Title: Developing Fluorescence Sensor Systems for Early Detection of Nitrification Events in Chloraminated Drinking Water Distribution Systems

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Abstract

Detection of nitrification events in chloraminated drinking water distribution systems remains an ongoing challenge for many drinking water utilities, including Dallas Water Utilities (DWU) and the City of Houston (CoH). Each year, these utilities experience nitrification events that necessitate extensive flushing, resulting in the loss of billions of gallons of finished water. Biological techniques used to quantify the activity of nitrifying bacteria are impractical for real-time monitoring because they require significant laboratory efforts and/or lengthy incubation times. At present, DWU and CoH regularly rely on physicochemical parameters including total chlorine and monochloramine residual, and free ammonia as indicators of nitrification, but these metrics lack specificity to nitrifying bacteria and may be aberrant only after a nitrification event is fully established. To improve detection of nitrification in chloraminated drinking water distribution systems, we seek to develop a real-time fluorescence-based sensor system to detect the early onset of nitrification events by measuring the fluorescence of soluble microbial products (SMPs) specific to nitrifying bacteria. Preliminary data indicates that protein-like fluorophores at excitation/emission wavelengths of 225-235/325-350 nm have the sensitivity to measure the SMPs, but several remaining challenges will be explored in this presentation. We will focus on results from ongoing annular reactor experiments designed to (1) identify fluorescence wavelength pairs and data processing techniques suitable for measurement of SMPs from nitrification and (2) assess potential interferences, such as those from iron, nitrite, nitrate, pH, and dissolved organic matters. Fluorescence sensor packages, tuned to suitable excitation-emission pairs, will be validated. Findings from this research could be leveraged to identify nitrification events in their early stages, facilitating proactive interventions and decreasing the severity and frequency of nitrification episodes and water loss due to flushing.