

ESPA+

Hydranautics Energy Saving Membrane



Introduction

When high productivity from a membrane element is important, the ESPA family of products is the choice. ESPA (Energy Saving PolyAmide) membranes achieve high flux without compromising standards for high rejection. Since its introduction in the late 1990s, the ESPA membrane has gained wide acceptance in the water treatment industry due to the significant operational cost savings associated with their use. Lower pressure means lower energy costs and less expensive pumps, piping, and vessels. This economic advantage has fueled the widespread acceptance of ESPA membrane elements. The success of the ESPA series has driven Hydranautics to further enhance its ESPA product line by further improving the ESPA2 with the introduction of the ESPA2+.

Description

The original ESPA breakthrough came in 1998, which allowed a membrane element to deliver more flow than a comparably sized CPA element, but at 66% of the standard test pressure. Moreover, the standard of quality for salt rejection was not compromised. The highest rejecting ESPA membrane, the ESPA2, achieved a nominal salt rejection of 99.6%. With the introduction of ESPA4 in 2001, further progress was made using ESPA technology. While maintaining a high rejection of 99.2%, ESPA4 achieved the highest permeability of the ESPA series with a standard test flow of 12,000 gpd at only 100 psi.

Pushing the envelope further, Hydranautics released the ESPA2+ in 2005. This element uses the same high rejection membrane as the standard ESPA2, but takes advantage of improved element design and automated manufacturing to increase the element's area which leads to lower pressures and/or fewer elements per Train. A summary of the various ESPA products is found in **Table 1** below.

Membrane	Test Pres. psi	Flow gpd	NaCl Red %	Area Sq. ft.
ESPA2	150	9000	99.6	400
ESPA3	150	14000	98.5	400
ESPA4	100	12000	99.2	400
ESPA2+	150	12000	99.6	440

Table 1. Comparison of ESPA membranes at standard test conditions of 150 psi, T = 25 C, pH = 7 treating a 1500 ppm NaCl feed.

Applications

ESPA membrane is suited for many brackish applications including: municipal drinking and waste water plants, bottling operations, and light industrial uses. ESPA elements are routinely specified in brackish applications when flow is the critically desired performance attribute.

ESPA elements have a high degree of utility in applications where energy is relatively expensive or where cold water temperature and/or high TDS combine to cause high pressure requirements. For these systems, pay-back related to energy savings alone may approach \$200/element per year when ESPA elements are used instead of standard composite membranes.

ESPA2 is suited for applications with high or low salinity brackish waters when low pressure and very high rejection is required. ESPA3 is ideal for systems with low salinity feedwater (under 1000 ppm TDS) where very low feed pressures are needed along with good permeate quality. Very low pressures can be achieved with ESPA4 on medium salinity waters (1000 – 3000 ppm TDS). ESPA4 is also ideal for targeting the removal of specific contaminants such as arsenic or nitrate.

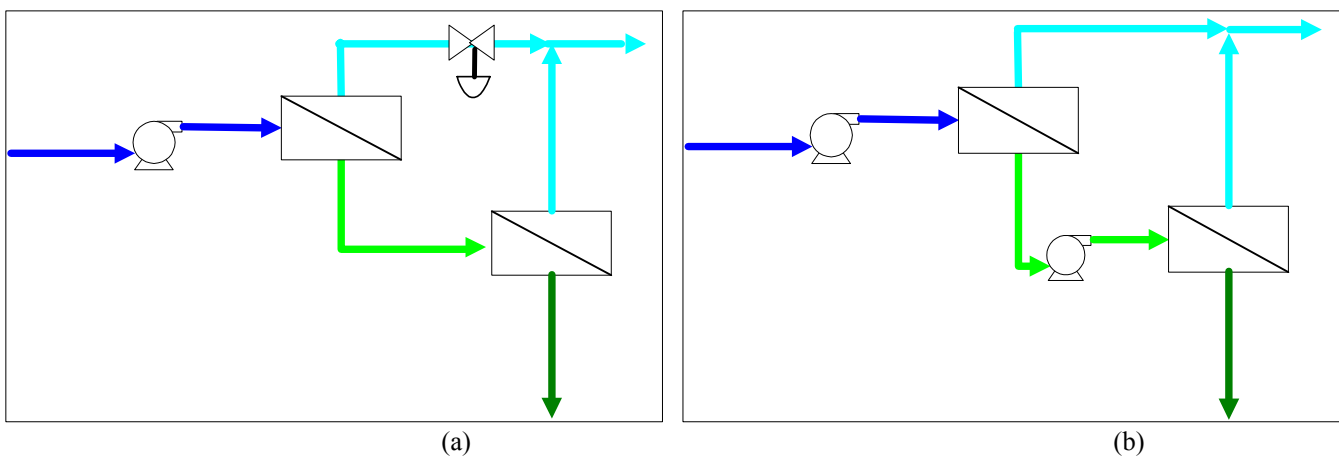
Like ESPA2, the ESPA2+ can be used on high or low salinity brackish streams when the highest rejection is required. The higher area of 440 square feet in the ESPA2+ translates into either capital savings or operational savings depending on the specific system design. For example, if an RO system is designed using the same number of ESPA2+ elements as ESPA2 elements, the increased area per element will lead to lower pressures and a lower rate of fouling which in turn leads to lower operating cost. If, however, capital cost savings is preferable, fewer ESPA2+ elements can be used in

an RO system to achieve the same flux as a system designed with more ESPA2's. Fewer elements, less pressure vessels, and less piping translate into additional capital savings.

Design Considerations

When designing a system with ESPA membranes, the high permeability of the elements can result in high flux rates in the lead elements, leading to poorly distributed flows in a system. The imbalance can be easily corrected however, with the use of either first stage permeate backpressure or an interstage booster. The application of backpressure to the first stage limits Net Driving Pressure (NDP) in that stage, and thus reduces output. Alternatively, the addition of an interstage booster increases flow and pressure to the second stage, resulting in more flow from that stage. In both cases, flow distribution is improved, resulting in more efficient operation. A proposed flow distribution for a 2-stage system running at 75% recovery is approximately 75% flow from the first stage and 25% from the second stage.

The following two-flow diagrams show permeate throttling and the use of an interstage booster pump. Generally, the use of permeate throttling on the first stage is done with lower pressures; as more and more permeate backpressure is required, it is preferable to employ the booster pump for more efficient operation.



Two Stage RO System with (a) Permeate Throttling Valve After First Stage (b) Booster Pump Before Last Stage.

For additional information about Hydranautics' ESPA2+ membrane products, please contact your sales representative or visit us online at www.membranes.com or call us at 1-800-CPA-PURE or 760-901-2500.