TriSep's New Membrane Concepts

By Evan Calkins, Sales Engineer, TriSep Corporation

The first practical reverse osmosis (RO) membrane was invented in 1959 by Loeb and Sourirajan at the University of California, Los Angeles. Fifty-four years later, there are seven major manufacturers of RO membranes in the world, even more that make their own NF/UF membranes, and numerous other companies that buy membrane sheet for the purpose of fabricating commodity-type membrane elements. Even after the emergence of so many different players over half a century, there are few companies offering a diverse line of membrane chemistries that are committed to providing value-added products based on application-specific requirements.

TriSep's proprietary membrane and element technologies and ability to customize are exactly what make them the Specialty Membrane Company. TriSep™ membranes are used in a variety of applications, from sugar and protein processing to treatment of industrial and municipal water and wastewater. As a company, TriSep focuses on markets and applications wherein clients may derive the most value. Often that requires utilizing customization capabilities to make products that other companies can't.

The six main components in a spiral-wound element are the membrane, feed spacer, permeate carrier, permeate tube, outer wrap and, in some cases, anti-telescoping devices (ATDs). TriSep has the ability to use custom materials, sizes and geometries for each of these components to meet the needs of a particular application. Wider feed spacers are often used in process applications to manage pressure drop or account for high viscosity. Custom permeate tubes (length, diameter, male versus female) and element dimensions allow TriSep to match the specifications of other manufacturers' products, which comes in particularly useful when a customer requires a direct replacement to a product that has been discontinued.

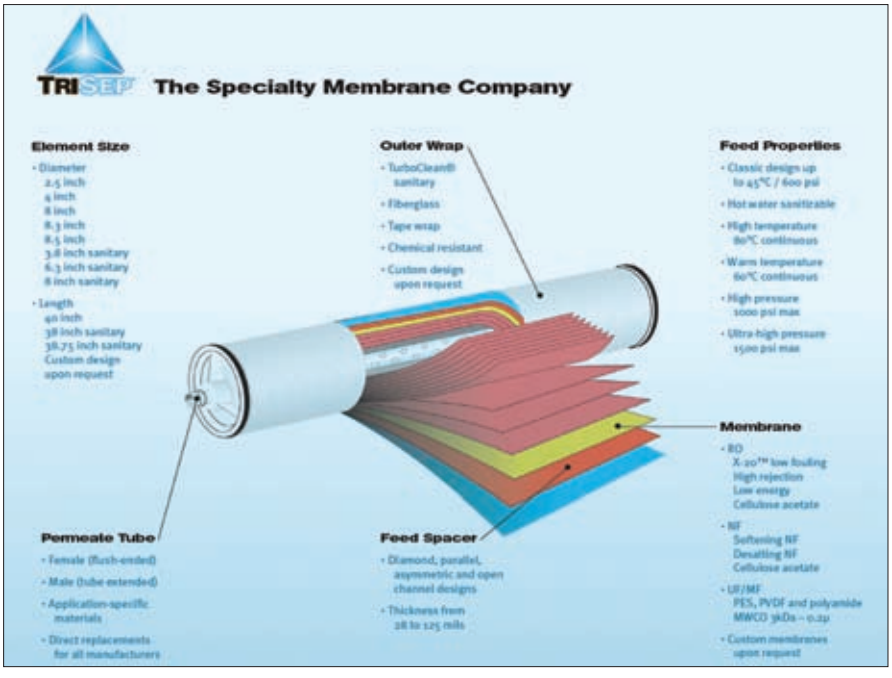

Figure 1: TriSep element design capabilities

A relatively new offering for TriSep is a line of high temperature elements for both continuous operation and periodic sanitization. Continuous high temperature operation, up to 80°C, is advantageous because it allows plants to control potential microbiological issues within their system, operate at lower pressure, or save on costs related to cooling and heat exchangers. When operating at high temperature, it is important to consider the combined effect of temperature, feed pressure and pressure differential. At high temperature, there is greater potential for the membrane to be forced or "intruded" into the permeate carrier under high feed pressure, thus causing an irreversible flow loss. Moreover, at high temperature and high differential pressure, the membrane and feed spacer are more likely to "extrude" down the element in the direction of flow, in some cases causing catastrophic failure. TriSep has developed special manufacturing methods to limit the effects of intrusion and extrusion under such operating conditions.

Another concept that has gained popularity in recent years is the use of hard shell elements in sanitary applications. Up until several years ago,

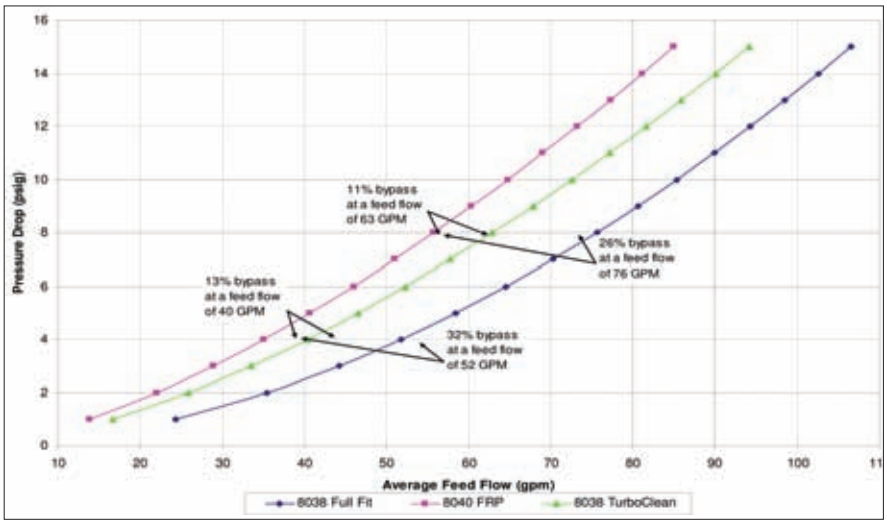

Figure 2: Pressure drop profiles for 8 inch elements

Figure 3: TurboClean versus full-fit outer wrap

the only sanitary elements used in food and dairy, pharmaceutical, and high purity applications were made with a net or open cage outer wrap. Sanitary elements are useful because they allow for bypass flow around the element to eliminate stagnant areas where biogrowth can occur, but unfortunately these designs typically allow 30-40% of the feed flow to bypass around the membrane itself wasting energy and reducing cross-flow velocity. TurboClean® sanitary hard shell elements have a controlled diameter which limits element bypass to 10-12%. The benefit of reduced bypass flow can be realized through improved performance due to higher cross flow velocity or, conversely, less energy consumption due to lower recirculation requirements.

The best way to compare the effects of reduced bypass is to examine

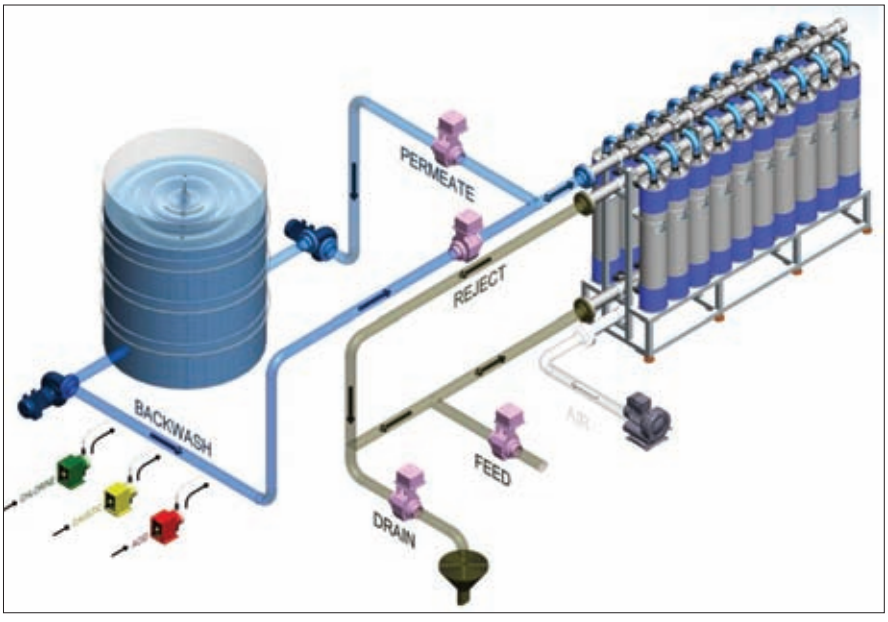

Figure 4: iSep UF Process Flow

Figure 5: iSep UF flow channels

pressure drop as a function of feed flow. For a given element diameter and feed spacer design, pressure drop is directly proportional to the cross flow velocity through the element feed channels. As seen in Figure 2, the pressure drop profile for an eight-inch diameter TurboClean element is actually closer to that of a standard element than it is to a net-wrapped (or full-fit) element.

The TurboClean shell also provides a noticeable rigidity to spiral wound elements, virtually eliminating the occurrence of "smiles" or "channeling" within the element, a common method of failure in food and dairy. Moreover, operators prefer TurboClean elements because their ease of installation and handling saves time during membrane changes.

TriSep's most unique concept when it comes to spiral-wound element design is the back-washable *i*Sep™ UF membrane. *i*Sep is the first skid mounted, submerged UF format on the market that is specifically designed to treat high fouling water and wastewater streams. Unlike conventional cross-flow configurations, water is "pulled" through the *i*Sep UF membrane using about 3 to 5 psi of vacuum pressure. Simultaneously, air is bubbled up through the element feed channels, actively scouring the surface of the membrane. As solids accumulate and trans-membrane pressure increases, the membrane backwash cycle is initiated to

remove particulate matter from the UF membrane surface. If necessary, a chemically enhanced backwash (CEB) can be performed by dosing chlorine, caustic, or acid to help remove organic or inorganic foulants.

In addition to being vacuum driven and back-washable, iSep modules utilize a 90 mil corrugated feed spacer in order to handle TSS levels of up to 1000 ppm in the feed. Moreover, due to their relatively small hold up volume, iSep modules can be drained frequently to help manage solids accumulation.

From river water pre-treatment for RO to MBR peak flow management, the high suspended solids capability of *i*Sep allows it to be used in a wide variety of applications. In MBR peak flow management, *i*Sep is used as a side stream system to remove TSS and pathogens from screened, raw municipal wastewater during peak flow events. Although raw municipal wastewater is one of the most difficult waste streams to directly treat due to high TSS and organic levels, *i*Sep performance is seamless. *i*Sep UF is ideal for river water pre-treatment due to its capability of handling seasonal variations in water quality. When a pressurized hollow fiber (PHF) UF system might be forced to shut down or run at lower flux rates during a storm event, *i*Sep will power through the event without compromising on effluent quality. From a system design standpoint, original equipment manufacturers (OEMs) benefit because *i*Sep does not require extensive pretreatment.

Another issue with PHF membranes is the mechanical integrity of the membrane itself. The rigid spiral-wound design of *i*Sep eliminates this issue by holding the membrane in place such that zero stress is placed on the membrane; there is no membrane breakage as regularly occurs with hollow fibers. For this reason, *i*Sep UF provides excellent pretreatment to reverse osmosis.

TriSep is constantly working to develop the next *i*Sep or TurboClean in order to help solve the world's most challenging water and wastewater problems. The company encourages clients to come with projects or ideas that might seem difficult or even impossible. TriSep engineers have an extensive knowledge base of membrane element and system design, application know-how, and troubleshooting solutions. If they don't have the right products or expertise to solve your problem, they will do their best to direct you to someone who can.

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