Evaluation of MIEX® Process Impacts on Different Source Waters [Project #2840]

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OBJECTIVES:
The primary objectives of this project were to evaluate the MIEX® process under different water quality conditions to demonstrate its applicability for the removal of naturally occurring matter (NOM) and for control of disinfection by-product formation. Testing was also conducted to assess removal of selected inorganic anions. Results of the full-scale operation at the Wanneroo Groundwater Treatment Plant in Western Australia (WGTP) are also discussed to develop additional guidance for planning and implementation based on actual conditions of operation.

BACKGROUND:
Water utilities are being required to provide higher levels of disinfection while also reducing the concentrations of disinfection by-products. One new technology for meeting these goals is the MIEX® process for removing dissolved organic carbon (DOC). This process may also work well in conjunction with coagulation by both reducing the dose of coagulant needed and by working in combination to achieve a higher level of NOM removal than is available with either process separately.

HIGHLIGHTS:
This research showed that the MIEX® process achieves removals of DOC and UV254, along with associated reductions in THM and HAA formation. The extent of removal appeared to vary with the nature of the organics and the background levels of inorganic ions that can compete with organics for ion exchange sites. Therefore, testing is important to confirm the applicability at a given location. In addition to removal of NOM, the MIEX® process exhibited capability to remove several anions of interest, including bromide, sulfide, arsenic, and perchlorate. The extent of removal of these anions varies depending on water quality.

APPROACH:
Testing included one week of combined pilot plant startup and bench scale testing followed by four weeks of pilot operation at each location. Resin used in bench scale testing was obtained from the pilot plant after a period to reach steady state conditions of operation. This allowed the use of resin that was in a normal operational state along with freshly regenerated resin in a typical blend to develop basic kinetic relationships for organics and inorganic anion uptake. Pilot plant testing assessed process relationships under continuous flow conditions that reflect actual mode of operation. Testing was also performed to assess a process sequence with coagulation at two locations and direct filtration at one location. The impact on chlorine and ozone demand relationships was also assessed.

RESULTS/FINDINGS:
A wide range of DOC removal was observed for the MIEX® process; DOC removals were 60 percent or greater at two sites, slightly lower (50 to 60 percent removal) at a third site, and less than 35 percent at the fourth site. There was a trend of increased removal at higher SUVA levels and a more hydrophobic characteristic of the DOC. Increased NOM uptake also corresponded with lower total dissolved solid and sulfate levels in the raw water, and it is likely that these have an effect on removals of inorganic anions of interest as well. THM and HAA formation were reduced. The extent of reduction proved to be site-specific and generally tended to vary with the extent
of NOM removal. Because of these observed variations, applicability of the MIEX® process to meet treatment goals could be site specific.

Simulations of a MIEX®-coagulation sequence demonstrated that the processes could work together to achieve higher levels of NOM removal as well as potential reductions in coagulant dose.

Successful full-scale performance of the MIEX® process has been demonstrated since November 2001 through operation of the 30 MGD (112.5 ML/day) WGTP.

**IMPACT:**
This project confirms the potential application of MIEX® for removing NOM and reducing the formation of THMs and HAAs. It provides information relative to the performance of the process under different conditions and provides general cost information for guidance in assessing general applicability. Process benefits and potential constraints are also presented. The process could represent an alternative for many utilities for complying with both existing and future disinfection by-product regulations and the information that is provided will assist these utilities in understanding the process and its applicability.

**RESEARCH PARTNERS:**
- Southern Nevada Water Authority
- Tampa Bay Water
- Commissioners of Public Works of the City of Charleston, S.C.
- Northern Kentucky Water District