

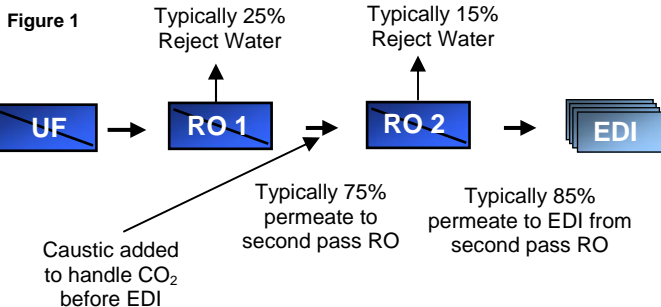
China Power Plant Installs Advanced Integrated Membrane System (IMS) to Reduce Capital Costs and Decrease Energy Use

For many years Double-pass RO + EDI systems have been a widely used water treatment combination to produce ultra-pure water. However, as engineers come under increasing pressure to reduce maintenance and operating costs, alternative system designs are being considered. Integrated Membrane Systems (IMS) have come to the forefront of the industrial water treatment industry.

An Integrated Membrane System is an industrial water treatment system that combines multiple membrane-based water treatment processes into a single system.

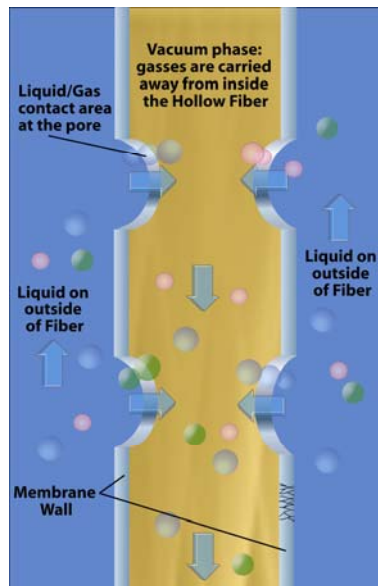
A Heat & Power plant in Northeast China recently adopted an Integrated Membrane System to replace a conventional water treatment process (Multimedia Filter [MMF] + Double Pass RO + Electrodeionization [EDI] system). (See figure 1.)

Conventional System Design – Double Pass RO



The IMS selected at this plant consists of four major membrane-based water treatment components: Ultrafiltration (UF), Single Pass Reverse Osmosis (RO), Liqui-Cel[®] Membrane Contactors (LMC) and Electropure[™] Electrodeionization (EDI).

The Liqui-Cel Membrane Contactors used in this system are microporous Hollow Fiber membrane devices that remove dissolved gasses from liquids. Gas flows across one side of the



membrane and liquid is on the other side. Because the membrane is hydrophobic only the gasses can pass through the pores.

Lowering the partial pressure of the gas allows the dissolved gasses in the liquid to easily transfer through pores in the membrane wall of the Hollow Fiber.

System Configuration

Flow rate: 2 x 80 m³/h Integrated Membrane Systems

- 1) UF flow rate: 120 m³/h
- 2) RO system flow rate: 90 m³/h;
- 3) Liqui-Cel CO₂ removal technology flow rate: 90 m³/h;
- 4) EDI flow rate: 80 m³/h

Liqui-Cel Membrane Contactor Operating Conditions

- 90 m³/h water flow
- Two 14 inch contactors in parallel
- X-50 membrane
- Operating mode: combo with air sweep and vacuum
- Vacuum pump: 360 m³/h at vacuum level: -0.094 Mpa (55 mm hg)

Results Before and After Installation

RAW WATER QUALITY ANALYSIS

TDS	406 - 600 mg/l
pH	7.5 - 7.7
Total Alkalinity	280 mg/l (as CaCO ₃)
SiO ₂	5.5ppm

RO PERMEATE ANALYSIS

Conductivity	6.8 µs/cm
CO ₂ Concentration	10 - 12ppm

LIQUI-CEL MEMBRANE PERMEATE WATER QUALITY

Outlet CO ₂ Concentration	1 - 2ppm (actual result)
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EDI PERMEATE WATER QUALITY

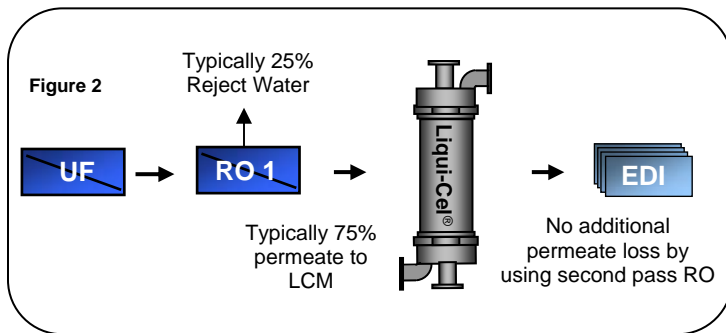
Conductivity	0.071 - 0.06 µs/cm (14 - 16.7 MΩ)
SiO ₂	5ppb

The IMS was selected to replace the conventional system because it lowered capital and operating costs. Additionally, the water reclaim rate was greatly improved compared with the traditional MMF process.

Benefits of Integrated Membrane Systems Compared with Conventional Processes

- The RO + Liqui-Cel® Contactor system eliminates the need for a second pass RO and an RO pump. This significantly reduces capital costs and lowers the power required to operate the system because there is no longer a need for a second RO pump.
- Water is saved as the reject water from the second pass RO in the conventional double-pass RO system is no longer lost. (See Figure 2.)

- Since Liqui-Cel Membrane Contactors remove the CO₂, chemical consumption at the plant is reduced due to the elimination of caustic formerly required to increase pH before the second pass RO. (Compare figure 1 to figure 2.)
- The Liqui-Cel Membrane Contactor system also has a much smaller footprint compared to the system utilizing a second pass RO.
- Improves EDI silica removal efficiency due to lower CO₂ concentration of EDI feed water. For example, EDI permeate SiO₂ concentration is below 5ppb conductivity at 0.071µs/cm - 0.06µs/cm.



The Liqui-Cel Contactor system offers other unique benefits. This system can remove both Carbon Dioxide and Oxygen at the same time. 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.

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

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Membrana - Charlotte
A Division of Celgard, LLC
13800 South Lakes Drive
Charlotte, North Carolina 28273 USA
Phone: (704) 587 8888
Fax: (704) 587 8610

Membrana GmbH
Oehder Strasse 28
42289 Wuppertal
Germany
Phone: +49 202 6099 - 658
Phone: +49 6126 2260 - 41
Fax: +49 202 6099 -750

Japan Office
Shinjuku Mitsui Building, 27F
1-1, Nishishinjuku 2-chome
Shinjuku-ku, Tokyo 163-0427
Japan
Phone: 81 3 5324 3361
Fax: 81 3 5324 3369

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