香港城市大學
City University of Hong Kong

Discovery-based Learning using interactive hands-on methods for engineering innovative water treatments

Project Number: 6000764

Principal Investigator: Dr. Alicia Kyoungjin AN

Grant Type: TDG

Abstract:

Urban water systems have undergone significant transformation in recent decades as it has been forced to deal with pressures from changes in economies and climate. As half of the world's population now lives in urban areas, which is expected to continue to grow, water resource quality has been degraded by pollution from domestic and industrial sources. Most recently, microplastics and the occurrence of other emerging contaminants, such as materials in personal care products, in water and wastewater have drawn attention due to their impacts on both human health and the environment. This increase has been attributed to their increased utilization and poor removal from existing treatment facilities. For instance, a recent study conducted in Hong Kong reported that each 1 m3 of treated sewage effluent contains up to 10,816 pieces of microplastics (MPs), with removal efficiencies of the Shek Wu Hui WWTP (SWH) and Stonecutters Island WWTP (SCI) reported to be 86.9% and 60.4%, respectively. In addition, current treatment methods have poor removal efficiency of chemicals used in consumer products (i.e., coating additive for non-stick, water repellent, and stain resisting surface in food packaging, cookware, textile, paper, leathers, and carpets) such Bisphenol A (BPA), resulting in an annual discharge of 730 kg/year in Victoria harbor. As Hong Kong augments its fresh water supply through desalination and water reclamation, while also improving local water quality, the ability to monitor and remove these contaminants is of significant importance to water system managers.

As a result, advanced treatment technologies are needed to address these emerging issues and these solutions will be created by students such as those trained here in the SEE at City University. SEE students have opportunities to learn the theory and application of physical and chemical processes for the improvement of water quality, as well as how to design, engineer, and analyze treatment plants in courses such as SEE4218 and 2201, students have few chances to apply this knowledge in a hands-on and practical fashion. Therefore, this proposal aims to create a lab teaching and learning module component for students that focuses on the design and application of current and advanced treatment technologies. Students will be given the chance to visit the water/wastewater treatment facilities in Hong Kong followed by the opportunity to test various treatment unit/methods in a lab setting to see how effective they are at treating different quality water/wastewater. Students will then have the opportunity to propose effective treatment designs, considering targeted pollutants and use of energy and chemicals, and use their theoretical knowledge in simulated real scenario. By designing water treatment, desalination, or water reclamation systems, students will develop hands-on experience with the advanced technologies taught in this course, such as different membrane-based treatment system

including reverse osmosis (RO), forward osmosis (FO), nanofiltration (NF), ultrafiltration (UF), microfiltration (MF), and membrane distillation (MD), while also learning about their benefits and limitations. The combination of field exposure with in-class and laboratory teaching will help in developing a clear understanding about the water treatment technologies in use today and in the future.

Academic Publication:

Yeo, J., Chopra, S. S., von Eiff, D., Jeong, S., Zhang, L., & An, A. K. (2022). An integrated techno-economic analysis on wastewater reclamation in Hong Kong: A comprehensive cost – Benefit analysis with life cycle assessment. Journal of Cleaner Production. https://doi.org/10.1016/j.jclepro.2022.131838