Drinking Water Microbiome as a Screening Tool for Nitrification in Chloraminated Drinking Water Distribution Systems

Gomez-Alvarez, Vicente, U.S. Environmental Protection Agency, Cincinnati, OH

Revetta, Randy, U.S. Environmental Protection Agency, Cincinnati, OH

Many water utilities in the US using chloramine as disinfectant treatment in their distribution systems have experienced nitrification episodes, which detrimentally impact the water quality. A chloraminated drinking water distribution system (DWDS) simulator was operated through four successive operational schemes, including two stable events (SS) and an episode of nitrification (SF), followed by a 'chlorine burn' (SR) by switching disinfectant from chloramine to free chlorine. The current research investigated the viability of biological signatures as potential indicators of operational failure and predictors of nitrification in DWDS. For this purpose, we examined the bulk water (BW) bacterial microbiome of a chloraminated DWDS simulator operated through successive operational schemes, including an episode of nitrification. BW data was chosen because sampling of BW in a DWDS by water utility operators is relatively simpler and easier than collecting biofilm samples from underground pipes. The methodology applied a supervised classification machine learning approach (naïve Bayes algorithm) for developing predictive models for nitrification. Classification models were trained with biological datasets (Operational Taxonomic Unit [OTU] and genus-level taxonomic groups) generated using next generation high-throughput technology, and divided into two groups (i.e. binary) of positives and negatives (Failure and Stable, respectively). We also investigated biomass and water quality signatures as potential predictors of nitrification in DWDS and evaluated the signatures identified in this study as potential predictors of nitrification in publically available data.