This study evaluated alternative sulfide treatment processes for potable water systems that rely on groundwater supplies. Research for this study was conducted at the Imperial Lakes (IL) and Turner Road (TR) water treatment plants (WTPs) in Polk County, Florida. These WTPs are in the process of refurbishment and expansion, and will require the installation of a new groundwater well. The IL and TR WTPs both rely upon groundwater sources that contain total sulfide at concentrations ranging from 1.4 to 2.6 mg/L. Sulfide is a concern because if left untreated it can impact finished water quality, corrosivity, create undesirable taste and odor, and oxidize to form visible turbidity. For this reason, the raw water will require treatment per Florida Department of Environmental Protection (FDEP) “Sulfide Rule” 62-555.315(5)(a). This rule does not allow the use of conventional tray aeration (currently in use at the IL and TR WTPs) for wells that have significant total sulfide content (0.6 to 3.0 mg/L).

This research was commissioned because the potential water treatment method identified in the Sulfide Rule (i.e. forced-draft aeration) would not adequately fit within the confines of the existing sites and would pose undue burden to neighboring residents. In addition, an effective sulfide treatment process was desired that offered a low profile, did not necessitate the need for additional complex chemical feed systems, minimized the extent of electrical infrastructure upgrades, and was inexpensive to construct and operate.

To meet these goals, several alternative technologies were evaluated at the desktop and bench-scale; these included anion exchange, various oxidation methods, and alternative media filtration processes. From that effort, several processes were selected for evaluation at the pilot scale: bleach (NaOCl) oxidation preceding electromedia filtration; manganese (IV) oxide (MnO2) filtration continuously regenerated with bleach; and ferrate (Fe(VI)) oxidation.

Electromedia and MnO2 filtration were shown to be effective for total sulfide treatment. Both processes reduced total sulfide content to below detection levels (< 0.1 mg/L) for groundwater supplies containing as much as 2.6 mg/L of total sulfide. The use of bleach oxidation ahead of media filtration also produced finished water with low turbidity (< 1.0 NTU) as compared to conventional tray aeration and chlorination processes (6-16 NTU, as observed in this study). It was determined that the media filtration approach (electromedia and MnO2) was effective for sulfide treatment and met the County’s site objectives established at the outset of the project. Ferrate was also shown to reduce total sulfide content to below detection levels (< 0.1 mg/L) for groundwater supplies containing as much as 2.6 mg/L of total sulfide.

An opinion of probable capital costs for installing a sulfide oxidation/filtration process at either the Imperial Lakes or Turner Road WTP was estimated to range from roughly $830,000 to $1,100,000. That equates to a $/kgal capital cost of $0.10 to $0.32 (at 8% for 20 years). An opinion of probable bleach chemical costs was estimated to range from $3,500 to $9,800 for the IL WTP and $3,500 to $5,800 for the TR WTP.

Major: Environmental Engineering

Educational Career:
Bachelor’s of Civil and Environmental Engineering, BS, 2008, University of Central Florida

Committee in Charge:
Dr. Steven J. Duranceau, Chair, Civil, Environmental and Construction Engineering
Dr. Christian A. Clausen, Chemistry
Dr. Andrew A. Randall, Civil, Environmental and Construction Engineering
Approved for distribution by Dr. Steven J. Duranceau, Committee Chair, on June 1, 2010.

The public is welcome to attend.