DURAFLOW

Total Performance: membranes, chemistry, service

Application Bulletin

Wastewater Recycle

Wastewater Recycle Challenges

Wastewater recycle has emerged as a long-term strategy for the improved management of the world's precious water resources. The role of wastewater recycle is certain to continue to grow in line with increasing pressure on limited fresh water supplies and escalating cost of water and effluent treatment. Reverse Osmosis (RO) is a widely accepted membrane technology for wastewater purification. The pre-treated wastewater is typically pressured between 200 to 600 psig and processed through thin film composite or cellulose acetate RO membranes. Typical RO recovery ranges from 75% to 90%. Despite its capability to produce re-usable water, a large number of RO recycling installations have experienced difficult operational problems in the field. The most common problems include unreliable filtration production, decrease in salt rejection, frequent membrane cleaning, and premature membrane failure.

All these deficiencies result in high operating cost and in some cases shut down of the water recycle plants. The primary cause for such an undesirable or unacceptable performance is that RO membrane has low tolerance for a broad range of incompatible components in water. These substances, if not removed, will cause scaling, fouling or permanent degradation of the RO membrane.

Duraflow Solution

Influence Analysis ➔ Chemistry Development ➔ Microfiltration Design

Duraflow employs a three-step approach to define a pre-treatment process fully compatible with the RO recycle operation. The goal is to achieve complete removal of all detrimental components and generate a flow stream with NTU (<1.0) and SDI (<3.0) values in full compliance with the RO feed water criteria.

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

- Calcium Precipitates
- Heavy Metals
- Organic Matter
- Silica Colloids
- Biological Matter
- Oxidizers (Cl_2, H_2O_2)
- Surfactants
- Metal (Fe, Mn) Oxides

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(2) ***Chemistry Development*** – Based on the types and quantities of fouling substances identified in the wastewater, a chemical treatment process is developed to counteract each of the fouling factors. 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 reaction.

The chemical treatment will typically include one or more of the following processes:

- Lime Softening - Hardness precipitation for scaling control
- Magnesium Hydroxide – Silica colloid adsorption for fouling prevention
- Dithiocarbamate (DTC) - Heavy metal precipitation and biological growth control
- 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

(3) ***Microfiltration Design*** – After chemical reaction, the pre-treated wastewater is processed through the Duraflow microfiltration membrane filters designed for separation of the incompatible 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 45 – 50 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 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 physical surface cleaning by periodically reversing the filtrate flow direction.

Duraflow MF Modules

Industry Applications

Automotive	Power Generation
Battery	Printed Circuits
Chemical Process	Semi-Conductor
Metal Finishing	Steel Manufacturing