Technical Note

Pre-treatment to Micro- and Ultrafiltration

Benefits of MIEX® Treatment

MIEX® Treatment: A Proven Technology

There are currently (in 2006) four full-scale membrane plants in operation where the MIEX® Process pre-treats water prior to the membrane process. Two plants use Microfiltration (MF) and two use Ultrafiltration (UF). This technical note highlights the benefits of MIEX® Treatment prior to MF and UF based on operating data and experience at these facilities. In particular, data is provided from the MIEX® Treatment facilities at the Big Elk Meadows Water Association 50-gpm MF plant in Lyons, Colorado, and the Mt. Pleasant 370-gpm MF plant in South Australia. Data illustrating effective dissolved organic carbon (DOC) removal is also included from the City of Vallejo 1-mgd conventional plant in Suisun, California.

Effective for DOC Removal

Although effective for removing turbidity and particulates, MF and UF membranes are generally ineffective for removing dissolved organic carbon. DOC not removed by pre-treatment increases membrane fouling, passes through into the treated water, and causes increased disinfection byproduct (DBP) formation.

MIEX® Pre-treatment before membranes is effective for removing DOC, and provides additional benefits compared to treatment alternatives for DOC removal, such as powdered activated carbon (PAC), coagulation, and granular activated carbon (GAC).

Up to 80% DOC removal. – MIEX® Treatment removes 60 to 80% of raw water DOC at Big Elk Meadows. At Mt. Pleasant, MIEX® Treatment removed 42% of DOC during 2004 to 2005. An average of 60% of total organic carbon was removed at Vallejo in 2006.

Up to 80% reduction of DBPs. – Big Elk Meadows was in noncompliance with the Stage 1 DBP Rule. Installing MIEX® Treatment resulted in lowering TTHMs and HAA5 by 80%. At Mt. Pleasant, MIEX® Treatment removed an average of 43% of TTHM Formation Potential. Average distribution system THM levels were lowered at Vallejo by 67% in 2006.

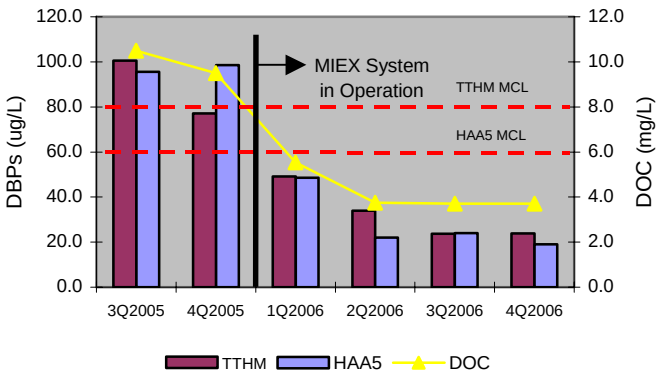
Improving Membrane Performance

In all four full-scale membrane plants with MIEX® Pre-treatment, membrane performance has been improved compared to operation without MIEX® Pre-treatment.

Improved membrane throughput (flux) – Pre-treatment with the MIEX® Process improves membrane feed water quality, resulting in higher flux rates. Testing of a ZeeWeed® UF unit on MIEX® treated River Murray water in Australia increased flux rates by 30%.

Reduced membrane fouling. – The MIEX® Process can remove a wide range of DOC, with a particular affinity for the negatively charged, low molecular weight (LMW) range of DOC. LMW DOC has been identified as a primary cause of irreversible membrane fouling.

Decreased frequency of membrane cleaning. – Improved membrane feed water quality means less frequent membrane cleaning. At Big Elk Meadows, the need for MF chemical cleaning was substantially reduced after the installation of MIEX® Pre-treatment. At Mt. Pleasant, membrane resistance has been consistently stable during operation with MIEX® Pre-treatment, resulting in less frequent cleaning required.



MIEX® Treatment resulted in Big Elk Meadows and the City of Vallejo complying with the Stage 1 DBP Rule.

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Operational Advantages of MIEX® Treatment

- MIEX® Treatment is straightforward and requires minimal time and cost for operation and maintenance.
- Smaller volumes of non-hazardous waste are generated, compared to other treatment alternatives.
- The MIEX® Process is not affected by turbidity, so it is typically used first, improving the effectiveness of downstream processes.
- Recovery of membrane flux following cleaning is improved.
- Transmembrane pressure (TMP) required to achieve the desired plant production rate is typically lowered.
- Membrane life is increased, less frequent membrane replacement is needed, and operating costs are lowered.
- Reject water volumes are lowered. MIEX® Treatment prior to ZeeWeed® UF reduced reject water loss by 45%.
- The MIEX® Process is suitable for water systems of all sizes, providing flexibility to meet future needs.
- For small systems, MIEX® Process units are preassembled and compact.

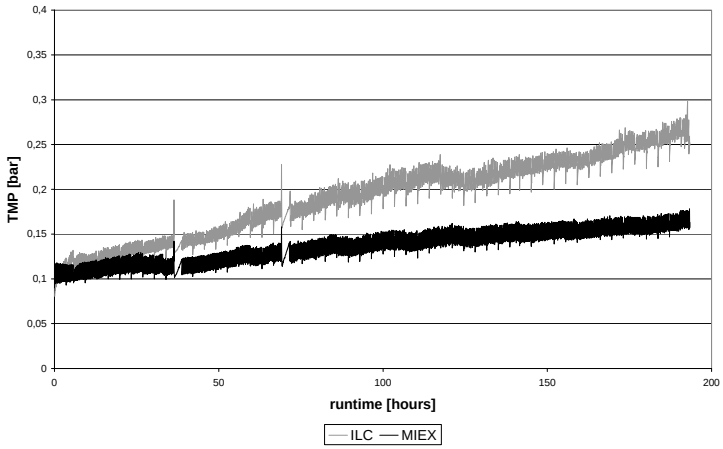
MIEX® Treatment Improves Water Quality

- Chlorine demand is lowered. At Big Elk Meadows, sodium hypochlorite use dropped approximately 50%. At Mt. Pleasant, chlorine demand was reduced by 69%.
- Disinfectant residuals are more stable.
- Color, taste, and odor are improved.
- Distribution system water quality is enhanced.
- UV transmittance is increased (for UV disinfection).
- Downstream coagulant doses and pH adjustment are lowered, if the MIEX® Process is used prior to coagulation.
- Algae growth in open downstream process tanks is less due to reduced TOC load, which occurred in Vallejo.

MIEX® Treatment vs. PAC and Coagulation Prior to Membranes for DOC Removal

- MIEX® Treatment has been found to provide greater overall DOC removal than PAC and coagulation.
- MIEX® Treatment has been found to be more effective than PAC and coagulation at removing LMW DOC.
- Coagulant addition and PAC load membranes with solids that increase flux rate decline, increase fouling, and may reduce membrane hydraulic performance.
- PAC and coagulants are more technically challenging to operate than MIEX® Treatment.
- PAC and coagulants produce a greater chemical waste volume that requires disposal.

During operation of a UF unit, TMP increased more rapidly with coagulation pre-treatment than with MIEX® Pre-treatment, as shown below.



MIEX® Treatment vs. GAC after Membranes for DOC Removal

GAC treatment after membranes effectively removes DOC. But because the DOC first passes through the membranes, post-membrane GAC treatment will not provide any membrane performance benefits provided by MIEX® Pre-treatment.

In general, capital and operating costs of post-membrane GAC treatment are higher than MIEX® treatment. Typically, the GAC must be completely replaced or regenerated about every 90 to 180 days, depending upon the GAC process design.

References

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