

Duraflow Membrane Product Data Sheet

The Duraflow Membrane Filtration (DFMF) is designed to remove selected inorganic, organic, or heavy metal contaminants to meet the regulatory compliance and/or water recycle objectives. The DFMF is an advanced product proven to be more efficient and reliable than conventional clarification treatment methods. Two process steps are critical to the success of a DFMF system operation: (1) chemical pre-treatment to convert the contaminants of concern to filterable particulates and mitigate membrane fouling effects, and (2) physical separation of the particles by membrane microfiltration.

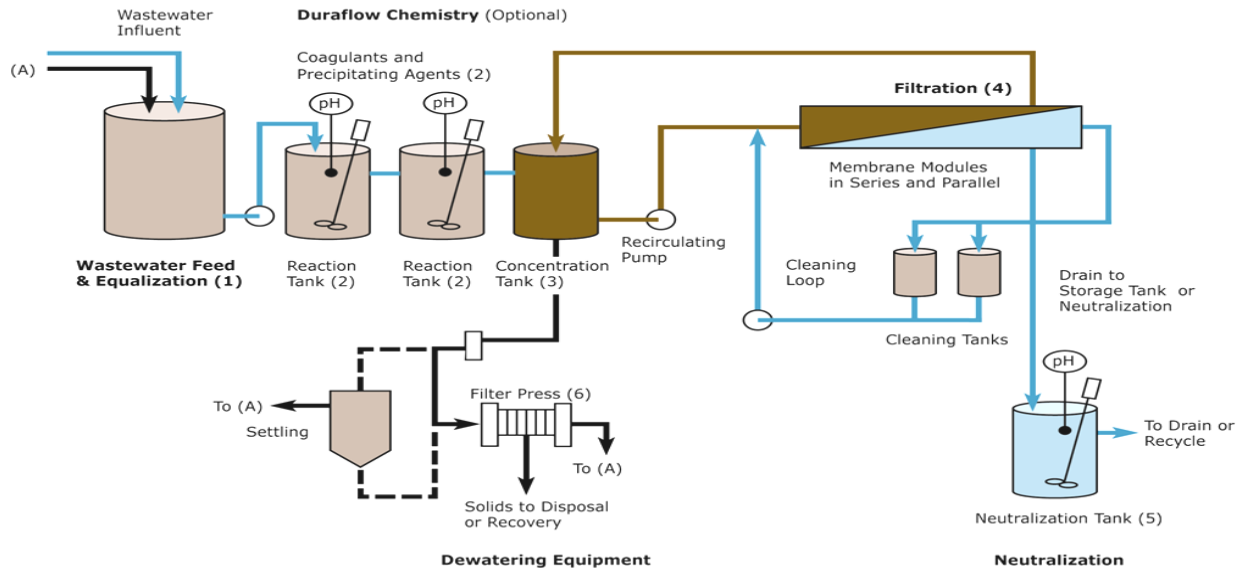
Chemical Pre-treatment - Based on the complexity of the wastewater, a chemical treatment process is developed to address each of the contaminants via bench-scale or pilot-scale tests. Contaminants such as those that foul RO membrane can be removed with proper pre-treatment. The chemical treatment may take the form of precipitation, adsorption, chemical reduction/oxidation, pH adjustment and microbial control. The chemical treatment is carried out in a two- or three- stage reaction, which will typically include one or more of the following processes:

Chemical Pre-treatment	
Chemicals	Targeted Contaminants & Functionality
Lime Softening	Hardness precipitation for scaling control
Magnesium Hydroxide	Silica colloid adsorption for fouling prevention
Sulfide/Dithiocarbamate (DTC)	Heavy metal precipitation and bio-growth control
Powdered Activated Carbon	Organic reduction and oxidant destruction
Cationic (Ca/Fe/Al) Coagulants	F, SO ₄ , PO ₄ precipitation and coagulation
Polymeric Coagulants	Suspended solid agglomeration for flux enhancement
Acid/Alkali	pH adjustment for optimum reactions

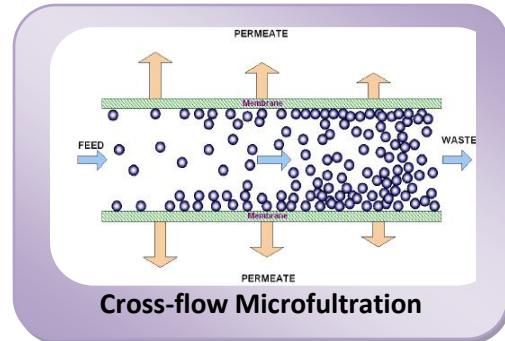
DFMF Process Operation - As depicted in Figure 1, after chemical reaction, the pre-treated wastewater is processed through the Duraflow microfiltration membrane filters designed for separation of the precipitates from water. The wastewater is pumped at a high velocity through the membrane modules connected in series. 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. An automatic low-pressure back-pulse mechanism is an integral part of the operation design to provide physical surface cleaning by periodically reversing the filtrate flow direction.

Figure 1 – Duraflow Membrane Filtration System Treatment Process Diagram

Duraflow Process Schematic

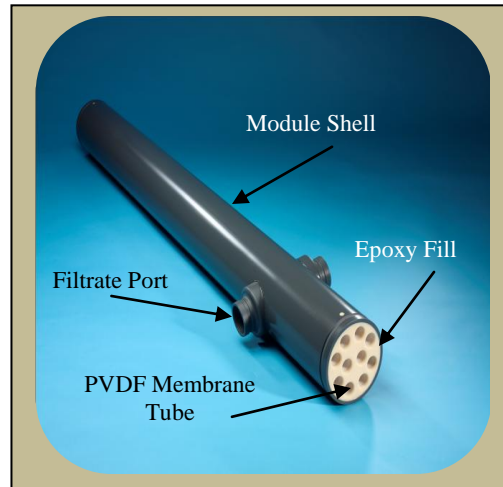


Operating Parameters System with 10-Tube Modules	
Flow configuration	Cross-flow
No. of modules per train (max)	Up to 18
Operating inlet pressure (max)	60 PSI (4.2 Kg/CM ²)
Operating temperature (max)	110°F (43°C)
Operating TSS in Conc. Tank	2 to 3 % (wt.)
Feed flow velocity	15 Ft/Sec (4.5 M/Sec)
Feed flow per train	350 GPM (80 M ³ /Hr)
Rated design flux (Typ.)	500 GFD (850 LMH)
Rated filtrate flow (application specific)	5 GPM (1.1 M ³ /Hr)
Back-pulse frequency/duration	20 Min / 10 Sec
Back-pulse volume/module	1.5 – 3.0 GPH (6 – 12 LPH)



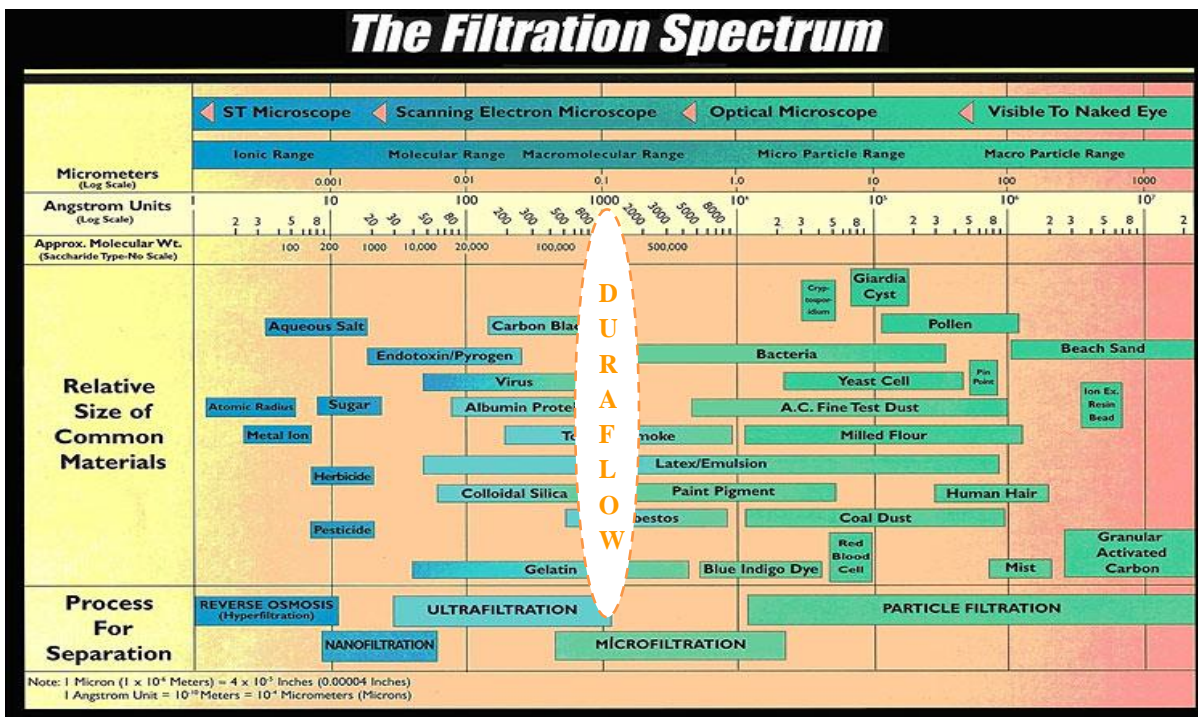
DF Microfiltration Module - Duraflow microfiltration membranes are manufactured in a tubular configuration capable of handling high solid concentration. The membranes, made of PVDF, are cast on the surface of porous polymeric tubes to produce a nominal pore size of 0.1 micron. Special features of the modules are summarized in the specifications chart below. Figure 2 presents a comparison of the DF microfiltration and other membrane filtration methodologies (UF, NF & RO) based on pore size rating. The 0.1 micron membrane is selected for the DF membrane to provide the fine filtration of UF and the higher flux performance of MF.

DF Membrane Module Specifications	
No. of tubes per module	4 or 10
Dimensions	4 –Tube: 4" (10 cm) dia. x 72" (183 cm) long 10 –Tube: 6" (15 cm) dia. x 72" (183 cm) long
Tube diameter	1" (2.5 cm)
Membrane area	
4 –Tube:	6 ft ² (0.56 M ²)
10 –Tube:	15 ft ² (1.40 M ²)
Shell construction	Schedule 40 PVC
Membrane material	PVDF
Nominal pore size	0.1 micron
Module Weight	
4 –Tube:	26 lbs (11.8 Kg)
10 –Tube:	40 lbs (18.2 Kg)



Model DF-415 10-Tube Module

Figure 2 – Membrane Filtration Spectrum



Membrane Cleaning - Membrane cleaning is a routine part of the system operation. In the filtration process, chemically pre-treated wastewater is re-circulated from the concentration tank through one or multiple trains of membrane modules. The interior surface of the membrane tubes will gradually be coated with inorganic and organic particles in the wastewater. As a consequence, the effective filtration area will be reduced and the filtrate flow or flux will decrease. Although effective chemical pretreatment can extend the time between cleanings, all systems will require cleaning eventually. The extraordinary chemical resistant property of PVDF allows the use of a wide range of chemicals – acids (H₂SO₄, HCl),

oxidizers (bleach, peroxide), and bases (caustic) for cleaning of the persistent fouling substances. CIP can be accomplished by circulating the cleaning solution through the modules or soaking the modules for an extended period for the more severe fouling condition.

DF Microfiltration System Engineering - Figure 3 illustrates typical design of the Duraflow microfiltration systems engineered as a stand-alone compact package for processing of chemically pre-treated wastewater. The basic package is a skid-mounted unit engineered to integrate all major components including the DF membrane modules, recirculation pump, clean-in-place (CIP) membrane cleaning equipment, back-pulse components, sludge transfer pump, instruments and controls. The filtration unit can be custom engineered with various sizes and configurations as shown to fit the available floor space in the plant.

Figure 3 – Duraflow Microfiltration Systems



DF Membrane Performance - With proper chemical pre-treatment and operation of the DFMF system, high filtrate quality as presented in the following chart can typically be achieved. However, these values may vary depending on treatment protocol and background chemistry of the raw water. Actual filtrate quality can be determined by pilot testing during the design phase. Consult with Duraflow for contaminants not included in the list.

Contaminant	Concentration (mg/L) in Filtrate	Contaminant	Concentration (mg/L) in Filtrate
Arsenic	<0.005	Mercury	<0.005
Cadmium	<0.005	Nickel	<0.05
Chromium	<0.05	NTU	<1.0
Copper	<0.005	RO Fouling	<3.0 SDI
Cyanide	<0.01	Silica (SiO ₂)	<15
Fluoride	<10.0	Silver	<0.01
Hardness (Tot.)	<60 (CaCO ₃)	Tin	<0.1
Iron	<0.02	TSS	<1.0
Lead	<0.05	Turbidity	<1.0 NTU
Manganese	<0.02	Zinc	<0.05