DURAFLOW

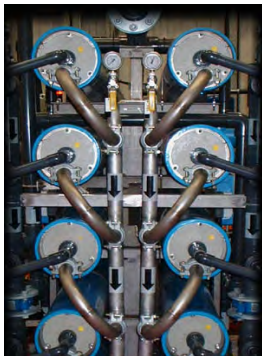
Total Performance: membranes, chemistry, service

Application Bulletin

RO Brine Recovery

RO Brine Recovery Challenges

Reverse Osmosis (RO) is a widely accepted membrane technology for industrial process water purification and wastewater recycling. The pre-treated water or wastewater is typically pressured between 150 to 600 psig and processed through thin film composite or cellulose acetate RO membranes. Typical RO recovery ranges from 50% to 80% of feed. The brine or reject stream generated from the RO filtration process contains 2 to 5 times the salt concentration of the feed water. The brine contains a wide variety of inorganic and organic dissolved solids with TDS concentration up to several thousand mg/L. Reducing volume of RO brine by increasing the % recovery in a system is being driven by today's regulatory, environmental and economic factors. Most of the large plant operations can no longer afford or are not permitted to dispose of the RO brine and are seeking brine recovery technologies. The driving factors consist of:



RO Membrane Modules

- Availability & quality of water supply
- Effluent discharge quality standards
- Discharge volume restrictions
- Reliability of water resource
- Price of water
- Operating cost for process water treatment
- Operating cost for wastewater treatment
- Net saving for brine minimization

Duraflow Solution

RO Brine Analysis ➔ Chemistry Development ➔ Microfiltration Design

Duraflow employs a three-step approach to define a pre-treatment process fully compatible with the recovery of RO brine using a secondary RO system. The treatment objective is to remove all detrimental components and generate a brine stream with NTU (<1.0) and SDI (<3.0) values in full compliance with the RO feed water criteria.

(1) ***RO Brine Analysis*** - Evaluate the RO brine to identify all potential RO membrane fouling agents. Depending on the production process and source of water, the fouling components may include:

- Hardness (Ca & Mg)
- Heavy Metals
- Organic Matter
- Silica Colloids
- Biological Matter
- Oxidizers (Cl_2, H_2O_2)
- Surfactants
- Metal (Fe, Mn) Oxides

Duraflow MF/RO Recycling System

RO Brine Recovery

(2) ***Chemistry Development*** – Based on the types and quantities of fouling substances identified in the brine solution, a chemical treatment process is developed to counteract each of the fouling factors. The chemical treatment may take the form of precipitation, adsorption, pH adjustment and microbial control. The chemistries are evaluated for their compatibility and combined effect. The treatment process is carried out in a two- or three- stage chemical reaction. The chemical treatment will typically include one or more of the following processes:

- Cold Lime Softening - Hardness precipitation for scaling control
- Magnesium Salt – Silica colloid adsorption for fouling prevention
- Activated Carbon - Organic reduction & oxidant destruction
- pH Adjustment – pH optimization for the integrated chemistries

Duraflow MF 10-Tube Modules

(3) ***Microfiltration Design*** – After chemical reaction, the pre-treated brine solution from the primary RO system is processed through the Duraflow microfiltration membrane filters designed for separation of the incompatible precipitates from water. The waste solution is pumped at a high velocity (12 – 15 feet per second) through the membrane modules connected in series with an inlet pressure of 45 – 60 psig. The turbulent flow, parallel to the membrane surface, produces a high-shear scrubbing action which minimizes deposition of solids on the membrane surface. During operation, clear filtrate permeates through the membrane, while the suspended solids retained in the re-circulation loop are periodically purged for further de-watering. The filtrate is directed to a brine recovery RO system designed for processing of high TDS solution.

Duraflow microfiltration membranes are manufactured in a tubular configuration capable of handling high solid concentration. The membranes, made of PVDF, are cast on the surface of porous polymeric tubes to produce a nominal pore size of 0.1 micron. The extraordinary chemical resistant property of PVDF allows the use of a wide range of chemicals - acids, bases and solvents for cleaning of the persistent fouling substances. An automatic back-pulse mechanism is an integral part of the operation design to provide periodic physical surface cleaning.

Brine Recovery – Total Hardness Balance (Typical)