Dr. Soryong Chae, Assistant Professor in the Department of Biomedical, Chemical, and Environmental Engineering at the University of Cincinnati completed an Ohio Water Resources Center funded project via Ohio Water Development Authority subaward. This project titled "**Prevention of harmful algal blooms through nutrient zero wastewater treatment using a vertical membrane bioreactor with food waste"** aimed to develop and optimize an engineering process for the efficient removal of nutrients from municipal wastewater. This research will allow for development of novel engineering solutions for the production of easily degradable organic matter that will eventually increase nutrient removal efficiency in biological nutrient removal (BNR) systems and also reduce HABs' risks to public health and the environment.

There is an increase need to limit nutrient input from all sources into aquatic ecosystem, including limiting the concentration of nitrogen and phosphorous from municipal wastewater treatment effluents. BNR is one of the most cost-effective method to achieve decrease of nutrients in effluent, but there is many uncertainties in practical optimization of this process. Dr. Chae investigated utilization of food waste to improve nutrients removal in a vertical membrane bioreactor (VMBR).

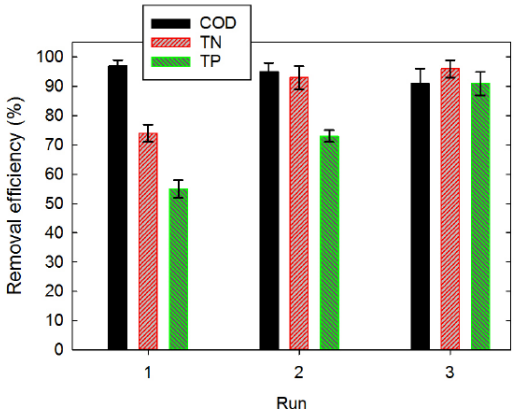

Figure 1 Removal efficiencies of carbon (COD), nitrogen (TN) and Phosphorous (TP) without food waste added (Run 1), with ~378 and 606 mg/L of soluble food waste aded in influent (Run 2 and 3, respectively)

A bench-scale VMBR (treatment capacity = 10 L/day at HRT = 8 hr) with anoxic and oxic zones in one reactor was operated over 4 months with synthetic wastewater and synthetic wastewater supplemented with condensate of food waste created by sonication. As shown in Figure 1, typical removal efficiencies of nitrogen and phosphorus by the VMBR with synthetic wastewater were 74% and 55%, respectively (Run 1). As the soluble organic carbon concentration increased from 150 to 605.5 mg/L by adding the carbon from sonicated and fermented food waste, removal efficiencies of nitrogen and phosphorus significantly increased up to 96% and 91%, respectively (Run 3). However, the supplemented food waste increased carbon concentration in the effluent and increased membrane resistance. The results provide a fundamental understanding of 1) the effects of ultrasound on the fate and conversion of recalcitrant organic compounds in food waste, and 2) the effects of organic matter originated from food waste on the enhanced biological phosphorous removal (EBPR) efficiency and membrane fouling in membrane bioreactor. Such investigations are critical for the development of eco-friendly management of food waste and the enhancement of biological phosphorus removal activity in biological nutrient removal systems to protect watersheds in Ohio from nutrient enrichment.

Researcher Profile: Dr. Soryong Chae received his Ph.D. from Korea Advanced Institute of Science and Technology (KAIST) in 2004 and he's pioneered research in the application of nanotechnology for membrane, water and energy. His research interest includes environmental implications and applications of engineered nanomaterials; membrane technology for drinking water production; and membrane bioreactor (MBR) for municipal and industrial wastewater recycling.