Unique Design Features of Omexell™ Spiral wound Electrodeionization Technology

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Introduction

Electrodeionization (EDI) technology continues to be increasingly preferred over polishing mixed beds for the final deionization process in high purity water systems. While the majority of EDI components employed today are first generation plate and frame designs, many newer EDI designs have incorporated the next generation, spiral wound EDI technology, into their systems.

The rapid growth of spiral wound EDI modules has occurred primarily at new, state of the art manufacturing, semi-conductor, pharmaceutical and power plants in the Asia Pacific Region. Spiral wound EDI modules represent noteworthy improvements over plate and frame configurations in that they provide leak-free operation, simple system integration and low maintenance designs.

Spiral wound EDI Process

EDI processes use a combination of ion-selective membranes and resins placed between two electrodes under a direct current voltage to remove ions from reverse osmosis (RO) permeate water. Spiral wound OMEXELL™ EDI modules consist of a series of thin chambers that alternately contain mixed resin for water purification and a concentrate water flow to carry away impurities (Figure 1).

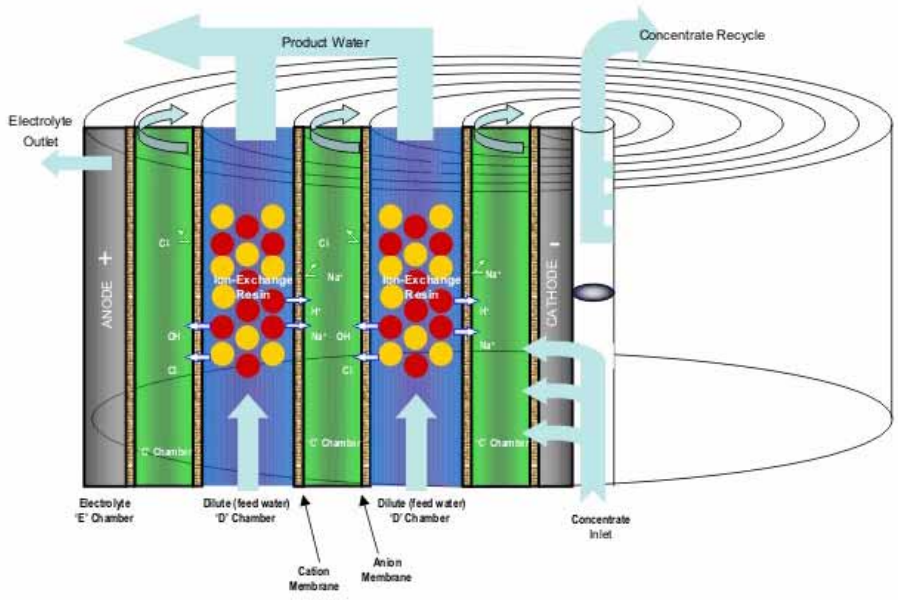


Figure 1: Spiral Wound Electrodeionization device

The DC current also splits water molecules into hydrogen and hydroxide ions that allows a portion of the resins in the EDI to always be in the fully regenerated state.

The spiral wound EDI modules are similar to that of RO membranes in that the membranes and spacers are rolled to form a cylindrical element (Figure 2).

The element is placed into a fiber glass pressure vessel and the dilute chamber spacers are filled with resin. The unit is then sealed inside the pressure vessel. As a result the modules are truly leak free and not susceptible to salt bridging (electrical shorts caused by salt buildup on the outside of plate and frame modules). A central stainless steel fitting acts as the cathode and the concentrate distributor and collector. A titanium shell lines the inside of the fiber glass pressure vessel and serves as the anode.

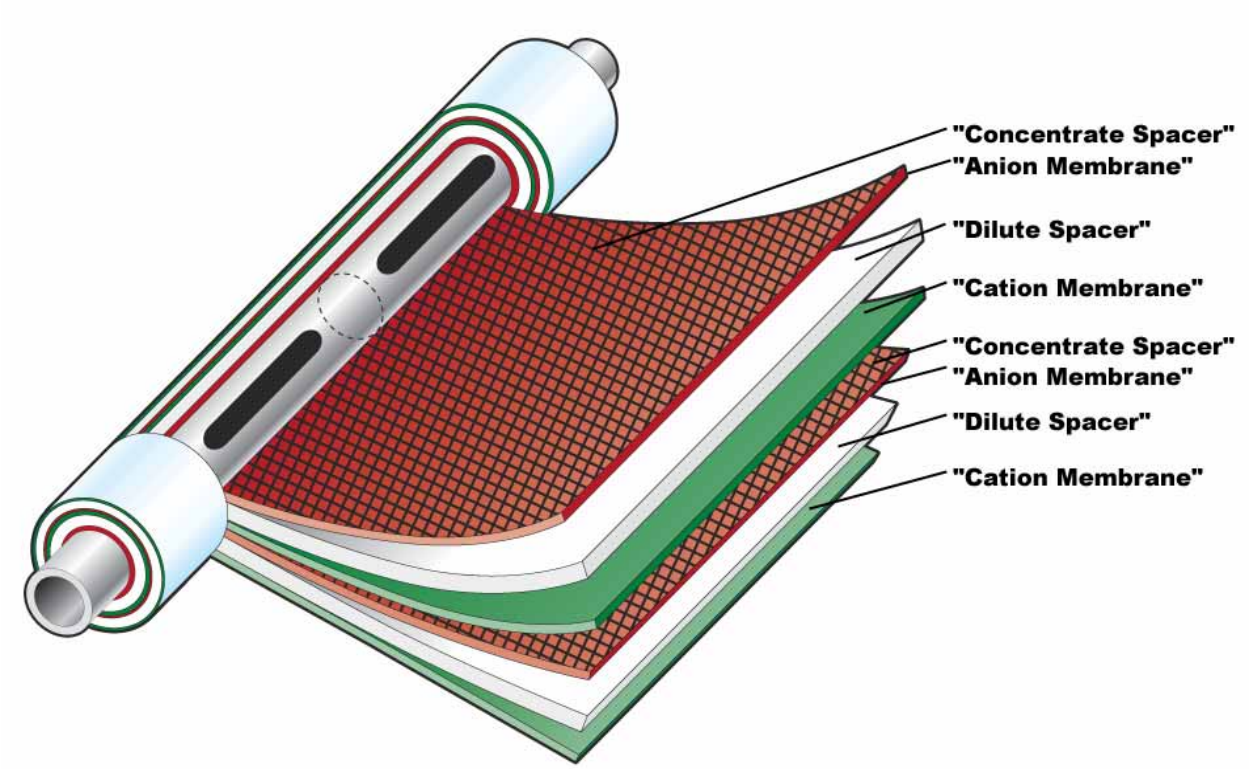


Figure 2: Spiral wound EDI with central cathode – Drawing of Omexell Spiral wound EDI module

Spiral wound EDI Feedwater requirements

Appropriate pretreatment of feed water is a basic prerequisite for the optimum performance of any EDI system. Hardness, total organic carbon (TOC), silica, particulate matter, and chlorine must all be within the allowable manufacturer guidelines.

Since carbon dioxide is characteristically present at substantial concentrations in RO permeate water, the total exchangeable anion (TEA) load will generally exceed the total exchangeable cation (TEC) load. For this reason TEA is usually the limiting factor for achieving desired EDI performance.

The feed water requirements for OMEXELL™ EDI modules are as follows:

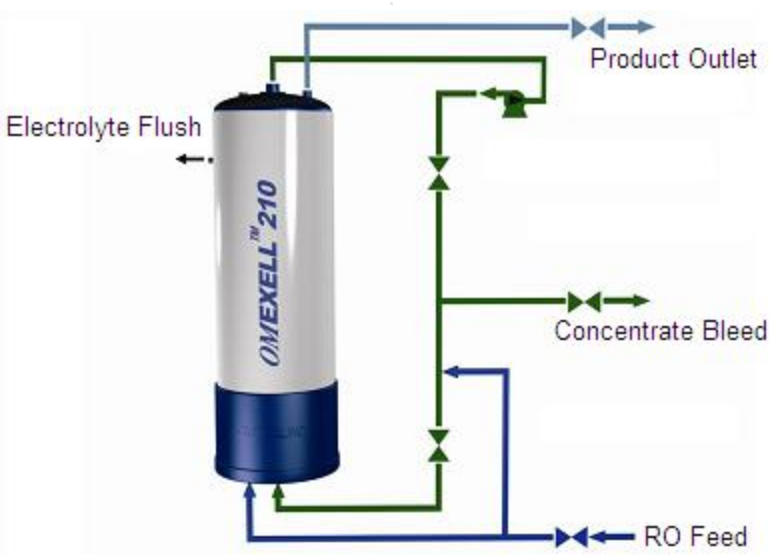
Module Specifications

OMEXELL™ EDI- Performance 210 Specifications		
Product Water Resistivity	≥ 5Ω-cm	≥ 15Ω-cm
Total Exchangeable Anions (TEA)	≤ 25 ppm ($CaCO_3$)	≤ 8 ppm ($CaCO_3$)

Based on standard test solution, actual module performance is based on specific feed water conditions.

OMEXELL™ EDI-210 Feed Water Requirements	
Parameter	**Specifications**
pH	5.0-9.0
Hardness	≤ 0.5 ppm ($CaCO_3$)
Dissolved Silica	≤ 0.5 ppm
TOC	≤ 0.5 ppm
Free Cl_2	≤ 0.05 ppm
Fe, Mn	≤ 0.01 ppm
Turbidity, NTU	≤ 0.1
Oxidizer, mg/L	None

Based on RO permeate feed water.



Module Operating Conditions

Module Operating Conditions	
Parameter	**Specifications**
Dilute Product Flow Rate	6.6-10 gpm (1.5-2.2 m^3/h)
Recovery Rate	up to 95%
Inlet Temperature	50-100°F (10-38°C)
Inlet Pressure	36-80 psi (2.5-7.0 bar)
Dilute Pressure Drop	22-36 psi (1.5-2.5 bar)
Concentrate Inlet Flow	2.2-4.5 gpm (0.5-1.0 m^3/h)
Concentrate Pressure	7-10 psi (0.5 - 0.7 bar) less than Dilute Pressure
Electrolyte Flush	0.22-0.30 gpm (50-70 lpm)
Concentrate Conductivity	250-600 µs/cm
Electrical Current	9A
Maximum Working Voltage	160V DC

Advantages of spiral wound EDI

Omexell™ EDI spiral wound modules offer a variety of benefits.

No Leakage: OMEXELL™ EDI modules are reliably sealed with high pressure top and bottom end caps, eliminating leakage problems commonly associated with plate and frame EDI designs.

Quality Control: Each OMEXELL EDI module is performance and pressure tested prior to leaving our factory to ensure trouble free start-up and operation.

Low Maintenance: Unlike plate and frame EDI systems OMEXELL™ EDI modules do not require tightening of nuts and bolts at installation or the re-torque of bolts on an ongoing basis to prevent leaks. Consequently, Omexell spiral wound EDI systems traditionally require very little maintenance in a properly designed system.

Cost Effective: The spiral wound OMEXELL EDI modules allow system integrators to build systems that have both lower capital and operating costs when compared to plate and frame EDI devices and is truly a cost-effective replacement for conventional mixed bed ion-exchange.

Conclusion

It is expected that EDI will continue to grow in popularity resulting in the obsolescence of many traditional mixed bed water system designs. Many of the shortcomings of the generation one plate and frame EDI modules have been overcome with the newer, generation two spiral wound EDI design. This newer design ensures leak free performance, simple system integration and reduced maintenance requirements.