

## Rokeby Generating Station Saves 50% in Capital Expense by Using Liqui-Cel® 14x28 Membrane Contactors to Remove CO<sub>2</sub> to Extend Mixed Bed Resin Life

Lincoln Electric Systems (LES) recently commissioned a membrane decarbonation system using Liqui-Cel® 14x28 Membrane Contactors to remove CO<sub>2</sub> prior to their mixed bed deionizers. The system was installed at the Rokeby Generating Station (RGS) in Lincoln, Nebraska.

### Background

The Rokeby Generating Station is LES' primary peaking power station, totaling 255 MW and consisting of 3 dual fuel combustion turbines. The existing DI water system consisted of two single-pass, two-stage RO skids followed by a 31 ft<sup>3</sup> (0.87 m<sup>3</sup>) mixed bed deionizer and two 250,000-gallon (943 m<sup>3</sup>) storage tanks.

LES determined that the mixed bed unit was producing only 30% of its expected capacity (90,000 gallons actual vs. 300,000 gallons expected or 341 m<sup>3</sup> actual vs. 1136 m<sup>3</sup> expected). It was determined that the cause of the decreased capacity was due to dissolved CO<sub>2</sub> in the water, which was overloading the anion resin. As the power capacity demand increased, LES had to act quickly to update their winter contingency plans.

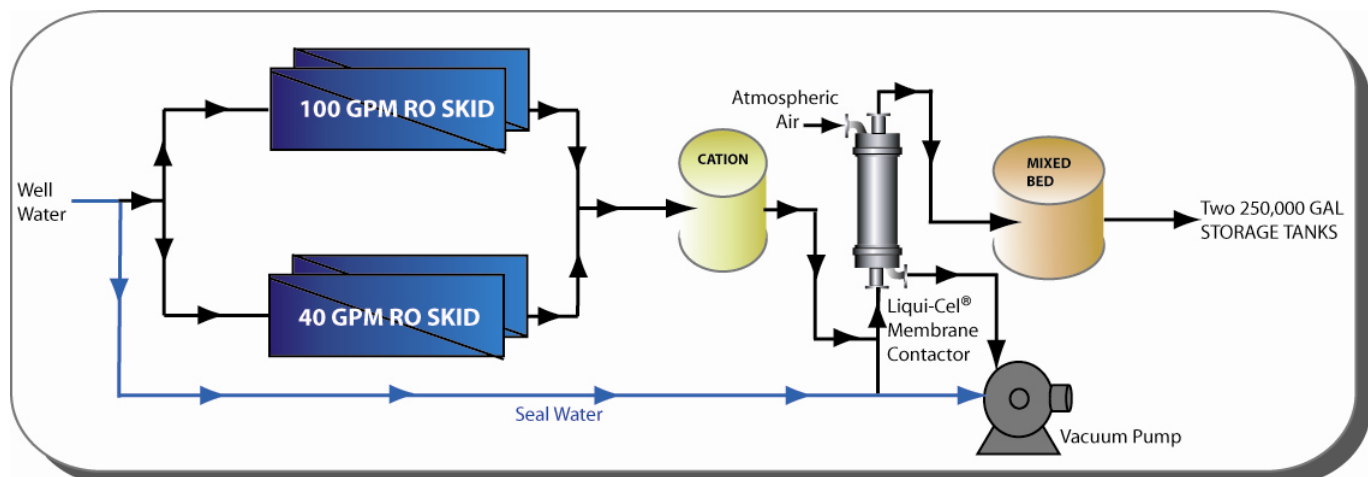
### Treatment Options

Multiple treatment options including chemical treatment and the installation of a forced draft degasifier were considered. Ultimately, chemical treatment was considered too risky because of its negative impact on increasing scale on the RO membranes. A forced draft deaerator was also considered impractical due to the large capital expense and size constraints at LES.



### System Design

In 2005, LES began engineering a membrane decarbonation system using Liqui-Cel 14x28 Membrane Degasifiers. The system was designed to treat the combined water flow from both RO skids, approximately 150 GPM (0.6 m<sup>3</sup>). The goal was to achieve approximately 90% reduction of dissolved CO<sub>2</sub>. Additionally, the system was designed to operate with vacuum assisted air sweep, using a liquid ring vacuum pump to draw atmospheric air through the Liqui-Cel Contactors.



Since the LES staff was able to design, fabricate, and install the Liqui-Cel degassing system, the total capital cost was approximately 50% less than the cost of a forced draft degasifier. The compact design also allowed LES to build the system inside of an existing building with minimal modification. The low system pressure drop through a Liqui-Cel Membrane Contactor system also eliminated the need for a re-pressurization pump further lowering operating costs for LES.

The degas skid was installed downstream of the RO skids and before the mixed bed. In order to maximize efficiency, a cation bottle was installed between the RO skids and the degas skid to reduce the pH and convert the HCO<sub>3</sub> to free CO<sub>2</sub> gas. (See Fig. 1)

### Test Set Up

LES temporarily installed three 3.3 ft<sup>3</sup> (0.09 m<sup>3</sup>) mixed bed bottles downstream of the degas skid. The bottles were installed in parallel for a total capacity of 9.9 ft<sup>3</sup> (0.28 m<sup>3</sup>). During the test, only one of the RO units was operated, resulting in water flow of 40 GPM.

LES expected to achieve 138,000 to 168,000 gallons (522 m<sup>3</sup> – 636 m<sup>3</sup>) throughput with this design. They actually achieved 191,000 gallons (725 m<sup>3</sup>). Specific conductivity was 0.5 μS/cm and silica was 7.5 ppb. LES estimates the full-scale capacity will be approximately 617,000 gallons [(32 ft<sup>3</sup> / 9.9 ft<sup>3</sup>)\*191,000 = 617,374 gallons (2337 m<sup>3</sup>)]. This represents an increase in the total capacity of the system by a factor of 5.9.

### Summary

Liqui-Cel Membrane Contactors offer a cost-effective, efficient option for removal of carbon dioxide from process water. Removal of carbon dioxide prior to the mixed bed resins *significantly* improves regeneration times, thereby reducing operating costs and improving overall efficiency by minimizing downtime.

If you would like a Membrana representative to size a Liqui-Cel Membrane Contactor system for your application, please visit [www.liquicel.com](http://www.liquicel.com) and click "contact us", or call us at the numbers listed below.

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