

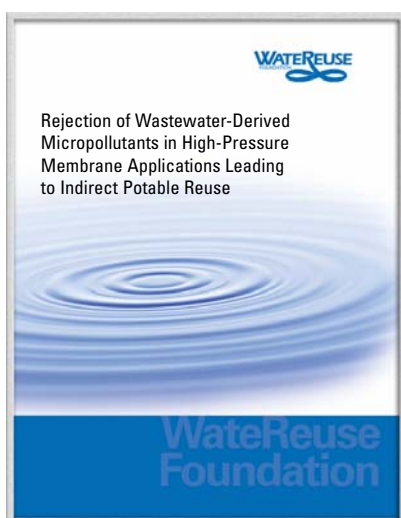
Project PROFILE



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Advancing the Science of Water Reuse and Desalination through Research

Rejection of Wastewater-Derived Micropollutants in High-Pressure Membrane Applications Leading to Indirect Potable Reuse: Effects of Membrane and Micropollutant Properties



Product Number: 02-001-01

WRF Subscribers: \$15

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Project Number

WRF-02-001

Principal Investigator

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Membrane processes such as reverse osmosis (RO), ultralow pressure reverse osmosis (ULPRO), and nanofiltration (NF) are becoming increasingly widespread in water treatment and wastewater reclamation and reuse applications where a high-quality product is desired.

Membrane processes are often chosen because these applications achieve high levels of removal of constituents such as dissolved solids, organic carbon, inorganic ions, and

regulated and unregulated organic compounds.

Knowledge on the rejection of trace organics during RO and NF treatment has been gained largely from observations at pilot- and full-scale installations. This experience has led to an empirical and incomplete understanding of how trace organics are rejected by membranes, with limited knowledge for rejection predictions.

Objectives

The objective of this study was to develop a mechanistic understanding of the rejection of emerging organic micropollutants by high-pressure membranes, on the basis of an integrated framework of solute properties, membrane properties, operational conditions, and various feed water compositions.

The specific goals of the project were as follows:

- (1) to determine physicochemical properties that are suitable to describe membrane-solute interactions and rejection behavior;
- (2) to explore the relationships among physicochemical properties of trace organics and rejection mechanisms; and
- (3) to develop a fundamental transport model to predict the rejection of trace organics in high-pressure membrane applications, based on hindered or facilitated diffusion.

Benefits

The removal of the compounds of concern in water and wastewater treatment applications is of great importance where a high product water quality is desired. This study increases the understanding of the factors affecting the permeation of solutes in high-pressure membrane systems.

Highlights

- Key membrane properties affecting rejection that were identified include MWCO, pore size, surface charge, hydrophobicity/hydrophilicity, and surface morphology.
- Several indicator compounds were chosen from chemicals classified as endocrine disrupting compounds, pharmaceutical residues, flame retardants, pesticides, and disinfection byproducts.
- Experiments with negatively charged indicator compounds demonstrated that rejection and solute properties such as molecular weight, solute width and length, and hydrophobicity are not correlated.
- Findings of the study indicate that membrane fouling does significantly affect organic solute rejection of CTA, NF, and ULPRO membranes and is less important for TFC RO membranes.

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The mission of the WateReuse Foundation is to conduct and promote applied research on the reclamation, recycling, reuse, and desalination of water.