PFAS and 1,4-Dioxane Treatment for Drinking Water System Optimization

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Background/Objectives. A comprehensive treatability study is being performed to optimize a drinking water system to treat 1,4-dioxane and various per- and poly-fluorinated substances (PFASs). The drinking water system, which consists of pumping well field, air stripper, and equalization tank, was able to effectively treat various chlorinated compounds. Since the discover of 1,4-dioxane and various PFASs in the system in 2015, the system has been taken off of service and an alternative drinking water source has been provided to the municipality. The main objective of the study is to support the design for the upgraded drinking water system optimization.

Approach/Activities. Advanced oxidation processes (AOPs) are being considered for 1,4-dioxane treatment while bituminous coal-based re-agglomerated granular activated carbon (GAC) is being evaluated as the polishing treatment after AOP to remove PFASs. The comprehensive study consists of two different phases. Phase 1 is to investigate the kinetics of 1,4-dioxane and PFAS reduction by two AOPs: titanium dioxide TiO_2/UV and peroxide UV/H_2O_2. Upon completion of Phase I, the optimal conditions of each AOP treatment will be identified. During the Phase 2 study, 55 gallons of water will be treated by the two different AOP vendors under their respective optimal conditions, and the treated water will be tested using rapid small-scale column tests (RSSCT) to identify the GAC usage.

The monitoring programs using different methods will include PFAS, PFAS precursors, 1,4-dioxane, disinfection byproduct (DBP), and oxidation scavengers. The entire program will be completed by the end of 2017. System full-scale design and implementation will occur in 2018.

Results/Lessons Learned. The study will explore PFAS treatment, impact of PFAS precursors, and comparison of different treatment technologies. The knowledge obtained from the study will expand the understanding of PFAS and 1,4-dioxane treatment because:

- 1,4-dioxane and PFAS treatment efficiency two AOP treatments will be compared. The side-by-side comparison of different AOP treatments was not conducted previously.
- Although PFAS oxidation via AOP is known to inefficient, the reduction pathway through TiO_2 based AOP will be investigated. The chemical reduction pathway enhanced by TiO_2 could be effective for some PFAS.
- The study will not only focus on perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), the two more well-known PFAS with regulatory standard, but also investigate PFAS precursors and 28 PFAS compounds that can be analyzed by commercial laboratories for their treatment potential.
- The PFAS precursors are known to convert to PFAS under oxidative condition and cause the increase of PFAS. The impact of PFAS pre-cursor on AOP and GAC absorption will be investigated through an extensive monitoring program via various innovative analytical methods.
- Different analytical methods of 1,4-dioxane and PFAS will also be compared.