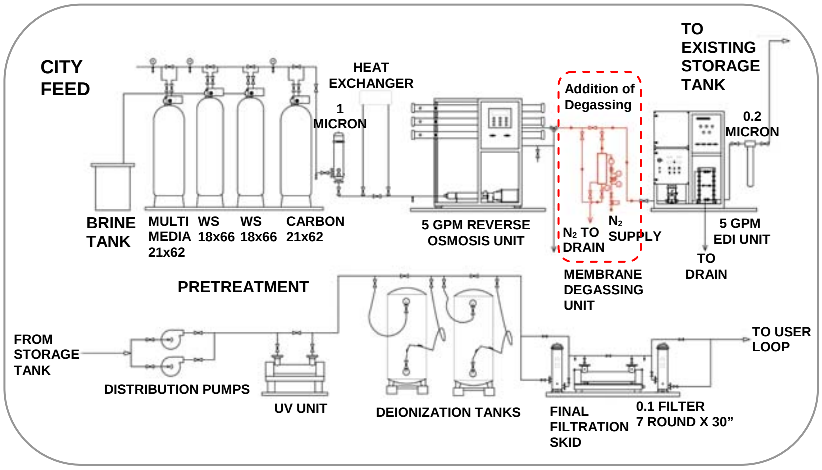
Using Liqui-Cel® Membrane Contactors to Solve Resistivity Problems in a High Purity Water Loop

Pureflow, Inc. is a Southeastern-based expert in designing complete water treatment systems as well as providing value-added solutions for fixing operational issues in existing systems. Pureflow teamed up with Membrana to help solve an operational issue at one of their customer's facilities.

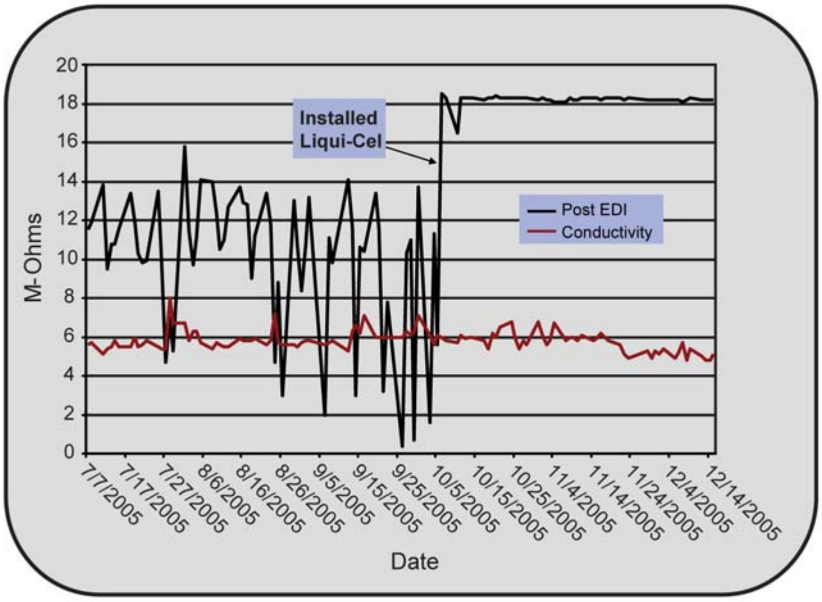
The existing high purity system consisted of a pre-treatment skid that supplied the feed stream for a 5 gpm reverse osmosis (RO) system. Product water from this RO system flowed to a 5 gpm electrodeionization (EDI) unit. Effluent from the EDI system went to a storage tank before moving to an ultra-violet light, and then to the resin-based deionization tank. The effluent then passed through final filtration before entering the facility's water loop. This system design is shown schematically in Figure 1.

Figure 1



Water fed to the facility was expected to be high quality ultra pure water with consistent effluent properties. One of the desired parameters of the product water was to have a resistivity reading of 18.0 M-ohm/cm or better. Measurements taken of the post-EDI water stream, however, showed resistivity ranging from a low of 1.0 M-ohm/cm to only 13.7 M-ohm/cm. Additionally, the readings were very inconsistent and erratic. Figure 2 shows actual readings taken over a 10 week period of time.

Figure 2: Post EDI Resistivity After Liqui-Cel® Membrane Contactor Installation



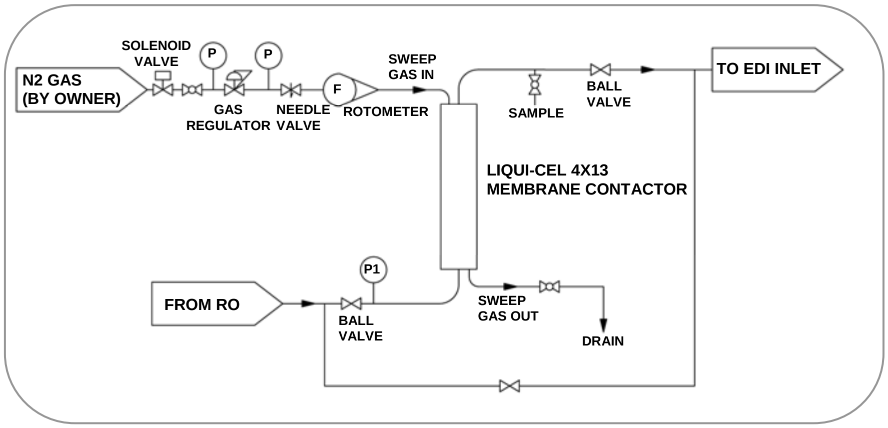
Further measurements taken upstream of the EDI equipment showed an abundance of carbon dioxide in the water. The amount of CO_2 in the water fluctuated from 8 to 20 ppm. It is well documented in technical papers that the presence of CO_2 and bicarbonate (HCO_3^-) reduces the performance of EDI systems. The presence of CO_2 and HCO_3^- in essence occupies excess "capacity" in the EDI unit leaving little to no capacity to remove silica and other components from the water. The result is that while the EDI unit may be functioning properly, chemistry within the unit dictates that compounds such as silica will "breakthrough" into the effluent. These contaminants contribute to declines in the water quality as measured by resistivity. As the CO_2 in the EDI feed increases, more capacity in the EDI unit will be lost causing increased drops in water quality.

In order to improve the quality and consistency of the water at this facility, it was clear that additional EDI capacity was required or that the dissolved CO_2 needed to be reduced before the EDI.

Pureflow and Membrana collaborated to provide a simple, economical solution to the water quality issue. An evaluation of the process conditions showed that the optimal Membrana unit for this application was a 4x13 Liqui-Cel® Membrane Contactor.

Liqui-Cel Membrane Contactors typically operate with either a vacuum pump, a vacuum pump and sweep gas combination, or only a sweep gas. The best mode of operation is dependent on the economics of the specific application. At this operating facility the customer had nitrogen readily available. It was determined that a simple flow scheme using a nitrogen sweep gas and a single 4x13 membrane contactor would be adequate to remove carbon dioxide to a level to allow the EDI equipment to operate at peak efficiency. The degassing process flow diagram is shown in Figure 3.

Figure 3



4 x 13 Liqui-Cel Contactor

In this design the water enters the membrane contactor and flows upward through the unit. It exits the degasifier and flows into the EDI system. A nitrogen strip gas flows counter-current to the water though the unit and exits the opposite end. The strip gas is then vented to atmosphere.

With the Liqui-Cel Degassing Contactor on-line, resistivity readings increased well above levels recorded prior to the installation. This is demonstrated in Figure 2.

The high purity system now produces water above the 18.0 M-ohm/cm specification. The resistivity values are also very consistent and the erratic readings have been eliminated.

From the results of this installation, one can see that the removal of carbon dioxide before the EDI unit has a significant benefit to the overall water quality. In addition, it also demonstrates the ease at which CO_2 can be removed from a water treatment system. Existing systems can be easily retrofitted with Liqui-Cel Degasifiers with minimal space requirements.

This application bulletin was produced with Jason Bailey of Pureflow, Inc. who was responsible for data collection, installation, and design of the Liqui-Cel Membrane Contactor system. For more information on their system expertise visit www.pureflowinc.com.

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