

Design and Development of Smart & Sustainable Drinking Water and Renewable Energy Systems

Abstract

The World Health Organization estimates that 1 in 3 people globally lack access to safe drinking water. Many regions with high water scarcity are off-grid, remote and have high solar insolation. Solar powered reverse osmosis water treatment systems can provide clean drinking water to these communities. However, to minimize the costs, these systems are configured with minimal battery storage and operated intermittently with extended shutdown periods. The experimental characterization of membrane fouling under intermittent operation, the development of an analytical membrane fouling model and a design optimization framework that considers these experimental results for solar powered water treatment systems will be presented. The experimental studies were performed using a fully-instrumented experimental lab-scale system that was designed, built, commissioned and operated with triplicate measurements of membrane permeability and membrane salt rejection. A novel automated design optimization framework developed using these experimental and analytical results will also be presented. The seminar will conclude with avenues for further research towards the development of smart and sustainable drinking water treatment systems powered by renewable energy.

Bio

Marina Freire-Gormaly, PhD is an Assistant Professor in the Mechanical Engineering Department at the Lassonde School of Engineering at York University. Her research focusses on the development of stand-alone renewable powered drinking water treatment systems, the optimized design of energy systems for remote communities that are off-grid electricity, and the characterization of porous materials. She completed her Ph.D. and M.A.Sc. from the University of Toronto in Mechanical Engineering. Some of her earlier work was on the pore space characterization of carbonate rocks using micro computed tomography and pore network modeling for advancing Carbon Capture and Storage Technology. She has also worked at Ontario Power Generation on the Darlington New Nuclear Project and the Darlington Refurbishment Project. She contributed to a World Bank project evaluating Canada's 'Regulator Indicators for Sustainable Energy' (RISE). She currently serves as the Chair of Student and Young Professional Affairs for the Canadian Society of Mechanical Engineers. As well, with Academics Without Borders, she is co-leading the Strengthening Engineering Research Initiative. She is passionate about research and teaching energy systems to inspire the next generation of engineers to tackle society's growing sustainability challenges. Her research interests include energy systems, optimization and design for global engineering contexts.