Environmental Engineering & Sciences

Department of Civil and Environmental Engineering
Spring '24: CEE 595AG Seminar

Friday, March 1, 2024 | 10:00 – 10:50 a.m. CST | 3310 Yeh Center

Defining the opportunity space for a novel modular system for distributed treatment of industrial wastewaters

Wastewater treatment is estimated to account for 1-3% of a nation's total electric energy consumption, but anaerobic treatment of high strength wastewaters has the potential to be energy positive. A Modular Encapsulated Two-stage Anaerobic Biological (METAB) system has been proposed for distributed treatment of high strength food/beverage industry wastewaters and the production of hydrogen (H2) and methane (CH4). The METAB system also lowers chemical oxygen demand (COD) loads to centralized wastewater water resource recovery facilities (WRRFs), directly reducing their operational costs and energy demand. A critical barrier in industry adoption of METAB systems lies in the identification of optimal contexts for deployment. Therefore, it is important to evaluate the financial viability and environmental impacts of METAB systems in different deployment contexts. To this end, a quantitative sustainable design (QSD) framework was utilized to characterize the economic, and environmental sustainability of operating centralized WRRF with pre-treatment of industrial wastewater by METAB.

The talk would address the implementation of (QSD) methodology to locate optimal context of METAB deployment. In our analysis we plan to model a portfolio of five WRRF configurations with varying degree of targeted treatment (BOD removal, and nitrification), combinations of sludge treatment units (e.g. centrifuge, mechanical thickener, gravity thickener, etc.), and energy recovery techniques (anaerobic digestion, and fluidized bed incineration). The talk would cover the analysis done on two WRRF configuration, one of which is a working model of Metropolitan WRRF located in Twin cities in Minnesota, USA. QSDsan, an open-source, community-led platform specializing in QSD of sanitation and resource recovery system has been used to model the coupled METAB + WRRF systems under consideration. The operational costs and associated environmental impacts of the two WRRF configuration is quantified under uncertainty with and without coupling with METAB, over a range of contextual parameters, such as the composition of high-strength food wastewater (organic loading), local utility costs, and emission factors for calculation of GHG emission. The study is expected to inform pilot and full-scale deployment of METAB system coupled with centralized facilities.

Saumitra Rai
Masters Student
Advisor: Jeremy Guest

Biography

Saumitra Rai (he/him) is a MS student of environmental engineering in the Department of Civil and Environmental Engineering at the University of Illinois Urbana-Champaign. He received his bachelor's degree in civil engineering from Birla Institute of Technology and Science-Pilani (BITS Pilani) in India. At UIUC, he works as a research assistant in the lab of Prof. Jeremy Guest where his efforts are directed towards understanding the paths through which engineering design of sanitation systems can be informed by economic incentives and contextual parameters. In his free time, he enjoys listening to podcasts, reviewing queer literature and cinema, and reading up on selected aspects of Indian history.