

# Membrane System Components RO & NF Systems

In order for TRISEP® reverse osmosis & nanofiltration elements to perform safely and efficiently, they must be installed in an appropriate operating environment with the correct components and controls. This guide reviews the various RO & NF membrane system components common to the membrane filtration industry.

## **PRETREATMENT COMPONENTS**

The pretreatment components necessary prior to an RO or NF system are highly site specific, based on the feed water quality. These can include coagulation, sedimentation, media filters, MF/UF membrane filtration, antiscalants, cartridge filters, etc. See **Pretreatment – Water Application RO & NF Elements** (TSG-C-011) for an overview of various pretreatment options.

## **MEMBRANE SKID FRAME**

Many different membrane skid frame materials are available, including Structural Fiberglass Reinforced Plastic (FRP), Stainless Steel, Steel, and Aluminum. Corrosion resistance is extremely important in order to keep maintenance at a minimum. RO & NF systems are intricate and therefore difficult to coat or paint after installation, so it is critical that corrosion resistant materials are chosen during initial design. The most corrosion resistant frame material is FRP, which requires virtually zero maintenance.

## **PRESSURE VESSELS**

Pressure vessels are available in various different lengths, fitting anywhere from 1 to 8 membrane elements. Material of construction is again critical; fiberglass is the most common and preferred material. Pressure ratings vary by material; fiberglass vessels can generally withstand pressure up to about 82.7 bar (1,200 psig). The selected pressure vessel should be chosen based on a pressure rating that accounts for changes in pressure with temperature changes, and allows for increased pressure over time in compensation for fouling. In many systems, normalized operating pressure may increase as much as 15% between cleanings.

Pressure vessels are available with either side feed/concentrate ports or end ports. Side ports are more commonly used because they allow vessels to be connected directly together, which reduces piping requirements and the footprint. Note that the static permeate backpressure should never exceed 0.35 bar (5 psi).

## **FEED PUMPS**

Multistage centrifugal pumps are the most common choice for the high-pressure feed pumps to a brackish water RO or NF system. Fixed speed motors on centrifugal pumps with throttling valves are common to the membrane industry, although variable frequency drives (VFDs) can be used to minimize power consumption and to control permeate flow. Control systems should be in place to ramp-up to operating pressure smoothly. If there is significant difference in feed temperature during different periods of operation, a VFD should be considered. Most brackish water applications should consider stainless steel for all wetted pump parts.

## **VALVES**

Valve selection will be site specific, and heavily depend on the operating pressure of the system. Each RO/NF system will need the following valves: a feed inlet valve, pump throttling valve, pump discharge check valve, permeate line check valve(s), atmospheric drain valve, concentrate line flow control valve, permeate drain valve for start-up and cleanings, and valves for connecting a CIP

skid. Butterfly valves are commonly used for the large process valves in the feed, permeate, and concentrate lines. Resilient-seat butterfly valves are typical in low-pressure piping, while high-performance butterfly valves are common to high-pressure piping. Globe or V-Port valves are used for throttling with modulation in high-pressure piping.

### INSTRUMENTATION & CONTROLS

Installation of the correct process instrumentation is critical for safe membrane operation. All instrumentation should be calibrated to the manufacturer's specifications, and re-calibrated on a long term schedule.

**Pressure** gauges should be installed on the high-pressure pump inlet and discharge side, the feed, concentrate, and permeate lines, and to measure the pressure drop across the membrane elements in each stage. Pressure switches should initiate shut down for low pump suction or high pump discharge pressure. Pressure relief should be switched on if permeate backpressure exceeds 0.35 bar (5 psi).

**Flow** gauges should be used to monitor the feed, concentrate, and permeate flowrates of each stage, along with the total feed, concentrate, and permeate flowrates. Most membrane systems are ran at constant flows. While magnetic flow meters are preferable to monitor the main process flows, paddlewheel flow meters can be used to save costs in smaller systems or for secondary type flow such as the cleaning flow rate.

**Conductivity** meters should be installed in the feed, concentrate, and permeate line. While, conductivity data can be used to track performance in real-time and schedule cleanings, samples should be taken regularly and analyzed more thoroughly to determine the TDS and constituent ions.

**pH** monitoring is critical in the feed line if acids or antiscalants are being fed to the system. pH meters have a finite lifetime and should be installed in areas with easy access for maintenance and replacement.

Oil detection, turbidity control, and oxidation reduction potential monitoring should also take place in the feed line to prevent damage to the membrane elements. Sampling ports should be installed in the feed, concentrate, and permeate lines, as well as in the permeate line directly following each pressure vessel.

### CIP SYSTEM

CIP systems are generally comprised of a cleaning tank, separate pump, cartridge filter, flow meters, and valves. Ports should be installed in the main RO/NF system to allow for easy connection of the CIP skid. For more details on CIP cleaning for RO and NF systems, see **Membrane Cleaning Guide - Water Application Elements** (TSG-C-001).

## Contact

#### Europe

Germany: +49 611 962 6001  
Italy: +39 0721 1796201  
info@microdyn-nadir.com

#### Americas

USA: +1 805 964 8003  
sales.mnus@microdyn-nadir.com

#### Asia

Singapore: +65 6457 7533  
China: +86 10 8413 9860  
waterchina@mann-hummel.com