

ABSTRACT

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Title: Stagnation Impact on Building Drinking Water Safety: The Pandemic and Microplastics

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As microplastic (MP) pollution is getting global attention, many people are trying to reduce plastic use such as grocery bags and straws. Yet, plastic materials are still being used a lot in human life, including our home appliances. Plastic plumbing components deteriorate into fragments and smaller pieces that reach faucets. Sometimes water softener resin that is also made of plastic polymer (polystyrene divinylbenzene) also comes out of the faucets when the water softener breaks. No studies have examined about MP fate in building plumbing or MP interaction with different pipe materials and biofilm. In order to better understand the fundamental role of MPs in building plumbing, it is important to know about plumbing system and building water quality. For this dissertation, author examined three different types of buildings during closed to low water use conditions. Chapter 1 describes the water quality during transition from Summer (low water use) to Fall (normal use) months at a 7 year old LEED certified middle school. The experiments revealed that more than half of first draw water samples exceeded copper health-based action limit during low water use. Copper concentration was related to the distance from building entry point. Chapter 2 and 3 describe the water quality during COVID-19 pandemic at university buildings with different purposes (Chapter 2), and elementary school buildings (Chapter 3). During the pandemic, many buildings were closed prompting health officials and building owners to become concerned about waterborne disease risks. After buildings were shutdown, many differed guidelines were available telling building owners do different things and no standard guideline was available when authors studied building stagnant water quality. Chapter 2 and 3 revealed that stagnation negatively impacted building water quality but flushing was effective at remediating high concentration of heavy metals and *Legionella pneumophila* at most locations. But in large buildings where building plumbing system is more complicated, flushing was not always the solution to remediate the water quality. Water quality also may deteriorate within two weeks of stagnation

at small buildings even after whole building system was flushed. It is important to understand own building systems to maintain water quality as each building complexity requires specific knowledge and solutions. Chapter 4 was about literature reviews on MPs in drinking water and bench scale experiments on MP fate and transport in building plumbing. Study reveals that MPs interact with plumbing pipe systems and some are removed by flushing. Study also shows a fundamental role of water softener resin as MPs in plumbing system that may deliver many future studies to start.