Environmental Engineering & Sciences

Department of Civil and Environmental Engineering

Spring '24: CEE 595AG Seminar

Friday, March 29, 2024 | 10:00 – 10:50 a.m. CST | 3310 Yeh Center

Examination of the release of lead and bacteria from activated carbon point-of-use filters

Drinking water distribution system infrastructure in the United States is aging and degrading, contributing to numerous public health crises and a rise in concern over chemical and microbiological water quality. Point-of-use (POU) filters certified to remove Pb, many of which are composed of porous solid block activated carbon media, have become increasingly popular as a temporary solution to address drinking water quality problems. Unfortunately, these filters can release high concentrations of bacteria and fail to effectively remove particulate Pb. For their rapid rise in usage, these POU filters are understudied, and some unintended consequences go overlooked in the pursuit of an inexpensive and convenient solution to decrease Pb exposure in drinking water. The goal of this work was to capture a holistic view of the contributions activated carbon POU filters make to drinking water quality.

We examined the impacts of the common corrosion inhibitor phosphate on biofilm characteristics and the relationship between biofilm structure and bacterial release from POU filters. Phosphate filters released lower concentrations of bacteria than groundwater filters, and phosphate biofilms grew to be thicker and rougher than groundwater biofilms. This knowledge is essential for understanding where these filters fit in a system where other lead contamination prevention measures may be in place.

We quantified the risk posed by Legionella pneumophila (L. pneumophila) in homes supplied by private wells and studied the role POU filters play on the microbial risk of drinking water. L. pneumophila was detected in about 30% of samples in rural homes. Systems without filters and without chlorine had the highest risk, followed by those with ripe filters, those without filters and with chlorine, and finally, those with new filters. Acquiring quantitative data and understanding the factors influencing the microbial risk in understudied water systems and from using these ubiquitous POU filters is essential for risk management in indoor environments.

We examined the impacts of water hardness and biofilm in the filters on the Pb removal efficiency of activated carbon POU filters. Adding calcium and dissolved biomass diminished the repulsion of negatively charged Pb phosphate nanoparticles, increasing aggregation and improving POU filter performance. This study provides important insights into how well filters will remove Pb as bacteria accumulate and grow, the contribution of aggregation to this Pb removal efficiency, and to what extent additional measures need to be taken to minimize bacterial growth.

Gemma Clark

PhD Candidate (Advisor Thanh Nguyen)

Gemma Clark is a 4th year PhD candidate in Professor Thanh H. (Helen) Nguyen's research group. She received her BS in Civil & Environmental Engineering from the University of Utah and her MS in Civil & Environmental Engineering, also in Professor Nguyen's group. Her current research is on the performance of point-of-use filters and their impacts on the chemical and microbiological quality of drinking water. In her spare time, she enjoys reading, playing the guitar and board games, and enjoying the company of her friends and cats.