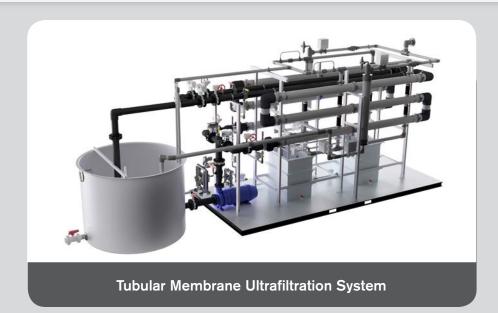
PROVEN TO REDUCE HAUL-AWAY COSTS UP TO 90%

Best Available Technology for Tertiary Filtration of Industrial Wastewater

Wastewater produced by industrial processes contaminated with solids, heavy metals, or oil and greases often require treatment prior to discharge or reuse. A treatment system using tubular membrane modules can significantly reduce solids and emulsified oil and greases, and in combination with chemical precipitation, provides excellent reduction of heavy metals (nickel, zinc, copper, lead, chromium, and more). Treated water (permeate or filtrate) is then ready for either disposal into existing municipal waste systems or further treatment for plant reuse/recycle. Tubular ultrafiltration is the best available technology for pretreatment before reverse osmosis systems, increasing recoveries for either process/wastewater recycling or pure water applications.



Features & Benefits:

- Best available technology for tertiary filtration and pretreatment for brackish water desalination
- System operates automatically, including cleaning sequence
- Modular package design minimizes site installation costs and allows for future capacity additions
- Separated control and high voltage circuits with single power disconnect

- Allen Bradley PLC & HMI
- 4-20 mA instruments on touch screen
- VFD motor starter
- Bank-by-bank cleaning manifolds and valves
- UF permeate flush on shutdown
- Automated air back-pulse allows high average membrane flux



REDUCE ENERGY USAGE AN AVERAGE OF 20%

Typical Permeate Quality

Contaminant	Influent (mg/L)	Membrane Permeate (mg/L)				
Oils Removal						
Oils & Grease	5,000 - 50,000 < 30					
COD/BOD¹	15,000 - 100,000 < 1500					
Metals Removal ²						
Cadmium - Cd	10 – 30	< 0.05				
Chrome - Cr	10 - 50	< 0.1				
Copper - Cu	20 - 130	< 0.1				
Iron - Fe	5 - 100 < 0.1					
Lead - Pb	1 - 15	< 0.1				
Nickel - Ni	5 - 75	< 0.1				
Zinc - Zn	5 - 130	< 0.1				
Fluoride - Fl	10-500	<5.0				
Solids - TSS	10 - 500	< 1.0				

¹ Dependent on influent water quality and source of COD/BOD

Tubular Membrane Filtration (TMF) System Operation

Inside a TMF Module

TMF modules utilize cross-flow filtration. They are composed of 1- or 1/2-inch polyethylene (PE) or polyvinyldene difluoride (PVDF) support tubes that have been coated on the inside with a PVDF material to form a filtration membrane. Next, several of the membrane-coated tubes are bundled into a larger housing to form a single TMF module.

About the TMF System

The TMF system is an excellent treatment system for many uses involving both waste and process water. Combined with proper chemical pretreatment, TMF systems will provide many years of efficient, trouble-free operation. High solids loading allowed by the rugged TMF modules results in a treatment system that surpasses many other types of membrane filtration systems.

TMF System Operation

A typical TMF system operates as follows:

- 1. Influent water flows by gravity from a chemical reaction system into the concentration tank of a TMF system.
- 2. This water is then pumped from the concentration tank through the TMF membrane modules for solids separation via cross-flow filtration, forming a slurry within the center of the membrane tubes.
- 3. The slurry is pumped at a high velocity through the center of the membrane tubes and returned back to the concentration tank.



² Pretreatment required

PRAB TUBULAR MEMBRANE FILTRATION TECHNOLOGIES DECREASE WATER COSTS OF UP TO 99%

Tubular Membrane Filtration System Operation (Continued)

- 4. The clear water, or permeate, passes through the membrane tubes and onto reuse or final processing.
- 5. The membranes are back-pulsed with air and clean (treated) water. Back pulse is used to force obstructions in the pores or on the membrane surface back into the slurry stream, resulting in greater average membrane flux rates.

TMF Process Concentration Tank

The purpose of the TMF concentration tank is to ensure that a consistent concentration of solids (between 2-5% slurry) is being pumped to and from the microfiltration or ultrafiltration membranes. The concentration tank is equipped with a level sensor that allows the ultrafilter feed pump to cycle on and off as the tank level varies.

TMF Solids Management

The solids are removed from the concentration tank by a pump. An air-operated positive displacement pump is used. Material is pumped from the concentration tank to a sludge settling tank. The sludge can then be removed from the solids settling tank to a filter press or other solids-handling method. The liquid from the sludge settling tank can be returned to the concentration tank. Occasionally, the operator will need to draw a sample from the concentration tank and do a simple settling test to determine if the sludge pump controls require field adjustment. Online TSS monitoring of the concentration tank is also available.

TMF Permeate Flow

TMF permeate is the water that has passed through the pores of the TMF membrane. It is continually monitored during system operation. If permeate flow drops below a predetermined rate, the TMF system will alert the operator that all or a portion of the modules (depending on module configuration) require chemical cleaning. Permeate from the modules flow under small pressure to the next stage in the treatment system, or to reuse or discharge.

TMF Modules and Chemical Cleaning

The TMF clean-in-place system contains a recirculation pump along with both a chemical cleaning tank and a fresh water tank. The chemical cleaning cycle may take several hours to complete. Cleaning chemicals are mixed in the chemical cleaning tank and are pumped into the membrane modules. The chemicals can be circulated in the modules or allowed to sit in the modules without circulation. Acid solutions are used to remove inorganic scale, while bleach or caustic solutions are used to remove organic materials. Once chemical cleaning has been completed, the TMF modules are flushed with fresh water prior to being placed back in service.

In the past 2 years PRAB has provided equipment saving customers nearly \$2.6 million annually by re-purposing their wastewater for reuse or sending to sewer.



REDUCE OILY WATER VOLUMES BY AS MUCH AS 98%

Tubular Ultrafiltration System Models:

6" Module - Tubular UF System Models						
		PWUF-10/12-1	PWUF-10/24-2	PWUF-10/36-3	PWUF-10/48-4	
Avg Permeate Flow Rate	[gpm] @ Design Flux	25	50	75	100	
		МЕМЕ	BRANES			
Design Flux [gal/ft²/day]		2	00		
Membrane Type		Tubular, PVDF Membrane, Cross-flow Ultrafiltration				
Diameter of membrane [in.]		1	1	1	1	
Membranes / Module		10	10	10	10	
Membrane Surface Area [ft²] / Module		15.2	15.2	15.2	15.2	
# of Modules		12	24	36	48	
# of Trains		1	2	3	4	
Membrane Mfg			Porex F	iltration		
		PROCESS	EQUIPMENT			
	Qty	1	1	1	2	
Combridge	Power [hp]	25	40	60	40	
Centrifugal Process Pump	Recirculation Flow Rate [gpm]	300	600	900	1200	
	Mfg	Gusher				
Process Tank	Qty	1	1	1	1	
	Volume [gal]	1000	1200	1800	2500	
Material		XLPE				
Flowrate		115 gpm at 80 psi				
Slurry AODD Pump	Mfg	Warren Rupp				
	^	CIP EQI	UIPMENT			
CID AODD Dumm	Flowrate	40 gpm at 80 psi				
CIP AODD Pump	Mfg	Warren Rupp				
	Qty	2	2	2	2	
Tanks	Volume [gal]	250	400	500	600	
	Material		P'	VC		
		ELEC	TRICAL			
PLC		Allen Bradley or Siemens				
Power		480/600 VAC, 3-phase, 60 Hz				
Control Circuit 120 VAC, Single phase 24 VDC						
		INSTALLATION & UTI	LITY REQUIREMENTS			
Skid L x W x H [ft.]		25 x 6 x 10	25 x 8 x 10	35 x 8 x 11.5	38 x 10 x 11.5	
Permeate Flange [in.]		3	3	4	4	
Concentrate Flange [in.]		1.5	1.5	2	2	
Power Drain Flange [in.]		1	1	1	1	
Air Supply Connection NPT [in.]		3/4	3/4	3/4	3/4	
Utility Water Inlet [in.]		2	2	2	2	





REDUCE WASTEWATER HAUL-AWAY COSTS UP TO 90%

Tubular Ultrafiltration System Models (Continued):

		6" Module - Tubula	ar UF System Models			
		PWUF-13/8-1	PWUF-13/16-2	PWUF-13/24-3	PWUF-13/32-4	
Avg Permeate Flow Rate	[gpm] @ Design Flux	22	44	66	88	
		MEMI	BRANES			
Design Flux [gal/ft²/day]		2	00		
Membrane Type		Tubular, PVDF Membrane, Cross-flow Ultrafiltration				
Diameter of membrane [in.]		1	1	1	1	
Membranes / Module		13	13	13	13	
Membrane Surface Area [ft²] / Module		19.8	19.8	19.8	19.8	
# of Modules		8	16	24	32	
# of Trains		1	2	3	4	
Membrane Mfg			Porex F	iltration		
		PROCESS	EQUIPMENT			
	Qty	1	1	2	2	
0	Power [hp]	30	60	50	60	
Centrifugal Process Pump	Recirculation Flow Rate [gpm]	375	750	1125	1500	
	Mfg	Gusher				
	Qty	1	1	1	1	
Process Tank	Volume [gal]	960	1200	2650	3050	
	Material	XLPE				
Slurry AODD Pump Flowrate Mfg		115 gpm at 80 psi				
		Warren Rupp				
		CIP EQ	UIPMENT			
Flowrate		40 gpm at 80 psi				
CIP AODD Pump	Mfg	Warren Rupp				
	Qty	2	2	2	2	
Tanks	Volume [gal]	250	400	500	600	
	Material	PVC				
		ELEC	TRICAL			
PLC		Allen Bradley or Siemens				
Power		480/600 VAC, 3-phase, 60 Hz				
Control	Circuit		120 VAC, Single	e phase 24 VDC		
		INSTALLATION & UT	ILITY REQUIREMENTS			
Skid L x W x H [ft.]		25 x 6 x 10	25 x 8 x 10	30 x 8 x 11.5	38 x 10 x 11.5	
Permeate Flange [in.]		3	3	4	4	
Concentrate Flange [in.]		1.5	1.5	2	2	
Power Drain Flange [in.]		1	1	1	1	
Air Supply Connection NPT [in.]		3/4	3/4	3/4	3/4	
Utility Water Inlet [in.]		2	2	2	2	



REDUCE ENERGY USAGE AN AVERAGE OF 20%

Available Options:

- Pre-treatment (coagulation, oxidation, pH adjustment)
- Clean-in-place chemicals
- Feed and/or permeate turbidity monitoring
- CIP neutralization
- Permeate storage tank
- Ethernet communication
- Allen Bradley or Siemens PLC

Lifecycle Services with Lifetime Support:

- Scheduled preventative maintenance services
- Operator training and resources
- Available remote monitoring
- Instrumentation calibration
- 24/7 technical support
- Upgrades to help you keep up with new technology

Construction Materials:

Piping	PVC Sch 80
Frame	Epoxy coated carbon steel
Enclosure	Nema 4
Clamps/Fittings	Zinc-plated





A true performance guarantee ensuring your PRAB equipment achieves the specific results it was designed and manufactured to deliver. And if you need technical support, call us. We are available 24/7.



