Announcing the Final Examination of Benjamin Yoakum for the degree of Doctor of Philosophy

Time & Location: June 30, 2017 at 9:00 AM in Engineering II 202A

Title: INVESTIGATING NOVEL WATER TREATMENT METHODS AND MONITORING TECHNIQUES FOR SULFIDE-LADEN GROUNDWATER SUPPLIES

The Polk County Utilities Division of Polk County (County), Florida owns and operates its drinking water utilities and provides potable water service to consumers within the county’s service areas. The University of Central Florida’s (UCF’s) Civil, Environmental and Construction Engineering Department initiated (at the request of the County) investigations into two of the County’s water treatment plants (WTPs). The first WTP, Babson Park Water Treatment Plant 2 (BPWTP2), produces approximately 80,000 gallons of drinking water per day and uses a combination of granular activated carbon (GAC) and tray aeration to treat their on-site groundwater source. The second water treatment plant, the Imperial Lakes Water Treatment Plant (ILWTP), produces approximately 1.3 million gallons of drinking water per day and uses a combination of oxidizing media filters and tray aeration to treat their on-site groundwater source. Four potable water treatment system studies were performed at these WTPs with each investigating a novel treatment technique or a novel treatment monitoring technique.

The first study investigated the efficacy of multi-pass spray aeration treatment to remove trihalomethanes (THMs) and to reduce the total THM formation potential (TTHMFP) of an aerated water column post-aeration. A recirculating spray aeration pilot unit was constructed to make this assessment. To assess the effect of multi-pass spray aeration on the TTHMFP water was recirculated through a fabricated spray nozzle for various lengths of time. Results showed that multi-pass spray aeration can remove chloroform, dichlorobromomethane, dibromochloromethane and bromoform to below detection levels (< 0.7 ppb) for the waters investigated. Additionally, spray aeration reduced the TTHMFP of chlorinated water. Results suggest multi-pass spray aeration may be a viable treatment option for some bromide container waters including BPWTP2.

The second study investigated using pre-existing tray aeration infrastructure to comply with Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules (STAGE2) which regulate the concentration of disinfection by-products in a water distribution system. To assess the efficacy of tray aerators to reduce the concentration of total trihalomethanes (TTHM) a pilot tray aerator was constructed. Results showed that after five tray passes the concentration of TTHMs was below the detection limit (i.e., less than 0.7 ppb per THM) of the instrument used to measure THMs. To assess the efficacy of tray aeration at full scale, BPWTP2 and the distribution system it serves were monitored for eight months. Results showed an approximate 40 ppb reduction in the TTHM concentration at the two on-site monitoring locations and the one off-site monitoring location. Results suggest that County could comply with STAGE2 regulations by using BPWTP2’s pre-existing tray aeration infrastructure to reduce formed THMs on-site.

The third study investigated the efficacy of using biological activated carbon (BAC) to remove disinfection by-product precursor mater to comply with STAGE2 regulations. To make this assessment a pilot scale BAC filter was operated for three independent test runs and two full scale WTPs using BAC were monitored. Results showed an approximate 40% removal of dissolved organic carbon (DOC) during the three pilot runs and an approximate 55% removal of DOC during full scale monitoring. Results showed that the reduction in DOC reduced the TTHMFP of BAC treated water. Results suggest that BAC treatment could be a viable treatment option at BPWTP2, one of the two full scale treatment plants monitored.

The fourth study investigated the suitability oxidation reduction potential (ORP) to monitor the effectiveness of an oxidizing media filter. Results showed that ORP was a more useful measurement when assessing filter bed health and regeneration event effectiveness when the ORP within the oxidative media layer was below 500 mV. Below this value free chlorine residuals were not measurable. Results showed a significant increase in turbidity and total manganese occurred when the ORP within the filter bed dropped below 400 mV. More frequent cycling of the filters was found to be
an effective treatment option to maintain ORP values above 400 mV operational threshold.

Major: Environmental Engineering

Educational Career:
Bachelor's of Environmental Engineering, BS, 2010, University of Central Florida
Bachelor's of Biology, BS, 2010, University of Central Florida
Master's of Environmental Engineering, MS, 2013, University of South Florida

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Approved for distribution by Dr. Steven Duranceau, Committee Chair, on June 15, 2017.

The public is welcome to attend.