Dr. Paula Mouser, Assistant Professor in the Department of Civil, Environmental and Geodetic Engineering at the Ohio State University together with Professors Linda Weavers and Henk Verweij recently completed an Ohio Water Resources Center project jointly funded by the Office of Energy and Environment at OSU and an OWDA subaward to the OWRC. The overall objective of their project titled “Characterizing the influence of surface chemistry and morphology on biofilm formation of ceramic membranes in wastewater treatment” is to better characterize biological fouling of membranes used for water and wastewater treatment, and identify innovative cleaning technologies or improvements in membrane sciences to help prevent or reduce the rate of biological fouling.

Experimental results indicate ultrasonic cleaning outperforms conventional cleaning methods (rinsing and air scouring) with post-sonication flux measured as over 30% greater than post-conventional cleaning flux (Figure 1). Characterization of extracellular polymeric substances (EPS) indicated proteins were effectively removed via sonication, whereas polysaccharides were more persistent foulants (Figure 2). Differences in pH affected both the surface charge of the membrane and the structural characteristics of the biological foulants. The highest recovery of membrane flux occurred at the pH closest to the isoelectric point of the ceramic membrane (pH 7), indicating that minimizing the membrane surface charge may be a key parameter for optimizing ultrasonic cleaning.

The research team, which included PhD student John Krinks, demonstrated the application of ultrasound to be an effective method of recovering flux across ceramic membranes fouled by municipal wastewater. Compared to conventional cleaning, the use of ultrasound results in differing distributions of EPS at the membrane surface and higher flux recovery. Regarding large-scale applicability of ultrasonic cleaning systems for membrane bioreactors, it is not yet considered viable to install transducers in aeration tanks adjacent to the membranes. Rather, such an application is better suited for a small cleaning system in which individual membranes could be removed from service, cleaned via sonication, and returned to the aeration tank.

Researcher Profile: Dr. Paula Mouser investigates microbial-environmental interactions in engineered subsurface systems ranging from floodplain aquifers and drainage channels to granitic bedrock aquifers and deep hydrocarbon shale. She is also interested in how microorganisms interact with material surfaces, such as membranes used for water treatment and casing used for shale gas wells. Applications of such research include improving detection and remediation strategies for the protection of water resources, and optimizing technologies for water treatment.