

Semiconductor Plant Improves Water Quality by Using Liqui-Cel® Membrane Contactors for Simultaneous Oxygen and Carbon Dioxide Removal from Water

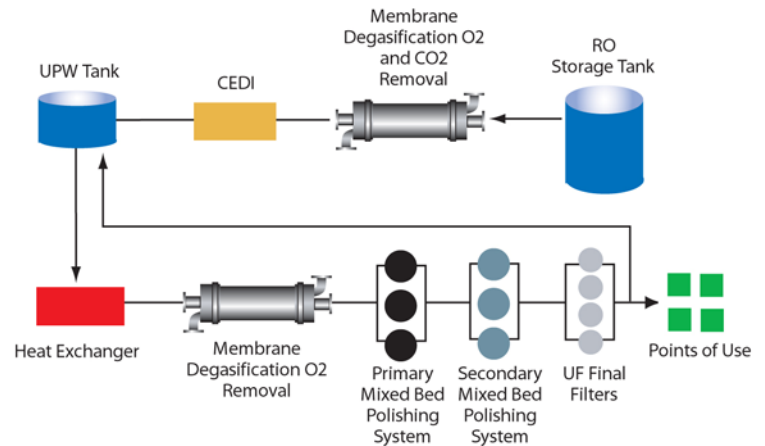
A semiconductor plant in Taiwan is using Liqui-Cel® Membrane Contactors to remove dissolved gas from their ultra pure water (UPW) system. The UPW system is used to purify water used in the chemical mechanical polishing process (CMP) at the fab. The water system was designed and built by United Purification Technologies in Taichung Taiwan.

The water system has two degasification stages. The first stage removes both carbon dioxide and oxygen from the water and the second stage is in the final polishing loop where additional oxygen is removed to <5 ppb. (See system flow illustration 1)

The UPW system uses CEDI (Ionpure) technology as the primary system to remove ions and charged particles from the water.

The feed water to the system is first treated by Reverse Osmosis (RO). RO membranes are designed to remove ions but gasses will freely pass through them. Analysis of the RO water found that about 7.5 ppm of carbon dioxide was present in the water. Outlet water quality cannot be achieved if CO2 loading is high on the CEDI system. In order to lower the ionic load into the CEDI system, UPT installed a membrane contactor system.

Membrane contactors are widely used to remove dissolved gasses from water. They utilize micro porous hollow fiber membranes to bring a liquid and gas phase in direct contact with each other. The membranes are hydrophobic so that water will not flow through the pores. Water flows on the outside of the membrane and gasses flow on the inside of the hollow fiber membrane. Controlling the partial pressure of gasses on the inside of the membrane creates a driving force to remove dissolved gasses from the water.



SYSTEM FLOW ILLUSTRATION 1

The first stage membrane contactor system operates at 29 m³/hr (128 gpm). It consists of four 10 inch X-IND membrane contactors configured two in parallel with two in series. This system is designed to remove 85% of the carbon dioxide in the water. It also lowers the dissolved oxygen to 6 ppb.

The conductivity measurement after the membrane contactor system is 8-10 µs/cm. This allows the CEDI system to continuously produce water with an outlet resistivity of 16 mega ohm-cm or higher.

CEDI Performance

	INLET to CEDI	OUTLET of CEDI
CO ₂ after Liqui-Cel®	< 1 ppm	not measurable
Conductivity	8-10 microSiemens/cm	
Resistivity		16-17.5 mega ohm-cm

The second stage system operates at 32 m³/hr (141 gpm) and consists of two 10-inch high-purity Membrane Contactors in a parallel configuration. The feed to this system is made up of the water from the primary system and the return water from the point of use. This system lowers the dissolved oxygen to <5 ppb.

Membrane Contactor Performance

	Dissolved Oxygen Inlet (ppm)	Dissolved Oxygen Outlet (ppm)	Carbon Dioxide Inlet (ppm)	Carbon Dioxide Outlet (ppm)
First Stage	8.5	0.006	7.7	<1.5
Second Stage	0.006	<0.001	Below Detection	Below Detection

Membrane Contactor Operating Parameters

	No. of Contactors (parallel x series)	Sweep gas rate (m ³ /hr / scfm)	Vacuum Load (ms / hr)	Vacuum Level (torr)	Pressure Drop (kg / cm ²) psi
First Stage	2 x 2	1.2 / 0.71	55.6	50	04 / 5.7
Second Stage	2 x 1	0.8 / 0.5	19.9	50	0.09 / 1.3

The system was commissioned in August of 2003 and has been successfully operating continuously since then. Thomas Chen, President and General Manager of UPT, is pleased with the low maintenance and ease of operation of the system. He recommends that membrane contactors always be installed upstream of the CEDI to improve the quality of the water produced.

For more information on using Liqui-Cel Membrane Contactors in your application, please visit us on-line at www.liqui-cel.com or call us at the numbers listed below.



First Stage Liqui-Cel System for CO₂ and O₂ Removal



Second Stage Liqui-Cel Polishing System for CO₂ and O₂ Removal

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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 8585

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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