship between TC concentration and *E. coli* detection rates across geologic, temporal, and well-specific variables.

Findings revealed differences among TC and *E. coli* detection rates across years, seasons, aquifer types, and well types ($p < 0.05$), among TC:*E. coli* concentration (CFU/100 mL) ratios across select depths and between select bedrock types ($p < 0.05$), and among *E. coli* detection rates at select TC concentrations (CFU/100 mL) across aquifer types, bedrock types, seasons, and well types ($p < 0.0001$). This study aims to contribute to the growing body of work in this field and will inform public health action and policy regarding the potential protective actions necessary to safeguard and manage private well water sources, as well as the development of policies and guidelines related to well water quality issues in Ontario.

Abstracts

Session 7
Microbiology & AMR

The development of heavy-metal mediated antimicrobial resistance in bench-scale pipe-loop system

Leah Vignale, Yves Filion, Pascale Champagne, Victoria Rilstone, Artur Sass Braga

Queen's University, INRS

The development of antimicrobial resistance (AMR) in biofilms that exist within drinking water distribution systems (DWDS) poses an emerging threat to public health. It remains widely unknown how the diverse physio-chemical parameters of the drinking water environment aid or hinder the development and dissemination of AMR. One such parameter is the presence of trace levels of heavy metals. Some clinical studies have demonstrated the development of heavy metal-mediated co-selection, a process by which concomitant evolution selects for both metal resistant genes (MRGs) and antimicrobial resistant genes (ARGs), even when singly exposed to the presence of heavy metals. Existing clinical studies examine mainly single species biofilms grown using typical plate culturing methods. This limits the relatability of conclusions compared to scale DWDS because the conditions within a DWDS consist of diverse multi-species biofilms grown under specific hydrodynamic conditions. The proposed study uses a novel bench-scale pipe-loop system to grow heterogeneous biofilms, mimicking the hydrodynamic conditions of scale-DWDS. The present study aims to examine the outcome of subinhibitory concentrations of heavy metal stress, specifically cadmium (Cd) (II) and lead (Pb) (II), on the increase of overall biofilm community AMR. The query is achieved through targeting known resistance genes, before and after the addition of subinhibitory concentrations of Cd (II) and Pb (II) using qPCR techniques. An increase or decrease in MRG abundance informs the overall state of resistance development in the biofilm community. Measurement of overall biofilm resistance to select antibiotics will be confirmed through biofilm minimal inhibitory concentration calculations and results compared to find any relationship between metal resistance and antibiotic resistance. Examining AMR within DWDS is critical to safeguarding public health and this study begins to understand the complex interactions between biofilms and physio-chemical water parameters.

Abstracts

Session 7
Microbiology & AMR

Examining the impacts of antibiotics on the promotion of antimicrobial resistance (AMR) and antibiotic resistance genes (ARGs) in biofilms of drinking water systems

Victoria Rilstone

Queen's University

A drinking water distribution system (DWDS) functions to collect, treat, store, and distribute clean water to consumers at the tap. However, as the drinking water is transported, biofilms have been found to inevitably form along the pipe walls. Biofilms are home to a diverse array of species from different kingdoms, presenting the threat that they may harbour and accumulate pathogenic organisms and accumulate or develop virulence factors. Simultaneously, antibiotics are also transported into the DWDS from lack of treatment and source water infiltration, resulting in their accumulation in the biofilms. When the biofilm, which already possesses intrinsic AMR properties interacts with antibiotics, ARGs are promoted and acquired. This research plans to examine the effects of 4 different antibiotics at relevant concentrations on AMR in drinking water biofilms. To achieve this, a bench-top scale DWDS replicating premise plumbing conditions will be used. This system will be inoculated with relevant microorganisms by cultivating them through a GAC filter to accelerate their development once within the system. The system will be run for 90-days to allow the microorganisms to attach to the pipe walls and grow into mature biofilms. Following this, an antibiotic will be selected at the concentration that it has been previously reported to be found at in literature and administered into the system. As the antibiotic is depleted, biofilm samples from the pipe wall will be taken and analyzed through epi-fluorescence, SEM, 16S rRNA, qPCR, and RNA-Seq to characterize its impact on AMR and acquired ARGs. There are currently no available results for this project. It is predicted that the biofilm will promote intrinsically resistant species, such as Pseudomonas aeruginosa and develop relevant multi-resistant ARGs. The next steps for this project are to begin growing the biofilm within the system and test Kingston’s tap water for antibiotic concentrations using LC-ESI-MS/MS.

Abstracts

Session 7
Microbiology & AMR

Classification of private well users in Ontario for quantitative risk assessment and socio-epidemiological modelling: A cross-sectional population study

Sarah Lavallee[1], Paul D. Hynds[2], Stephen Brown[1], Anna Majury[1,2]

1. Queen's University
2. Technological University Dublin
3. Public Health Ontario

Unlike consumers receiving water from regulated public systems in Ontario, private well users are responsible for protective behaviours, including source maintenance, treatment and laboratory testing. To improve protective behaviours, it is critical to understand and characterise unregulated well users in terms of their awareness, risk perceptions and practices. The current study sought to examine the effects of socio-demographics, experience(s), and cognitive factors on behaviours, and classify and characterise private well users in Ontario based on cognitive factors. A province-wide online survey was distributed over the 4-month period May to August 2018. The survey was designed to quantify Ontario well owners' awareness, perceptions and behaviours in relation to their personal groundwater supply and local sources of contamination. To both quantify and compare results, a scoring protocol for four cognitive factors or "risk domains" (i.e., awareness, attitudes, risk perceptions and beliefs) was developed. Two-step cluster analysis was used to classify the survey cohort based on individual risk domain scores. Binary logistic regression was employed to identify key variables associated with cluster membership. In total, 1140 survey respondents were included for analyses. Overall, increased awareness ($p = 0.018$) and positive attitudes ($p = 0.006$) towards personal well water supplies were associated with an increased probability of well water testing. Cluster analysis identified three distinct sub-groups based on two risk domains; groundwater awareness and source risk perception (high, moderate and low scores). Cluster analysis and binary logistic regression models indicate that drilled well users and those with higher educational attainments were significantly more likely to be characterised within the "high awareness and risk perception" cluster. Findings illustrate that specific risk domains and socio-demographic factors are significantly associated with well user behaviours. Cognitive clusters may be used to develop targeted interventions and communication strategies by effectively characterising well users. Characterisation of private well users will ultimately contribute to increasingly evidence-based modeling approaches (e.g., quantitative risk assessments, socio-epidemiological modelling) and reduce the health burden of water-related illness in Canada and further afield.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

The importance of using high resolution gas chromatography quadrupole time-of-flight mass spectrometry for analysis of polycyclic aromatic sulfur heterocycles in oil spill forensics

Jessica Ollinik[1], Christopher Cote[1], Taylor Filewood[1], Honoria Kwok[1], Jeffrey Yan[1], Daniel Cuthbertson[2], Graham van Aggelen[1], Pamela Brunswick[1], Dayue Shang[1]

1. Science and Technology Branch, Pacific Environmental Science Centre, Environment and Climate Change Canada, Pacific and Yukon Laboratory for Environmental Testing, North Vancouver, British Columbia, Canada
2. Agilent Technologies Inc, Santa Clara, California, USA

The use of high resolution Gas Chromatography Quadrupole Time-of-Flight mass spectrometry (GC/QToF) for identification and assessment of polycyclic aromatic sulfur heterocycles (PASHs) is an emerging topic in oil spill forensics. Previously, these analyses were dominated by application of low resolution mass spectrometry, resulting in potentially inaccurate determination of compounds and inconclusive outcomes. The most significant advantage of using a higher resolution mass accuracy instrument is in its increased certainty for targeted, untargeted, and unknown analysis. GC chromatographic separation together with a QToF mass analyzer facilitates acquisition of a full mass spectrum, while avoiding interferences and remaining highly sensitive, selective, and accurate. The mass spectral scan is further minable for additional compounds identified at later time points.

Recent advances in GC/QToF instrumentation have contributed to its rising application in both polycyclic aromatic compound (PAH) and PASH analysis, and, correspondingly, in oil spill investigation. The complex petroleum matrix contains many closely eluting isobaric compounds with identical nominal masses. The ability of a QToF instrument to selectively identify biomarkers and determine compounds by accurate mass has significantly enhanced differentiation of the complex mixture of PASH homologues from their PAH counterparts. The highly sophisticated artificial intelligence and statistical analysis software packages complementing new QToF instruments make its rise inevitable. The information rich data can be mined not only for identification of individual compounds, but also for the differentiation of sample cluster groups. Statistical analysis of such groupings has shown great potential for the attribution of oil spill source. In summary, our study has shown that, when combined with strategic sample preparation and column clean-up, the GC/QToF shows unparalleled resolving power and excellent promise in application to oil spill response and environmental monitoring.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

Determining the presence and concentration of polycyclic aromatic sulfur heterocycles in non-weathered oil samples

Taylor Filewood[1], Jessica Ollinik[1], Christopher Cote[1], Honoria Kwok[1], Jeffrey Yan[1], Daniel Cuthbertson[2], Graham van Aggelen[1], Pamela Brunswick[1], Dayue Shang[1]

1. Science and Technology Branch, Pacific Environmental Science Centre, Environment and Climate Change Canada, Pacific and Yukon Laboratory for Environmental Testing, North Vancouver, British Columbia, Canada
2. Agilent Technologies Inc, Santa Clara, California, USA

When oil spills occur, it is important to determine the type and source of the oil, not only for attribution, but for assessment of environmental impact. Each oil will exhibit different effects on the surroundings, according to the compounds present. These compounds include polycyclic aromatic sulfur heterocycles (PASHs), which show an increased toxicity compared to parent polycyclic aromatic hydrocarbons (PAHs). Despite their toxicity, PASHs have not yet been extensively studied, one reason being their chromatographic co-elution with PAHs, resulting in greater difficulties when isolating the specific compounds. In addition, PASHs also occur in lower concentration than PAHs, which correspondingly reduces their detection and identification.

In the current study, the presence and concentration of these PASHs in non-weathered and weathered crude oil and diesel samples were assessed. An Agilent 7250 Gas Chromatography Quadrupole Time-of-Flight Mass Spectrometer (GC-QToF) was used for analysis, offering high-resolution mass spectrometry for specificity. In addition, the instrument software allowed for compound identification of recognized oil biomarkers. In order to determine the concentration of the PASHs, parent PAH compounds were used as surrogate standards. Since these PAHs are similar in mass to the PASHs, they can also tentatively be used to locate the PASH peak regions in the mass spectrum. An aim of the study was to determine a response factor for the PASH versus the PAH peaks, allowing for calibration with recognized PAH standards and application of a correction factor for the concentration of observed PASHs. This ongoing study will be conducted to advance oil spill forensic research for the protection of our environment.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

Statistics and oil forensics: how performing a multi-tiered statistical analysis of non-weathered and weathered crude oils can allow us to identify source oils

Christopher Cote[1], Taylor Filewood[1], Jessica Ollinik[1], Honoria Kwok[1], Jeffrey Yan[1], Daniel Cuthbertson[2], Graham van Aggelen[1], Pamela Brunswick[1], Dayue Shang[1]

1. Science and Technology Branch, Pacific Environmental Science Centre, Environment and Climate Change Canada, Pacific and Yukon Laboratory for Environmental Testing, North Vancouver, British Columbia, Canada
2. Agilent Technologies Inc, Santa Clara, California, USA

Studying the adverse effects of released oil in our environment, and specifically the toxic polycyclic aromatic sulfur heterocycles (PASHs) components of oil, is an increasingly important field of study. Attributing spills to those responsible requires highly complex chemical biomarker forensic analysis. This process is hampered by a plethora of natural weathering processes that alter oil component compounds as soon as they are dispersed. Weathering processes include, but are not limited to, photodegradation, biodegradation, and evaporation, wherein compounds are unrecognizable from their source oil counterparts. Searching for unique and comparably stable components (biomarkers) of the weathered oils allows us to correctly identify and trace the origins of a spill.

A multi-tiered investigation is the most comprehensive approach to oil spill forensics. Following an initial oil typing analysis, gas chromatography (GC) with mass spectrometry (MS) was used to identify specific oil biomarkers. An internationally accepted approach to source identification employs a forensic biomarker ratio analysis. An aim of this study was to extend this ratio analysis to include specific oil biomarkers that can be applied to heavily weathered oils. Furthermore, recent advances in mass spectrometry statistical software and modelling stimulated study of Principal Component Analysis (PCA) plots on the collected data. By performing ANOVA and fold-change analyses, oil samples were differentiated spatially. Models were generated using a partial least squares discrimination algorithm and the models applied to collected oil samples for interpretation. Oil samples that were artificially weathered to simulate typical West Coast environmental conditions were used to determine the validity of the source models in application to weathered samples.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

A marine oil spill response support system by Bayesian Network and agent-based modeling

Xudong Ye[1], Bing Chen[1,*], Kenneth Lee[2], Rune Storesund[3], Xing Song[1], Baiyu Zhang[1]

1. Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory, Faculty of Engineering and Applied Science, Memorial University, Canada
2. Ecosystem Science, Fisheries and Oceans Canada, Canada
3. Center for Catastrophic Risk Management (CCRM), University of California, USA

Marine oil spill accidents cause negative impacts on the social, economic and ecological systems. An efficient marine oil spill response management system can significantly reduce the expenditure in both time and money. Uncertainties are considerable factors in a system. Effective estimation and management of uncertain factors can improve the applicability and accuracy of modeling for marine oil spill responses. In this study, a marine oil spill decision support system was developed with the integration of Bayesian Network and agent-based modeling. The modeling quantitatively evaluated the influence of various factors and errors associated with multiple operational stages from spill preparedness and response (i.e., occurrence, monitoring, contingency planning and spill response). A Bayesian network generated a probabilistic representation for the relationships of various causal elements in terms of mechanism failures, human errors and environmental conditions. The collective probabilities were further systematically combined with agent-based modeling to predict and evaluate the outcomes of response operations. The agent-based modeling aimed to simulate the action and interactions among response personnel, devices and procedures. The efficiency of the developed modeling was further tested with a case study. The proposed approach enhanced the connectivity and integrity of various procedures of spill responses and provided an improved support tool for decision making.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

Performance evaluation of chemical demulsifiers for marine oil spill response

Jingjing Ling, Fei Wu, Baiyu Zhang, Bo Liu, Bing Chen*

Northern Region Persistent Organic Pollution Control (NRPOP) Laboratory,
Faculty of Engineering and Applied Science, Memorial University

Oils mechanically recovered from a marine oil spill can form stable emulsions in the temporary storage spaces for months. This problem hinders the process of oil-water separation, resulting in prolonged response times and increased operational costs. Effective demulsification methods are therefore desired to improve the response efficiency of mechanical recovery. This study evaluates the performance of two representative demulsifiers, namely A (anionic) and B (non-ionic), in breaking up oil-water emulsions. Demulsifier A has the hydrophilic head of the sulfosuccinate group, which leads to higher solubility in water, while demulsifier B has the polymer structure, which has lower water solubility. Two oil samples (light crude and heavy crude) were selected for the test. The oil-water emulsions were prepared by mixing different oil samples with seawater using a homogenizer. Demulsifiers were then mixed with the emulsions and were allowed to separate by gravity settling. For light crude oil-water emulsions, the addition of demulsifiers reduced the separation time by ~50%. Both demulsifiers A and B showed similar separation efficiencies; however, demulsifier B resulted in lower TPH concentrations in separated water than the control and A enhanced sample, respectively. For heavy crude oil-water emulsions, demulsifier B had little effect on improving separation efficiency. The application of demulsifier A led to less separation time compared to the control, which is similar to its performance in light crude oil-water emulsions. The resulting TPH concentration in an enhanced sample is slightly lower than the control. The viscosity of recovered heavy crude oil from the B test was much higher than those of the A test and the control, respectively. Overall, demulsifier B is recommended for demulsification of light crude oil-water emulsions, while A is found to be suitable for different types of oil-water emulsions.

Abstracts

Session 8
Oil Pollution, Response & Treatment #2

The use of membrane bioreactors to clean-up marine oil spills

Anisha Bhattacharyya, Lei Liu

Dalhousie University

Water pollution due to oil spills is a growing environmental concern, causing severe damage, with many short- and long-term repercussions. The unintentional discharge of petroleum hydrocarbons through human activities, such as oil exploration and transportation, cause oil spills. Clean-up methods and regulations must be amended regularly in conjunction with the development of new technology. A membrane bioreactor is one such technology that has proven successful in municipal wastewater treatment; therefore, we would like to explore this process's potential in treating decanted oily wastewater from marine oil spills.

This experiment aims to achieve an oil concentration of less than 15 ppm in the effluent and alleviate membrane fouling incidents using bacteria to biodegrade petroleum hydrocarbons before pressurized diffusion of the contaminated water through a polytetrafluoroethylene membrane. This experiment will determine the parameters in which the membrane bioreactor can work effectively and efficiently. The desired effect from this project's results is to influence the Canadian Government to change its regulations and permit the discharge of effluent, at an acceptable concentration, back into the water body. This regulation change will help clean oil spills by freeing space in recovery ships and expediting the oil recovery process, reducing the cycle of trips to the shore. The spread of oil slick and oil mixing into the water column can be reduced by implementing the proposed methodology, minimizing water pollution.

Stay Tuned and Follow us!

The LEADERS Program

Program Director:
Dr. Stephen Brown
stephen.brown@chem.queensu.ca
Program Coordinator:
Sophie Felleiter
sf60@queensu.ca

https://www.queensu.ca/leaders-create/

@leaders-create

@queens_leaderscreate

LEADERS & PEOPLE 2021

The PEOPLE Network

Program Director:
Dr. Bing Chen
bchen@mun.ca
Program Coordinator:
Dr. Weiyun Lin
weiyun.lin@mun.ca

www.people-network.ca

@people_ntwrk

LEADERS & PEOPLE
2021 VIRTUAL SYMPOSIUM

Environmental Research and Career Training

July 20-22, 2021 | Zoom Meeting

LEADERS CREATE

PEOPLE Network

Two programs funded by NSERC CRSNG