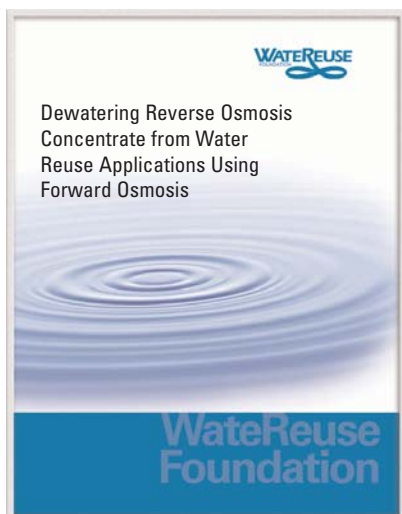


Dewatering Reverse Osmosis Concentrate from Water Reuse Applications Using Forward Osmosis



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Advancing the Science of Water Reuse and Desalination through Research



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Reverse Osmosis (RO) is an effective barrier in water production systems when removal of dissolved contaminants or salts is needed to achieve high finished water quality. RO concentrate usually comprises 10–30% of the influent to the process for surface water and 50–75% of the influent for seawater.

While coastal communities can utilize the ocean to discharge the RO concentrate, inland facilities must rely upon more problematic conventional

alternatives, such as surface water or sanitary sewer discharge, evaporation ponds, deep well injection, and land applications. These options are costly, not environmentally sustainable, and are becoming increasingly difficult to permit. Thus, proper handling and disposal of the RO concentrate has become a critical environmental issue.

A novel process of dewatering RO concentrate is forward osmosis (FO). FO is defined as the net movement of water across a selectively permeable membrane driven by a difference in osmotic pressure across the membrane. The main advantage of using FO in water and wastewater treatment is the very low energy consumption rate since no external pressure is required while rejecting a wide range of contaminants with possibly a lower membrane-fouling propensity than pressure-driven membrane processes.

The main challenges, however, exist in the manufacture of high performance FO membranes, the selection of easily separable draw solutions with a high osmotic pressure, and the optimization of process configurations to minimize concentration polarization.

Objectives

As a proof of concept, this study focuses on exploring innovative draw solutions, commercially available FO membranes, and the feasibility of applying FO to dewater RO concentrate.

Benefits

This report summarizes initial feasibility data on the application of FO to minimize the concentrate from RO process. It also contributes to the knowledge base of novel draw solutions and high-performance FO membranes.

Highlights

- The FO process is shown to be economically feasible for RO concentrate minimization.
- Dendrimers are a promising osmotic media as these macromolecules provide high osmotic pressure.
- Ultrafiltration (UF) has the potential to reconcentrate the dendrimer along with its surface ions, as preliminary UF experiments achieved 87.3% rejection of the surface sodium ions.
- Bench-scale experiments have shown that the RO concentrate was further concentrated in FO using salt (NaCl) as the draw solution.
- Magnetic nanoparticles were evaluated in this study as a candidate draw solution. However, the magnetic fluid could not provide the high osmotic driving force for dewatering RO concentrate.
- Albumin—a protein that has a special role in regulating the osmotic pressure balance within blood vessels—was also not able to provide the high osmotic pressure required for dewatering RO concentrate.

PROJECT PROFILE

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About the Foundation

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