

Integration of Membrana Ultrafiltration and Gas Transfer Membrane Technologies Produces High Quality Water and Controls Corrosion in Cooling Water System of Shanghai Disney Land



Application: Water Purification of Cooling Water **Location:** Shanghai, China
OEM/System manufacturer: China Huadian Corporation (CHD), Nanjing Nanzi Kelin System Engineering Co., Ltd.
End-user: Shanghai International Tourism Resort (Disney Land)

In 2013 Shanghai International Tourism Resort (Disney) realized that they needed to improve the quality of their make-up to the cooling water circulation system to effectively control contamination, scaling and corrosion and protect downstream system components. To accomplish its goals, the resort enlisted CHD to design and build a system using proven membrane technologies that effectively removed suspended solids, colloidal substances, chemical oxygen demand (COD), salt, and dissolved gases from the system. Ultrafiltration (UF), reverse osmosis (RO) and gas transfer membrane (GTM) technologies were included in the design.

For optimal results, CHD selected Membrana's Liqui-Flux® W10-07 Ultrafiltration Modules as pre-treatment to reverse osmosis (RO) and Liqui-Cel® 10x28-inch Gas Transfer Membranes as the post-treatment to remove dissolved oxygen and carbon dioxide.

Design & Operating Specifications	
Feed water source	City water
Plant capacity	960 ton/day
Ultrafiltration	
Liqui-Flux® Ultrafiltration W10-07	10 modules, RO pre-filtration
Liqui-Flux® Ultrafiltration, Flux	65 LMH flux, 40 minutes
Outlet water quality specifications	SDI: ≤ 2
	Turbidity: <0.2 NTU
	Bacterial removal rate: ≥ 99.99%
Dissolved Gas Removal	
Liqui-Cel® GTM, 10x28	8 pcs, O2 removal
Liqui-Cel® sweep gas	Nitrogen, 99.99% purity, < 4 Nm ³ /h
Liqui-Cel® vacuum level	50 torr
Dissolved O2 inlet	8-9 ppm
Dissolved O2 outlet specification	< 10 ppb

System Design

The entire system is designed to handle 960 ton/day of recirculated cooling water with two independent UF units with a capacity of 640 ton/day for each rack and degassing units with a capacity of 480 ton/day for each rack. Splitting the UF and degassing systems into two racks allowed for a more mobile and modular system design.

The UF plant is designed to operate with a 65 LMH flux with 40 min of filtration time and 250 LMH backwash flux. A backpressure above 2.0 bar is maintained due to downstream equipment requirements and piping demands. The feed water pressure is expected to remain above 3.5 bar. In operation, the feed water pressure is maintained at 4.0 bar and module tolerance pressure is 4.0 bar at 30°C. An in-line turbidity meter is installed for real-time monitoring of the outlet water and a chemical enhanced backwash (CEB) system is installed with a cycle time of once per day.

Liqui-Cel® Gas Transfer Membrane, also known as membrane contactors, are installed four in parallel and two in series to improve oxygen removal efficiency. The Liqui-Cel® system operates in combo mode (a nitrogen sweep gas and vacuum are applied to the degassing units) to further enhance gas removal efficiency.

Liqui-Cel® Contactors are used for degassing because the technology can reach a low dissolved oxygen concentration of < 10ppb, which is difficult with conventional gas removal processes. The compact design of the Liqui-Cel® Membrane Contactors also enabled the system builder to design small skids.

Operation

The system was commissioned in June of 2014. The Transmembrane Pressure (TMP) of the ultrafiltration units is maintained between 0.18 bar and 0.20 bar during filtration. A Chemical Enhanced Backwash (CEB) cycle is performed daily with CEB1 and CEB2 running every other day. Since commissioning turbidity remains consistently at 0.03 NTU with an SDI15 of around 2.0. the produced water from the UF continues to fully meet the RO inlet water requirements.

Dissolved oxygen levels remain below 5 ppb, which exceeded the customer's expectations and the system only uses one quarter of the nitrogen sweep gas that was anticipated based on the original design, even when operating at full operating capacity. No chemicals are needed to operate the system.



Liqui-Flux® W10-07 Ultrafiltration Modules
as pre-treatment to reverse osmosis



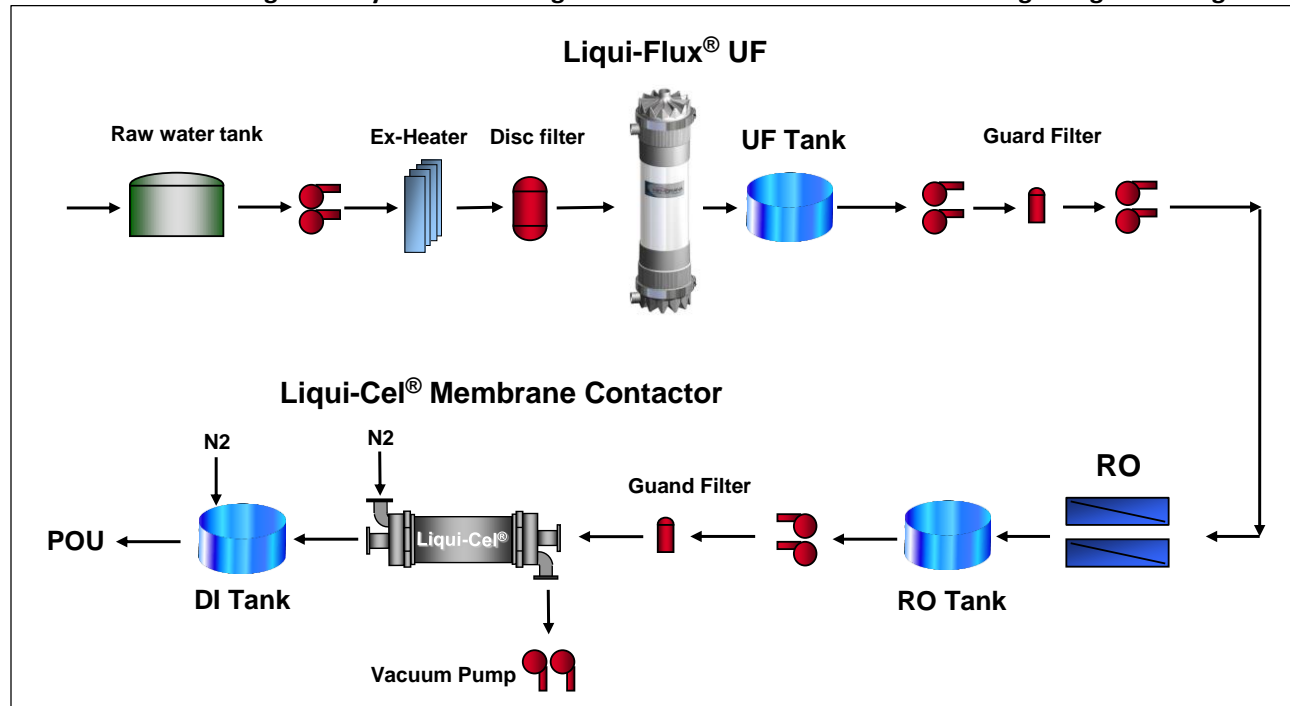
Liqui-Cel® 10x28 Gas Transfer Membrane System

CASE STUDY

The integration of Membrana's UF and GTM technologies before and after RO not only exceed design requirements, but continue to produce high quality water with low operating costs.

The UF modules easily tolerate the customer's pressure and harsh water requirements and the Liqui-Cel® Membrane Contactors continue to efficiently remove dissolved oxygen with minimal maintenance. The system outperforms traditional RO pre-treatment and gas removal processes. It also provides an efficient, cost effective solution for cleaning circulating water supply processes and reducing the risk of corrosion with low operating costs.

Process flow of cooling water system with integrated Membrana Ultrafiltration and Degassing technologies



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