TechBrief

Chinese Chemical Plant Optimizes Water Treatment by Replacing Double Pass RO with a Single Pass RO and Liqui-Cel® Contactor System

Electrodeionization (EDI) is widely used in many industrial water treatment systems throughout the world. In order to maximize the operating stability and life expectancy of an EDI system they were often designed with double pass RO using caustic injection pretreatment. However, in response to recent efforts to lower the capital expenditure and operating costs of double pass RO water treatment systems (DPRO), design engineers are looking at alternative options.

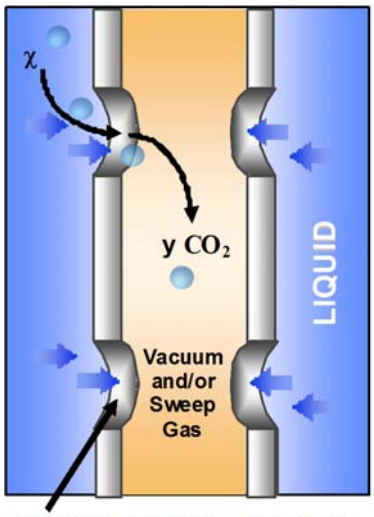
In high alkalinity feed water applications one economical option is to remove carbon dioxide from the water. Carbon dioxide gas dissociates in water to form HCO_3^- and CO_3^{2-}. These ionic species will contribute to the total anionic load to the EDI.

CO_2 Contribution to Total Exchangeable Anion (TEA) and Feedwater Conductivity Equivalent (FCE)

	TEA	FCE
1 ppm of CO2	1.938 ppm	2.66 us/cm
5 ppm of CO2	9.69 ppm	13.3 us/cm

Historically, the conventional method for CO_2 removal was to use a forced draft degassing tower (FDA) downstream of the RO. However, this is not a recommended practice today as the environmental air used in the tower comes into direct contact with the RO water which could cause significant contamination.

Liqui-Cel® Membrane Contactors are the superior solution for CO_2 removal. They operate under the same principle as a conventional FDA except the air and water contact is minimized with a membrane. Since the membrane pores are 0.02 microns in diameter, particles and other debris cannot pass through the pores to contaminate the RO water.



Liquid/Gas contact area at the pore


6-inch Liqui-Cel® Membrane Contactor System Upstream of EDI

The contactor operates by flowing gas on one side of the membrane and liquid on the other. Gasses are removed from the liquid by lowering the partial pressure of the gasses in contact with the liquid. Filtered room air is drawn into the contactor using a vacuum pump. Since the room air and vacuum pump are low in carbon dioxide they create the driving force to remove the gas from the water.

A chemical plant in China is using a Liqui-Cel Membrane Contactor system to remove CO_2 downstream of a single pass RO system. This design was selected over conventional two pass RO with a caustic injection system due to savings in capital and operating costs. The system was designed, built and installed by Changzhou Xianfeng Water Treatment Equipment Co., Ltd. The Deionization (DI) system is a fully integrated membrane system and operates without any chemical addition.

Liqui-Cel® MEMBRANE CONTACTORS

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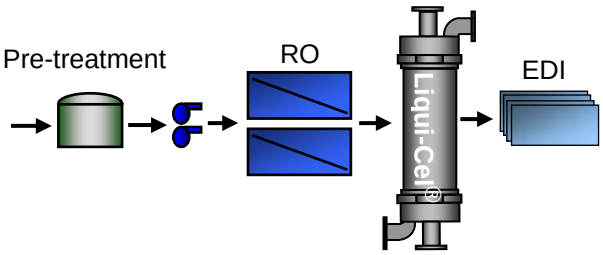
Water System Operating Details



RO feed water
Total alkalinity: 200 mg/l as $CaCO_3$
PH: 7.6

Liqui-Cel Membrane Contactor performance
Flow rate 11.5 m^3/h
Inlet CO_2: 10 ppm
Outlet CO_2: <2ppm
Two parallel 6x28 Liqui-Cel Contactors with X-50 membrane
Vacuum pump: 80 m^3/h, vacuum level at 100 mmHg

EDI performance
Water flow rate 10 m^3/hr
Permeate water resistivity: 15-17 MΩ

Comparison

The RO+Liqui-Cel system offers many benefits over a DPRO system. The RO+Liqui-Cel system eliminates the need for a second pass RO and an RO pump. This significantly reduces capital costs and less power is required because there is not a need for a second RO pump. Also, more water is recovered as the reject water from the second pass RO is not lost in the process. There is a significant space savings as the membrane contactor system has a much smaller footprint compared to the second pass RO system. Additionally, chemical consumption at the plant can be greatly reduced as the need to increase the pH before the second stage is no longer required to facilitate CO_2 removal.

The RO+Liqui-Cel Contactor system offers some other unique benefits. This system can remove both Carbon Dioxide and Oxygen. If the water is used for other applications, such as boiler feed water, the system can deliver water with a high resistivity and low levels of dissolved oxygen.

If THM is an issue, the Liqui-Cel Membrane Contactor system also has superior THM removal characteristics.

The capital, operating and reduction in chemical consumption costs make this an exciting and superior system design for a high alkalinity water treatment system.

For more information and system sizing, please contact your Membrana representative or visit us online at www.Liqui-Cel.com.

	RO-Liqui-Cel®-EDI	Double Pass RO with Caustic Injection-EDI
Capital Expenditure *	20-30% lower than DPRO	high
System Recovery Rate *	> 75%	> 65%
Power Consumption per m^3 (average) for 2nd pass RO and Liqui-Cel® **	0.05 Kwh/m^3	1.0 Kwh/m^3
Space	small equipment footprint	large equipment footprint
Chemical	chemical free	need to add caustic
	remove both CO_2 and dissolved O_2	caustic added in second stage increases pH into feed
	better THM removal	THM will pass through RO membrane

* Some data was provided by Electropure Shanghai 300m^3/h" RO Liqui-Cel-EDI" and "RO-Caustic injection–RO-EDI" case study

** RO+Liqui-Cel+EDI" process is suitable for high alkalinity feed water resource

Certified System™
ISO 9001
ISO 14001

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