Announcing the Final Examination of Cassandra Smith for the degree of Master of Science

Time & Location: March 20, 2015 at 10:00 AM in Engineering 2 211P
Title: TRIHALOMETHANE REMOVAL AND RE-FORMATION IN SPRAY AERATION PROCESSES TREATING DISINFECTION GROUNDWATER

Historically, chlorination has been widely utilized as a primary and secondary disinfectant in municipal water supplies. Although chlorine disinfection is effective in inactivating pathogenic microbes, the use of chlorine creates the unintentional formation of regulated chemicals. On January 4, 2006, the United States Environmental Protection Agency (EPA) promulgated the Stage 2 Disinfectants/Disinfection by-products rule (DBPR) that focuses on public health protection by limiting exposure to four trihalomethanes (THM) and five haloacetic acids (HAA5), formed when chlorine is used for microbial pathogen control. This thesis explores the use of spray aeration processes to remove semi-volatile THMs from chlorinated potable water supplies, and examines post-aeration THM formation.

A bench scale air stripping unit was designed, constructed and operated to evaluate spray aeration for the removal of the four regulated trihalomethane (THM) species from potable drinking water including bromodichloromethane, bromoform, dibromochloromethane, chloroform. The study was conducted using finished bulk water samples collected from two different water treatment facilities (WTFs) located in Oviedo and Babson Park, Florida. Both treatment plants treat groundwater; however, Oviedo’s Mitchell Hammock WTF supply wells contain dissolved organic carbon and bromide DBP precursors whereas the Babson Park WTF supply well contains dissolved organic carbon DBP precursors but is absent of bromide precursor. Three treatment scenarios were studied to monitor impacts on total trihalomethane (TTHM) removal and post-treatment TTHM formation potential, including 1) no treatment (non-aerated), 2) spray air stripping via GridBee® nozzle, 3) spray air stripping via BETE® nozzle. The non-aerated samples served as controls in order to compare treatment removal efficiency and post-treatment TTHM formation potentials. Select water quality parameters, chlorine residual, and total trihalomethane concentrations were monitored throughout the study.

Using statistical analysis of variance, at 85% confidence, it was found that there was not sufficient evidence to conclude that the two spray nozzles (GridBee® and BETE®) did not produce similar TTHM removal results. Therefore, the spray nozzles resulted in an average TTHM removal of 50.0% for the Babson Park WTF (BPPSW) samples, and 42.9% for the Mitchell Hammock WTF (MHWTF) samples. The lower percent removals at the MHWTF is attributed to the presence of bromide in the water samples. In addition, chlorine residuals were maintained post spray aeration treatment, and initial chlorine residual and trihalomethane concentrations did not significantly impact overall spray nozzle performance. Among other findings, it was concluded that spray nozzle aeration is a feasible option for the Babson Park WTF for TTHM compliance. For Oviedo’s Mitchell Hammock WTF spray aeration was successful in removing TTHMs, however it was not effective in maintaining DBP rule compliance due to the excessive nature of DBP formation and presence of bromide.

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Approved for distribution by Steven Duranceau, Committee Chair, on June 5, 2015.

The public is welcome to attend.