Spiral-Wound Elements Construction & Advantages

TRISEP® membranes are rolled into a spiral-wound configuration to form elements. This bulletin illustrates what constitutes a spiral-wound element and how they are constructed.

INTRODUCTION

Spiral-wound elements offer many advantages compared to other designs including tubular, plate and frame and hollow fiber. Typically, a spiral-wound configuration offers significantly lower replacement costs, simpler plumbing systems, easier maintenance, the highest membrane-packing density with the smallest footprint and greater design freedom than other configurations.

CONSTRUCTION

Spiral-wound elements are made from layers of flat sheet membrane, feed spacer, permeate carrier and a single perforated permeate tube. TRISEP elements are constructed based on their intended use. Depending on the application, feed water quality and operating parameters, the element is constructed using multiple membrane leaves, a specified feed spacer thickness and geometry, a chosen permeate carrier and is wrapped in either tape, fiberglass or a TurboClean® shell.

First, a sheet of membrane is laid out and folded in half with the membrane facing inward (and the substrate facing outward). A sheet of feed spacer is then put in-between the folded sheet of membrane as shown in Figure 1 below. This forms a "membrane-feed spacer-membrane sandwich". The purpose of the feed spacer is to provide enough room for water to flow uniformly between the membrane surfaces. Different feed spacer thicknesses, materials and geometries are available for unique feed viscosities and applications.

The permeate carrier is then attached to the permeate tube (which collects the permeate). Next, the "membrane-feed spacer-membrane sandwich" is glued on three sides forming an envelope, open to the permeate tube to allow permeate water to flow. This gluing process is repeated until all of the required permeate carriers have been attached to folded sheets of membrane to form multiple membrane envelopes.

As illustrated in Figure 1, the membrane envelopes create a combination comprised of two sheets of membrane glued together back-to-back with a sheet of permeate carrier in-between. This combination is referred to as a membrane leaf.

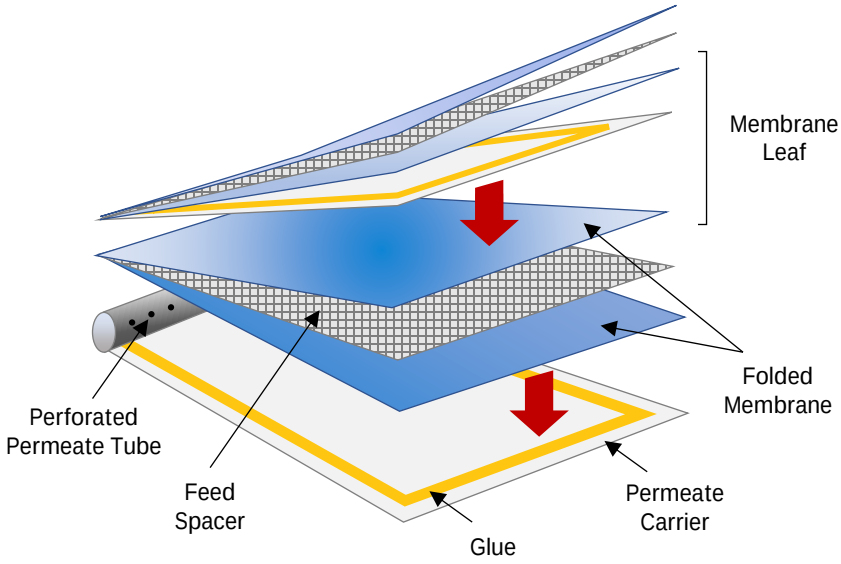

Figure 1. Membrane leaves separated by feed spacers.

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Figure 2A illustrates a cross-section of a membrane element and the direction of flows. Feed water (shown in green) travels through the channels of the feed spacer, tangentially across the length of the element. The water that passes through the membrane becomes permeate (shown in blue) and travels through the permeate carrier and into the perforated permeate tube where permeate is collected. The untreated water exits the end of the element and is known as the concentrate (also referred to as retentate, reject or brine) stream.

Once all folded membrane has been glued into membrane envelopes, the finished membrane layers are then tightly wrapped around the permeate tube creating the spiral shape shown in Figure 2B.

After the membrane layers are completely wound around the permeate tube, an outerwrap is applied to the outside of the element (Figure 2C). Depending on the application, elements can be wrapped in fiberglass, tape, or sanitary-style outerwrap materials to keep the membrane leaves in their spiral-wound configuration.

ADVANTAGES

TRISEP® spiral-wound elements are available in a multitude of configurations with different feed spacer geometries and thicknesses; various permeate carrier thicknesses and materials; over 25 different membranes and chemistries; fiberglass, tape or TurboClean® shell outerwraps; and a wide range of element lengths and diameters that allow them to fit multiple applications.

Spiral-wound elements have a very high packing density, offering a small footprint and greater design freedom than other membrane configurations. Spiral-wound elements also offer lower replacement costs, simpler operating systems and easier maintenance due to cleaning in place (CIP) systems.

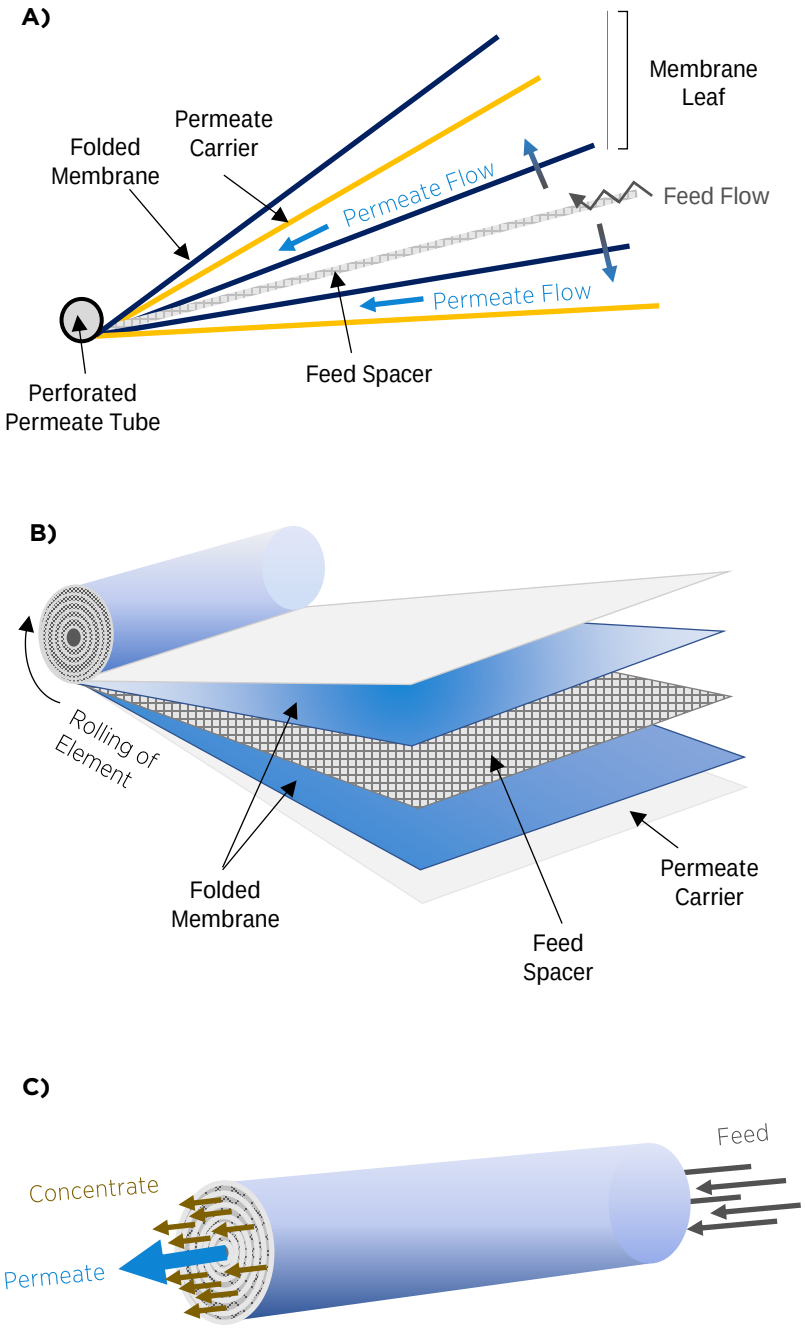

Figure 2. A) Cross-section of a membrane leaf. **B)** The finished membrane leaves are wrapped around the permeate tube ultimately creating a spiral-wound element. **C)** Finished spiral-wound element.

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