Dr. Soryong Chae, Associate Professor in the Department of Chemical and Environmental Engineering at the University of Cincinnati, completed an Ohio Water Resources Center funded project via the Ohio Water Development Authority subaward. The project titled **"Efficient removal of emerging per- and poly-fluoroalkyl contaminants using electrically heatable carbon nanotube hollow fiber membrane distillation"** aimed to pioneer an innovative engineering system to achieve energy-efficient removal of per- and poly-fluoroalkyl substances (PFAS) from water and wastewater.

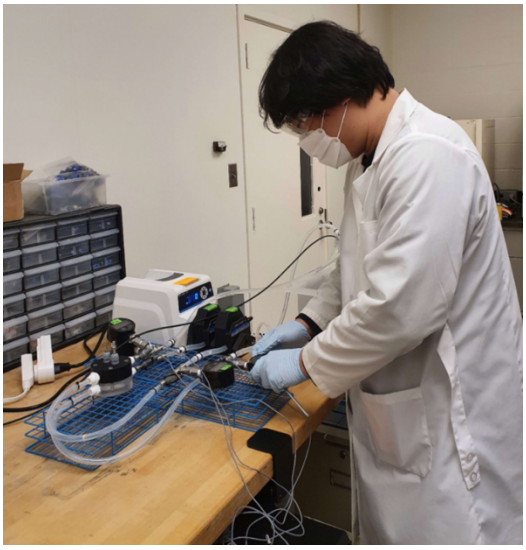

Figure 2. A graduate student (Mr. Hyunsik Kim, Ph.D. candidate) is optimizing a bench-scale membrane distillation system with the carbon nanotude/PVDF hollow fiber membranes to remove PFAS from water efficiently.

PFAS have a significant impact on drinking water quality, fish and animal habitat, human health and ecosystem services in Ohio. The extreme environmental persistence of PFAS with the increasingly higher aqueous solubility as the chain length shortens creates increasing difficulty for impacted water to be treated by many conventional remediation and treatment technologies. Dr. Chae and his team focused on the incorporation of carbon nanotube (CNT) sheets onto hollow fiber membranes and the effects of Joule heating on the removal of emerging PFAS via membrane distillation (MD) from water to address the current performance and productivity of MD technology.

The removal of PFAS by the electively heatable CNT (30 layers)/PVDF hollow fiber membrane was studied using a bench-scale vacuum membrane distillation (VMD) process (treatment capacity = ~7.6 L/d). The CNT hollow fiber membranes with 30 CNT layers showed excellent removal (> 99.9%) of a model PFAS compounds (i.e., PFOA) at lower concentrations in feed (i.e., 1 and 10 mg/L PFOA) during 12 hr operation. However, when the VMD system was fed with 1,000 mg/L PFOA solution, PFOA concentration in the membrane permeate gradually increased, and the removal efficiency dropped below 99% after 6 hr operation. The results provide insight into processes for the effective removal of PFAS from water and wastewater subjected to advanced treatment technologies for safe and beneficial re-use of the reclaimed water as well as fundamental and mechanistic understanding of fate and transport of PFAS through CNT layers and polymer membranes.

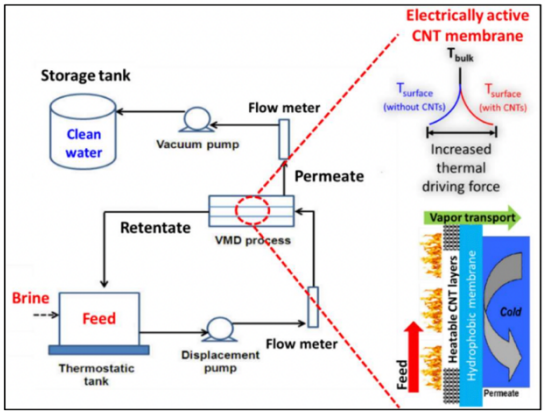

Figure 1. Schematic diagram of a bench-scale VMD system with electrically active CNT hollow fiber membranes.

Researcher Profile: Dr. Chae received his Ph.D. from Korea Advanced Institute of Science and Technology (KAIST) in 2004 and pioneered research in the application of nanotechnology for membrane, water and energy. His research interests include environmental implications and applications of engineered nanomaterial, membrane technology for drinking water production and MBR for municipal and industrial wastewater recycling.