*By **Ben Movahed**, PE, BCEE*

If you have a tip or a suggestion for a future design article, please contact
Ben Movahed
(240) 780-7676 | movahed@watek.com

Material Selection for **MEMBRANE FACILITIES**

It is well-known that since Seawater RO systems are in a harsher environment, they require closer attention. However, material concerns and corrosion issues also apply to brackish water RO as well as low pressure membrane plants (MF/UF/MBR). Proper material selection in a membrane plant is one of the major design factors impacting the life expectancy, ease of operation and maintenance, and, in some cases, even the performance and water quality of the membrane system.

Corrosion is one of the typical problems in membrane filtration and desalination plants. Corrosion can cause a variety of undesirable consequences such as: loss of equipment integrity; unplanned shutdowns; expensive repairs; leaks and contamination of product water; and, potentially, personal safety issues. Seawater plants are more prone to corrosion due to their relatively aggressive environments consisting of seawater, seawater-air, salt-air aerosols, corrosive gases and very-fast or slow-moving liquids. Pitting (localized), crevice (oxygen/chloride), galvanic (contact between dissimilar metals) and contact (carbon particles on surface of stainless steel) are the most common types of corrosion in membrane plants.

Corrosion of steel material is a complex process and depends on many factors, such as concentration of chlorides, pH and chemistry of the liquid, fluid velocity and stagnation, water temperature, methods of welding, machining stainless steel components, and more.

In certain cases, Microbiologically Influenced Corrosion (MIC) may also occur. Corrosion resistant materials, such as stainless steels, can be impacted indirectly by the presence of certain microbes. What makes MIC unique is that microorganisms can actually transform certain chemical species, normally present in the water, into other more aggressive forms that would not otherwise be present.

Generally, the higher Chromium, Molybdenum and Nitrogen concentrations in steel offer better corrosion resistance. In addition to selecting the proper type of stainless steel, methods used for machining, welding procedures, polishing and final cleaning also play important roles. Typically, corrosion starts at the welds—the "weak points"—before they are seen in other parts of the pipe or equipment.

Follow these simple corrosion protection guidelines, when designing a membrane plant. For complex situations, make sure you have a corrosion engineer on your team:

- Use the proper stainless steel pipe, pumps, valves and housing materials for the application. Typically, 304/316 for low pressure membranes, 316L or duplex for brackish waters, and special alloys for seawater (AL6XN, 254 SMO, Hastelloy C, or similar). For brackish waters with high temperature and chlorides, special alloys may be required.
- Use non-metallic piping and components such as PVC, FRP, HDPE or other composite materials for low pressure applications as much as possible.
- Have a tight specification and control of material preparation, welding and finishing procedures, and enforce it.
- Require passivation and pickling of stainless steel material in corrosive environments to remove all carbon contamination particles.
- Install equipment indoors in a controlled environment, especially near the shore if salt-air aerosols are a concern. Make sure they are protected from the sun, with properly designed ventilation and air filtration systems.
- Avoid metal/metal contacts unless the materials are exactly the same. Use rubber, neoprene or other non-metallic isolation between dissimilar metals. As an example, 316 stainless steel U-bolt on a duplex pipe without a liner will create significant corrosion if salt dust and moisture (condensation) are present.
- Use the best marine grade epoxy coating available. And remember, those cuts and drilled holes made after a nice shop coating will be the weakest point and corrosion will show up before you expect it! ■