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

Principal Investigator

Dr. Jörg E. Drewes, *Colorado School of Mines*

Cash Contributors (in addition to the Bureau of Reclamation):

State Water Resources Control Board (CA)

West Basin Municipal Water District

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.