

Power Plant in Thailand Uses Liqui-Cel® Membrane Contactors to Remove CO₂ From Water

A major power plant in Thailand is using Liqui-Cel® Membrane Contactors to remove carbon dioxide from a DI water system. The system is an expansion project and will be used to feed a high pressure boiler. Liqui-Cel Membrane Contactors are being used to lower the CO₂ inlet into an Ionpure Electrodeionization (EDI) system. Carbon dioxide adds an ionic load to the EDI system, which can reduce the performance of the system. Manufacturers of the EDI equipment suggest lowering the inlet CO₂ to reduce the load on the equipment and improve the water quality.

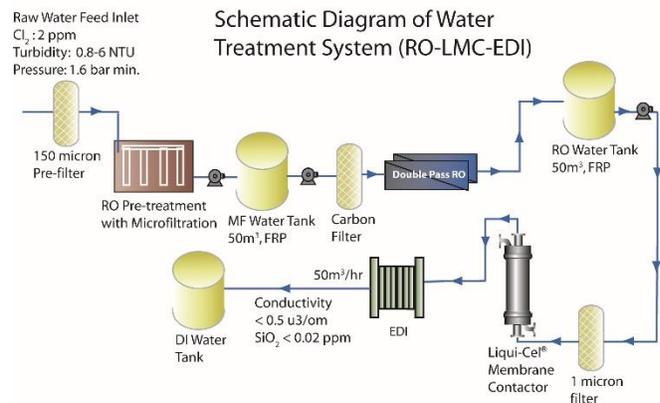
The system was designed, built and installed by Liquid Purification Engineering International Co., Ltd. in Bangkok Thailand. LPE designed the DI water system as an all membrane based system that does not require the use of ion exchange resin or chemicals. The system uses a double pass Reverse Osmosis (RO) membrane, a Liqui-Cel Membrane Contactor and Ionpure EDI technology. The system produces water with a resistivity >16.0 MΩ-cm. (See water quality and flow diagram.)

The Liqui-Cel Membrane Contactor system consists of one 14-inch Membrane Contactor that operates in combination mode using vacuum and air sweep.

Liqui-Cel Membrane Contactors utilize a hydrophobic polypropylene membrane to remove dissolved gasses from water. Water flows on one side of the membrane and a vacuum or strip gas is passed on the other side of the membrane. In this system air is drawn into the membrane under vacuum. The high flow rate of air sweep under vacuum creates a driving force to move the dissolved carbon dioxide from the water into the gas phase.

Historically, forced draft deaerators have been used to remove CO₂ from water. This type of deaerator uses ambient air that is fed into the tower with a blower, putting the air in direct contact with the water. This direct air-to-water

Water Quality Influent Analysis Water Source	Clarified Surface Water
Turbidity, NTU	0.8-5
pH	6.5-8
Conductivity, Micro siemen-cm	400
TDS, mg/l	280
M- Alkalinity, mg/l as CaCO ₃	100
Total Hardness, mg/l as CaCO ₃	120
Calcium Hardness, mg/l as CaCO ₃	75
Chloride, mg/l as Cl ⁻	45
Iron, mg/l as Fe	0.01
Sulfate, mg/l as SO ₄	26
Phosphate, mg/l as PO ₄	0.03
Silica, mg/l as SiO ₂	15
Effluent Quality, RO feed	
Turbidity, NTU	<0.5
SDI	<3
Effluent Quality, DI. water	
Resistivity, MΩ-cm	>16.0
Silica, mg/l as SiO ₂	<0.02

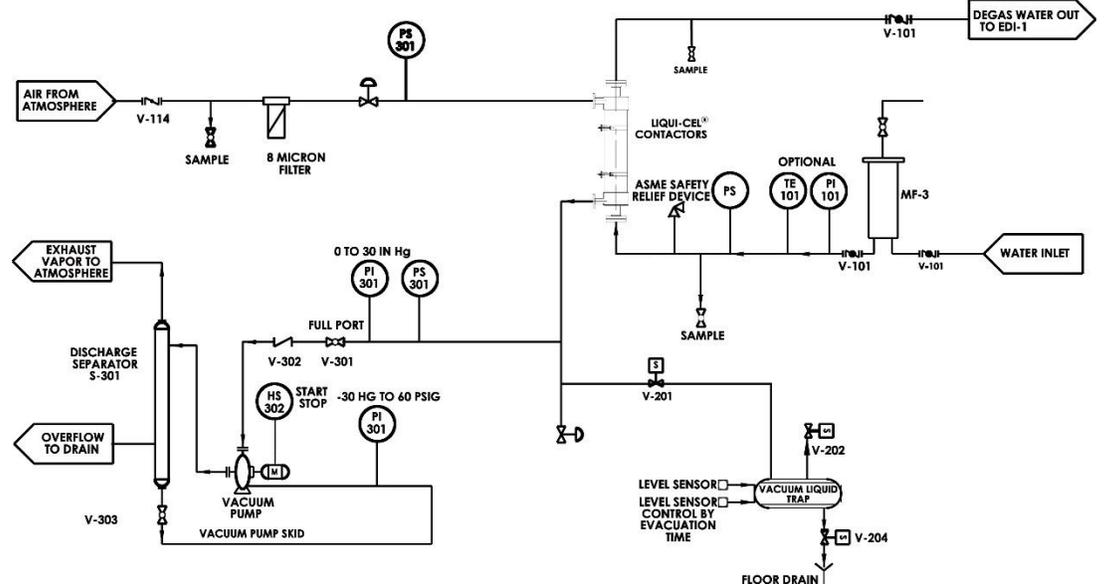


contamination from any contaminants that are present in the air. For this reason, using a forced draft deaerator downstream of an RO membrane system is not recommended.

Membrane Contactors, however, are well suited to remove dissolved carbon dioxide and other dissolved gasses along side of an RO membrane system because the membrane has tight 0.03 μm pores that prevent air stream contamination from coming into contact with the RO water.

Membrane Contactors are mechanical devices that remove the dissolved carbon dioxide gas that will ionize in water and be present in both gaseous

and ionic forms. The amount of CO₂ gas present in the water depends on the pH of the water. The lower the pH, the greater the amount of CO₂ present in the water. Due to the natural decrease of pH across the RO membrane system, the pH inlet to the membrane contactor is below 6. This favors the formation of CO₂ gas and allows the membrane contactor to efficiently remove CO₂ gas from the water.



The power plant is very pleased with the membrane based DI water system. It requires little maintenance and exceeds the performance specifications for the system. In addition, by incorporating Liqui-Cel® Membrane Contactors into the system to remove carbon dioxide the amount of chemicals used in the plant are reduced. By mechanically removing the CO₂ the end user did not need to adjust the pH up to facilitate removal by the RO membrane system or use ion exchange beds upstream of the EDI to lower the CO₂ load on the EDI.

Liqui-Cel Membrane Contactors are used in thousands of systems throughout the world to remove dissolved gasses from water. This design is one example of how membrane contactors can be used in a water system. Please visit our web site at www.liqui-cel.com for more information on Liqui-Cel Membrane Contactor installations and applications.



Technical Information: The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

Product Use: Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

Warranty, Limited Remedy, and Disclaimer: Unless an additional warranty is specifically stated on the applicable 3M product packaging or product literature, 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. If the 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M's option, replacement of the 3M product or refund of the purchase price.

Limitation of Liability: Except where prohibited by law, 3M will not be liable for any loss or damage arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

3M, Membrana and Liqui-Cel are trademarks of 3M Company. © 2015 3M Company. All rights reserved. (TB56 Rev1)



**Industrial Business Group
Membranes Business Unit**
13840 South Lakes Drive
Charlotte, North Carolina 28273
USA

**3M Deutschland GmbH
Membranes Business Unit**
Öhder Straße 28
42289 Wuppertal
Germany

**3M Japan Ltd.
Membranes Business Unit**
6-7-29, Kita-Shinagawa,
Shinagawa-ku, Tokyo | 141-8684
Japan



Phone: +1 704 587 8888
Fax: +1 704 587 8610

Phone: +49 202 6099 - 658
Fax: +49 202 6099 - 750

Phone: +81 3 6409 5732
Fax: +81 3 6409 5827

www.liqui-cel.com

