Washington University in St. Louis
School of Engineering & Applied Science

Energy, Environmental & Chemical Engineering

EECE Department Seminar

Friday, May 5, 2017

11:00am

Brauer Hall, Room 12

Drinking Water Biofilm: Structure, Mechanical Properties, and Pathogen Release

ABSTRACT

Drinking water treatment processes, including disinfection technologies, are able to meet water quality regulations for producing water in the USA. However, maintaining water quality stability during distribution through millions of miles of pipeline infrastructure still remains challenging. Deterioration of distribution system (DS) components, including mains and service lines owned by water utilities as well as privately-owned premise plumbing (PP), is unavoidable. To overcome the challenge of maintaining water quality at the tap for end-users, we conducted a systematic study to answer the following questions: 1) how does DW chemical composition, including residual disinfectants and anti-scalant and anti-corrosion agents, influence the structure and mechanical properties of biofilm grown in PP, and 2) under what conditions will biofilm slough and pathogens be released? For the first time, we used magnetomotive optical coherence elastography and nano-indentation mode of atomic force microscopy to reveal that the biofilms developed from the groundwater with high hardness (drinking water source in central Illinois) were stiffer compared to biofilms developed either from the softened groundwater or the water containing a scale inhibitor. The high stiffness of biofilms developed from high hardness water was attributed to the high content of calcium carbonate. In addition to hardness in the water source, long term exposure to residual disinfectant also led to a stiffer biofilm. The risk of infection by *Legionella pneumophila* was simulated using a Monte Carlo model and experimental data of *L. pneumophia* released from biofilm with or without exposure to residual disinfectant. The study findings suggested that when *L. pneumophila* was associated with biofilm, it is essential to maintain residual chlorine-based disinfectant until taps in premise plumbing and shower time had the least impact on risk of infection by *L. pneumophila* released from the biofilms previously exposed to either free chlorine or monochloramine.

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Helen Nguyen, Associate Professor

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Dr Helen Nguyen is currently an associate professor of environmental engineering and a faculty affiliate with Institute for Genomic Biology at University of Illinois at Urbana-Champaign. She holds a Ph.D. in Environmental Engineering from Johns Hopkins University. Prior to joining University of Illinois, she was a Gaylord Donnelley Environmental Postdoctoral Fellow at Yale University. Her research group focuses on waterborne pathogens for global water and food safety. Besides a number of projects based in the US, her group is conducting research in developing countries on human resilience to waterborne infectious disease outbreak related to extreme natural events. Her group has published on a wide range of topics related to human health impact of water reuse, food safety, and pathogens in drinking water distribution systems. She has led multiple interdisciplinary projected funded by the National Science Foundation, the Environmental Protection Agency, and the US Department of Agriculture. She is currently leading three interdisciplinary projects on human health impacts of on-farm reuse of wastewater in small rural communities and urban hydroponic farming in the US and in Israel. Dr. Nguyen is the recipient of the 2006 AEESP/CH2M Hill Outstanding Dissertation Award, 2010 NSF CAREER award, 2010 ASCE/EWB Sustainable Development Award, 2012 and 2016 University of Illinois College of Engineering Dean's Award for Research Excellence. She was also awarded with a Fulbright Fellowship to Israel and a Visiting Fellowship from Japanese Society for the Promotion of Science. She is currently serving on Editorial Advisory Board for Environmental Science & Technology.

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