# Recommendations for Water Purification

The following are operating recommendations for Membrania® elements used in water purification. It is the user's responsibility to determine the appropriateness of Membrania products for the user's specific end uses. For questions or additional information, please contact DC Solutions Technical Service.

**BIOLOGICAL MATTER**

Biological activity inside the element must be controlled during operation so that system water quality and quantity are not affected.

**CHLORINE/BROMINE**

If the normalized performance is unsatisfactory, it is important to check the following:

- DC Solutions recommends that the total free chlorine and bromine content of water entering thin-film composite element(s) be non-detectable.
- Total free chlorine tolerance for Membrania thin-film composite membranes is in the range of 1000 – 2000 ppm-hrs, when exposed at concentrations less than 1 ppm.
- The total free chlorine and bromine content of all water entering cellulose acetate (CA), polyethersulfone (PES) and polyvinylidene fluoride (PVDF) ultrafiltration (UF) and microfiltration (MF) element(s) is recommended to be <1.0 mg/L.
- The presence of iron and other transition metals, such as ferric hydroxide, may reduce the oxidation tolerance substantially of all membranes. Elevated temperatures will also reduce the oxidation tolerance of all membranes.

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## MISCELLANEOUS CHEMICALS

• Prevent chemicals which form a water-immiscible phase in the feed or concentrate from entering the element.
• Avoid use of cationic, anionic, or non-ionic polyelectrolytic compounds in elements.
• Keep all water entering the element free of strong oxidants such as $O_3$ and $KMnO_4$.
• Use caution when using hydrogen peroxide/peracetic acid sanitization solutions. Refer to **Membrane Disinfection Guide – Hydrogen Peroxide/Peracetic Acid Mixtures** (TSG-C-006) and consult the cleaning chemical supplier's instructions.
• Be sure that impurities present in chemicals added to the feed water do not affect element performance.
• Membrane damage caused by chemical compounds (e.g. surfactants, solvents, soluble oils, free oils, lipids, and high molecular weight natural polymers) shall nullify and void the warranty. Use with caution.

## SOLUBILITY LIMITS

• The Langelier Saturation Index (LSI) of the brackish water concentrate stream should be negative to prevent scaling.
• The LSI may be positive if an antiscalant is being used to combat scaling. When an antiscalant is used, flushing the system within 15 minutes after shutdown is recommended to remove the supersaturated salt solutions.

## SUSPENDED SOLIDS

The recommended feed turbidity is <1.0 NTU for all elements. Operation at turbidities higher than 1.0 NTU may require more frequent membrane cleanings and may reduce membrane life.

## SILT DENSITY INDEX

The Silt Density Index (SDI) value of the feed water entering a system correlates fairly well with the amount of fouling material present. Table 1 below lists recommended SDI values for different feed waters.

## SYSTEM DESIGN: TARGET FLUX

The fouling tendency of the feed water has the greatest influence on system design. Membrane fouling is caused by particles and colloidal material present in the feed water and are concentrated at the membrane surface. Fouling increases at the membrane surface with increasing flux (permeate flow rate per unit membrane area) and increasing element recovery (ratio of permeate flow rate to feed flow rate for a single element). Higher flux rates could lead to higher fouling rates and more frequent chemical cleanings.

A membrane system should be designed such that each element of the system operates within a frame of recommended operating conditions to minimize the fouling rate and to avoid mechanical damage. These element operating conditions are limited by the maximum recovery, maximum permeate flow rate, minimum concentrate flow rate and the maximum feed flow rate per element. The higher the fouling tendency of the feed water, the stricter the limits of these parameters become.

The target flux of a system is a useful number to quickly estimate the required number of elements for a project. Systems operating on high quality feed waters are typically designed at high flux values whereas systems operating on poor quality feed waters are designed at low flux values. However, systems can be designed with higher or lower flux values depending on capital or operational expenses. A continuous process designed around these considerations will show stable performance with no more than about four cleanings per year in standard applications. Exceeding the recommended limits may result in more frequent cleanings, reduced capacity, increased feed pressure and reduced membrane life. Table 1 lists the typical ranges of flux values for the majority of systems.

### TABLE 1. DESIGN RECOMMENDATIONS FOR RO ELEMENTS.

| Feed Source | RO Permeate | Well Water | Softened Municipal | Surface | Wastewater (filtered tertiary effluent) |
|---|---|---|---|---|---|
| Feed Silt Density Index (SDI) | < 1 | < 3 | < 3 | < 5 | < 3 |
| Typical Target Flux Lmh (gfd) | 37 (22) | 26 - 31 (15 - 18) | 27 - 31 (16 - 18) | 20 - 24 (12 - 14) | 17 - 22 (10 - 13) |
| Maximum Element Recovery % | 30 | 19 | 17 | 15 | 14 |

## OPERATING CONDITIONS: FLOW RATES

- Membrania® product specification sheets list the permeate flows (gpd) for each element, however Table 2 lists the recommended flow rates per pressure vessel for 4, 8, and 8.5 inch diameter elements:

**TABLE 2. RECOMMENDED FLOW RATES PER PRESSURE VESSEL FOR 4", 8", AND 8.5" ELEMENTS.**

| Model | Minimum Concentrate $m^3/h$ (gpm) | Maximum Feed $m^3/h$ (gpm) |
|---|---|---|
| 4" | 1.1 (50) | 4.5 (20.0) |
| 8" | 4.5 (20.0) | 18.2 (80.0) |
| 8.5" | 4.5 (20.0) | 19.3 (85.0) |

- For cleaner streams, systems may be successfully operated at lower concentrate flow. For streams that are more prone to fouling or scaling, systems may be successfully operated at higher concentrate flow.

## OPERATING CONDITIONS

Although the Membrania® product specification sheets list the maximum operating pressures and temperatures, it is recommended to keep the following in mind when operating a membrane system:

- The product pressure must never exceed the feed or concentrate pressure.
- For operation outside the limits listed on the product specification sheet, consult DC Solutions.

## FLUSHING

- Flush water must be of good quality and of low TDS (<2000 ppm). See Table 3 below.
- The product side must be open to atmosphere when flushing or adding water to the element.
- When scale inhibitor is used, the element must be flushed at shutdown within 15 minutes to remove antiscalant and the supersaturated salt solution.

**TABLE 3. WATER QUALITY RECOMMENDATIONS.**

| Solute | Recommended Limit |
|---|---|
| Iron (Fe) | < 0.05 mg/L |
| Manganese (Mn) | < 0.02 mg/L |
| Aluminum (Al) | < 0.05 mg/L |
| Silica ($SiO_2$) | < 5.0 mg/L |
| Total Hardness as $CaCO_3$ | < 50 mg/L as $CaCO_3$ |
| Total Alkalinity as $CaCO_3$ | < 50 mg/L as $CaCO_3$ |
| Chlorine | 0 mg/L |
| Turbidity | < 0.5 NTU |
| Silt | < 1 SDI |

**SHIPPING, HANDLING, & STORAGE**

- When not in operation, the membrane must be kept saturated with good quality feed water (see above Water Quality ) and having a low TDS (< 2000 ppm) at all times.
- The as-shipped elements must be kept sealed in their original oxygen-barrier bags, in a cool, dry place, out of direct sunlight, until required for installation.
- Please see DC Solutions' **Element Storage Guide – Storage for Offline Elements** and **Element Storage Guide – Storage & Re-wetting** (TSG-O-009 and TSG-O-010) for more detailed recommendations.

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