

DURASOFT Water Recycling

Softening & Recycling Challenges

Reverse Osmosis (RO) is a well-known membrane technology for wastewater recycle or process water purification. In the RO filtration process, water/wastewater is typically pressured between 200 to 600 psig and processed through TFC or CA RO membranes. Typical RO recovery ranges from 75% to 90%. Scaling occurs on RO membranes when the concentration of scale-forming species exceeds saturation, forming insoluble precipitation within the RO feed water. Scalants include calcium, magnesium, barium and strontium compounds, and reactive silica, which will adversely affect RO operation and performance in many ways:

- Low TDS rejection efficiency
- Elevation of operating pressure
- Low membrane recovery rate
- Frequent membrane cleanings

All these deficient performance result in declining water quality, high operating cost (chemical and energy) and frequent or extensive shut down of the RO treatment plants.



Duraflow Cross-flow Membrane

Durasoft Application

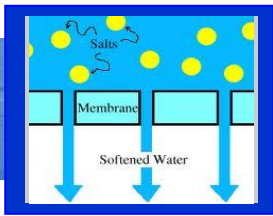
- Industrial wastewater
- Treatment plant effluent
- Mine Drainage Water
- Cooling Tower Blow-down
- RO reject
- Groundwater
- Any water w/ high hardness

DURASOFT Solution

Influence Analysis → Chemistry Development → DF Membrane Design

Chemical Softening - Based on the chemical characteristic and types/concentrations of hardness in the water/wastewater, a chemical softening process is developed to counteract each of the scaling elements and other fouling material present. The chemical treatment may take the form of precipitation, adsorption, chemical reduction, 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 softening reaction. The chemical treatment will typically include one or more of the following processes:

- Chemical Softening (Lime, Soda Ash, Caustic) - Hardness precipitation for scaling control
 - Calcium Removal - $\text{Ca}^{+2} + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 \downarrow + 2\text{Na}^{+1}$
 - Magnesium / Silica Removal - $\text{Mg}^{+2} + \text{SiO}_2 + 2\text{NaOH} \rightarrow \text{Mg}(\text{OH})_2\text{-SiO}_2 \downarrow + 2\text{Na}^{+1}$
- Powdered Activated Carbon - Organic reduction, oxidant destruction and bio-film prevention
- Fe/Al Coagulation – Precipitates and colloids agglomeration for membrane filtration enhancement
- pH Adjustment – pH operating zone optimization for the integrated chemistries



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Duraflow Membrane Design – After chemical softening, the pre-treated wastewater is processed through the Duraflow membrane filters designed for separation of precipitates from water. The wastewater is pumped at a high velocity (12 – 15 feet per second) through the membrane modules connected in series with an inlet pressure of 50 – 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.

Duraflow 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 oxidizers for cleaning of the persistent fouling substances. An automatic back-pulse mechanism is an integral part of the operation design to provide physical surface cleaning by periodically reversing the filtrate flow direction.

DF Softened Filtrate Quality	
Calcium	<15 mg/L
Magnesium	<10 mg/L
Tot Hardness (as CaCO ₃)	<80 mg/L
Silica	<12 mg/L
TSS	<1.0 mg/L
NTU	<1.0
SDI	<3.0



- Consistent RO permeate quality
- Steady RO permeate flow
- Extended RO membrane life
- Constant RO operating pressure
- Minimal unscheduled shutdown

Durasoft Membrane System Flow Diagram

