Seminar on

Demonstration of Smart Water Systems

Date: 1-May-2023, 9am-12pm

Location: Room (ERC2056), Ontario Tech University, 2000 Simcoe Street North, Oshawa, ON L1G 0C5 (map below) (Hybrid, zoom link below)

Summary:

This seminar will discuss the analysis, planning, and management of Smart Water Networks. The seminar will present evaluation approaches of different transition scenarios of water networks into smart water networks with optimized performance in buildings and infrastructures. Water treatment, analysis, and environmental monitoring techniques and technologies will be discussed.

9:00 – 9:05	*Opening and welcoming*
9:05 – 9:45	*Smart Water Networks*
9:45 – 10:25	*Characterization of natural and anthropogenic chromophoric dissolved organic matter in lakes in the Athabasca Oil Sands Region using fluorescence spectroscopy and Parallel Factor Analysis*
10:30 – 11:10	*Reducing Phosphorous Loading Using Strategic Eggshell and Woodchip Bioreactors*
11:15 – 11:55	*The Chemistry of Water Treatment*
11:55 – 12:00	*Closing*

Recent Publication: Hossam A.Gabbar, Sultan Islam. Ahmed Ramadan, Smart Water Network Infrastructures, Journal of Water Reuse, IWA Publishing, https://doi.org/10.2166/wrd.2023.063.

Moderator: Dr. Hossam Gaber, Ontario Tech University

Panelists:

Dr. Hossam Gaber, Professor, Faculty of Engineering and Applied Science, Ontario Tech University, Email: hossam.gaber@ontariotechu.ca.

Dr. Julian Aherne, Associate Professor, School of the Environment, Trent University, Email: jaherne@trentu.ca.

Dr. Maria Dittrich, Professor, Department of Physical & Environmental Sciences, University of Toronto, Email: m.dittrich@utoronto.ca.

Dr. Andrew Baer, Biotechnology Coordinator and Professor, Applied Biological and Environmental Sciences, Centennial College, Email: ABaer@centennialcollege.ca.

Talk Details

Talk-1

Title: Smart Water Networks

Dr. Hossam Gaber, Faculty of Engineering and Applied Science, Ontario Tech University (hossam.gaber@ontariotechu.ca)

Abstract

Water is critical to humans, animals, and plants; its importance is reflected in the associated industries, residential, and community infrastructures, including energy, food, agriculture, transportation, recreation, health, and waste processes. Canada and worldwide are experiencing climate and environmental changes with direct links to water networks. Governments around the world are committed to achieve smooth transition to net-zero emissions. Water cycles and processes are main contributors to climate change. This talk presents analysis of water supply and conservation strategies with effective transition to smart water networks (SWN). The interactions between water networks and community infrastructures will be discussed includng multiphysics modelling and simulation, which will be used to evaluate and assess water cycles, processes, treatment, storage, transportation, and utilization systems, and define associated model parameters and key performance indicators (KPIs). The talk will discuss the coupling modeling between water infrastructures and community systems considering water properties and performance measures. WSN will be used to answer questions to support water planning and management with learning capabilities from experts, real-time data, simulation, and historical data.

Talk-2

Title: Characterization of natural and anthropogenic chromophoric dissolved organic matter in lakes in the Athabasca Oil Sands Region using fluorescence spectroscopy and Parallel Factor Analysis.

Dane Blanchard, School of the Environment, Trent University (jaherne@trentu.ca)

Abstract:

The Athabasca Oil Sands Region (AOSR), located in northern Alberta, Canada, contains the world's largest known bitumen deposit. Oil sands (OS) operations are a significant source of atmospheric emissions which contribute to the deposition of acidic inorganic species and a wide range of organic pollutants to regional lakes. Shifting environmental acid-base conditions can fundamentally alter the composition and abundance of chromophoric dissolved organic matter (CDOM) within aqueous systems, which can lead to cascading ecological impacts. Despite these concerns, there is limited research evaluating the variability of CDOM and organic pollutant species within lake surface-waters throughout the AOSR. In this study, excitation emission matrix (EEM) fluorescence spectroscopy and Parallel Factor Analysis (PARAFAC) were applied to evaluate CDOM among fifty regional acid-sensitive lakes. Modelled fluorescent components were compared against supplementary biogeochemical data (including polycyclic aromatic compounds (PACs)) to explore CDOM–pH associations and identify fluorescent matter of anthropogenic origin. Two terrestrial humic-like (C1, C2) and two amino acid-like (C3, C4) fluorescent components were identified via PARAFAC modelling, all of which displayed weak associations with surface-water pH. Alternatively, C1 and C2 fluorescence was influenced by lake catchment characteristics and photodegradation, C3 was strongly associated with surface-water PACs, while C4 remained largely undefined. Although shifting acid-

base chemistry may present a relatively low immediate risk to CDOM quality in the AOSR, ongoing shifts in regional hydrology, climate, and catchment characteristics may be a source of growing concern. This preliminary work provided strong evidence that EEM-PARAFAC analysis can be used as a tool to screen for organic pollution within regional lakes.

Talk-3

Title: Reducing Phosphorous Loading Using Strategic Eggshell and Woodchip Bioreactors

Dr. Zach A. Diloreto (zach.diloreto@utoronto.ca) and Dr. Maria Dittrich (m.dittrich@utoronto.ca)

Abstract:

The Bay of Quinte Area of Concern (AOC) has highlighted the need to develop remediation processes and technologies to treat phosphorous (P) from agricultural runoff in the watershed. The overall target of remediation work in the AOC is a 20% average reduction in agricultural P, or a 20 ug TP/L (flow weighted) growing season average. However, despite targeted remediation efforts monitoring has shown that the AOC watershed has failed to meet flow rated targets. It has been suggested that particulate P and greater runoff during extreme precipitation events may be the driving factor and such extreme events are likely to increase in frequency as a result of climate change. Thus, further remediation action is required. We suggest that by using calcinated eggshell and woodchip bioreactors at key locations P loading could be reduced. Calcined eggshells are a desirable substrate as the calcination process converts $CaCO_3$ within the eggshells to CaO increasing their surface area and porosity to promote adsorption, additionally CaO has a high affinity PO_4^- forming hydroxyapatite a refractory P phase. The secondary substrate, woodchips, stimulate denitrifying microbes. However, this technology requires development and scaling considerations before it can be implemented. In our work we conducted batch removal and adsorption experiments with calcined eggshells which were shown to remove up to 80% of dissolved P with as little as 2-3 total weight% in only 8 hours. After batch experiments were completed a flow-through benchtop bioreactor was also created and natural agricultural runoff was treated. Similar removal results were observed showing that this technology is viable.

Talk-4

Title: The Chemistry of Water Treatment

Dr. Andrew Baer, Biotechnology Coordinator and Professor, Applied Biological and Environmental Sciences, Centennial College (ABaer@centennialcollege.ca).

Abstract:

Clean water is essential for human existence. As such water treatment, storage and transportation are critical components of modern society. This seminar will examine the current state of these processes and examine their potential development in the future. Special emphasis will be placed on the role of

chemistry in these processes and how chemistry can be used to address current and future challenges in water treatment.

Key Learning Outcomes:

- An overview of the current state of municipal and industrial water treatment processes.
- The role Chemistry plays in water treatment storage and transportation.
- Developing and future challenges facing the industry.

Zoom Link

Hossam Gaber is inviting you to a scheduled Zoom meeting.

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Speakers Bio

Hossam Gaber is a Professor at Ontario Tech University, in the Faculty of Energy Systems and Nuclear Science, and cross appointed in the Faculty of Engineering and Applied Science. He is the recipient of the Senior Research Excellence Award (2016), UOIT. He is recognized among the top 2% of worldwide scientists based on citation. He is a Distinguished Lecturer at IEEE. He obtained his B.Sc. degree from Alexandria University, and Ph.D. degree from Okayama University. He is leading research in the areas of process engineering, smart interconnected water-energy grids, and smart control and protection systems, and waste treatment and management. He joined Tokyo Institute of Technology, and Okayama University as an Associate Professor. He was a Visiting Professor at the University of Toronto. He has more than 240 publications, including patents, books/chapters, journal and conference papers. He has conducted training programs for professional development and public education in the area of smart and resilient systems and infrastructures.

Julian Aherne is a Professor in The School of the Environment at Trent University, where he held a Tier 2 Canada research chair in Environmental Modelling between 2005 and 2016. Dr Aherne was awarded the James M. Flaherty Visiting Professor by the Ireland Canada University Foundation in 2015. He has published 117 peer-reviewed publications, with h-index of 25, Since 2016, he has published more than 30 publications. Recent funding totals more than 1.5 million CAD, including NSERC Plastic Science for a Cleaner Future, and. Environment and Climate Change Canada Zero Plastic Waste Initiative. Since 2014, his total HQP training is 75, comprising 25 undergraduate theses, 24 MSc theses, 8 PhD, 7 research associates, and 11 technicians. He is currently supervising or co-supervising six PhD and five MSc.

Maria Dittrich is a Full Professor at the University of Toronto, Canada. She received a master's degree in physics with distinction from Moscow State University, Russia, Ph.D. in aquatic ecology from, Institute for Freshwater Ecology and Fisheries, Berlin, Germany and Habilitation in Biogeochemistry from ETH Zurich, Switzerland. Over the past years, Professor Dittrich initiated and collaborated on several projects focused on carbonate formation in extreme environments, phosphorus and carbon cycling in lakes and their catchments, as well as nanoplastics and natural nanoparticles, and. Professor Dittrich's research approach involves a combination of a wide range of field studies, modelling and laboratory experiments, analytical techniques, including Atomic Force and electron microscopy, and conventional and synchrotron-based spectroscopy (infra-red, electron energy loss; EELS, near-edge x-ray absorption fine-structure; NEXAFS). She teaches various Geomicrobiology and Aquatic Biogeochemistry courses at the University of Toronto and trained eleven postdoctoral fellows in Canada and Switzerland, ten Ph.D. students, twenty-four master students, and thirty-seven undergraduate students.

Andrew Baer is the Coordinator of the Biotechnology program as well as a Professor in the Applied Biological and Environmental Sciences Department at Centennial College. He received

his BScH and PhD in Chemistry from Queen's University, Ontario, Canada. Before coming to Centennial College, Dr. Baer spent ten years working in a variety of research positions at several Canadian Universities. At Centennial College he teaches Analytical and Environmental Chemistry in both the Biotechnology and Environmental programs. While at Centennial College he has been involved in many applied research projects with different external partners and has been the principal investigator for seven of them.

Dane Blanchard: Dane Blanchard is a third-year Ph.D. student studying environmental science at Trent University, Ontario, Canada. Blanchard's current work involves the chemometric analysis of chromophoric dissolved organic matter (CDOM) throughout the Athabasca Oil Sands Region (AOSR), Alberta, Canada. Optical analysis techniques such as fluorescence spectroscopy are applied to evaluate natural and anthropogenic CDOM within a variety of environmental media, including lakes, precipitation, and atmospheric particulate matter (PM). Blanchard has a background in air quality science, as both his B.Sc. and M.Sc. research included the in-field application of passive and active samplers to evaluate atmospheric concentrations and deposition of inorganic pollutant species. To date, Blanchard has been listed as an author in three peer-reviewed papers, a fourth of which is currently under review for publication

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- SSB — Student Services Building
- SVDH — South Village Dining Hall
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