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Abstract Title: Maximizing TOC degradation and disinfection while minimizing bromate formation during the ozonation high-bromide reuse water: a bench-scale study

Abstract: The Hampton Roads region is facing issues related to sea level rise, land subsidence, aquifer depletion, and high Chesapeake Bay nutrient loading. The Hampton Roads Sanitation District's (HRSD) Sustainable Water Initiative for Tomorrow (SWIFT) program aims to address these issues by augmenting groundwater sources with advanced treated wastewater effluent. Utilizing a biofiltration-based advanced treatment approach, ozonation is an integral part to ensure pathogen inactivation and organics degradation. To achieve maximum efficiency, high ozone exposures are needed, though with the drawback of increasing bromate formation, a regulated drinking water contaminant at a concentration of 10µg/L (Naumov et al., 2008).

Bench scale testing was used to determine the best methods for bromate suppression, such as free ammonia addition, monochloramination, and the chlorine-ammonia process. These tests were performed while simultaneously increasing ozone dose to maximize pathogen inactivation and organic degradation. While free ammonia addition was found to have only a negligible impact on bromate suppression, preformed monochloramination was found to greatly inhibit this compound's formation. Although previous work has suggested that monochloramine can act as a hydroxyl radical scavenger, thus hindering the formation of bromate, this investigation showed evidence that monochloramine also created intermediate compounds within the formation pathway. This result may have extremely valuable implications: monochloramine may be used to suppress bromate at high ozone exposures without constraining oxidation capabilities and pathogen inactivation. However, an increased ozone decay rate coupled with a decrease in total ozone exposure was also observed, suggesting a decreased oxidation potential.

A testing matrix with variable ozone dose, monochloramine dose, temperature, pH, free ammonia and nitrite is currently ongoing. Additionally, alternative methods for monochloramine formation (including in-situ chloramination and the preformed monochloramine process) are being investigated. Results from bench-scale optimization will be implemented in pilot-scale testing and full-scale operation at a 1MGD demonstration facility in May 2018.