

Trihalomethanes in Drinking Water: A Comparative Study between Conventional and Green Certified Buildings

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Urbanization and growth in population have led to an increase in impervious surfaces, which results in an As Over a century, chlorine has been extensively used as a disinfectant to control pathogens in drinking water (CDC, 2016). Despite its effectiveness, chlorine is known to react with natural organic matter (NOM) and produce disinfection by-products (DBPs) (EPA, 2017). Trihalomethanes (THMs) are the most common disinfection by-products and its concentrations are driven by contact time, pH, temperature, chlorine and organic matter concentrations in water systems (EPA, 2018). It is known that THMs may cause adverse health effects including liver, kidney or central nervous system problems and increased risk of cancer (EPA, 2017).

The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) is the most commonly implemented green building rating system in the United States that remarkably promotes energy and water conservation since 1998 (USGBC, 2018). In LEED certification, water efficiency in potable water use is mainly maintained by utilizing high-efficiency fixtures that have low-flow rates and occupant sensors (Haselbach, 2008). To date, adverse effects of green building practices on indoor environmental quality have been the topic of research, however the relationship between green premise-plumbing design and water quality hasn't been thoroughly investigated. Rhoads et al. (2016) observed higher pathogen activity and rapid chlorine decay due to high water age in green buildings compared to conventional buildings. Kelley et al. (2014) found that crosslinked polyethylene (PEX) water pipe which is a widely used building material in green construction, caused a decrease in disinfectant residual and exacerbated odor problems.

The purpose of this study is to evaluate and compare the levels of THMs in conventional and green certified buildings. Moreover, the effects of green plumbing design on water quality will be investigated. In this project, first flush water samples will be collected from various conventional and green buildings that are supplied by the same distribution system. The sample locations will be selected based on the faucet placements in buildings to evaluate water age. The samples will be analyzed using gas chromatography/mass spectrometry and statistical analyses will be conducted to determine whether statistically significant differences exist in THM concentrations between green and conventional buildings.

In this research, premise-plumbing design considerations (e.g., pipe length, stagnation time) and materials (e.g., pipes, fixtures) that are used in the selected conventional and green buildings will be compared. Based on the results, most compatible design elements that cause less THM levels will be identified. With this proposed research, the researchers are expecting to contribute to the construction and civil and environmental engineering body of knowledge by addressing the gap between green plumbing design practices and THM formation.

Keywords: Quality assurance, design-build, highway projects, DOT

References

- CDC. (2016). Disinfection By-Products. Retrieved from <https://www.cdc.gov/safewater/chlorination-byproducts.html>
- EPA. (2017). Ground Water and Drinking Water. Retrieved from <https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations#Byproducts>
- EPA.(2018). Drinking Water Treatability Database: Chlorine. Retrieved from <https://iaspub.epa.gov/tdb/pages/treatment/treatmentOverview.do#content>
- Haselbach, L. (2008). The engineering guide to LEED-new construction : sustainable construction for engineers. New York: New York : McGraw-Hill.
- Kelley, K. M., Stenson, A. C., Dey, R., & Whelton, A. J. (2014). Release of drinking water contaminants and odor impacts caused by green building cross-linked polyethylene (PEX) plumbing systems. *Water Research*, 67(C), 19- 32.
- Rhoads, W. J., Pruden, A., & Edwards, M. A. (2016). Survey of green building water systems reveals elevated water age and water quality concerns. *Environmental Science: Water Research & Technology*, 2(1), 164-173.
- USGBC. (2018). LEED is green building. Retrieved from <https://new.usgbc.org/leed>