

Jotem Water Treatment uses Liqui-Cel® for Oxygen Removal from the Feedwater of a Central District Heating System in a Dutch Power Station

Introduction

Central district heating systems have gained attention in recent years because they can be more efficient than localized boiler units. The efficiency of district heating is usually realized due to power generation plants being able to produce heat and electricity simultaneously. They also use more advanced flue gas cleaning than single boiler systems resulting in better pollution prevention.

In central district heating systems, heated water from power plants is distributed to densely populated residential and industrial areas by insulated piping networks. Large storage tanks are typically used to safely store heat for use during periods of peak load demand. High water quality is required to maintain the integrity of a centralized system's infrastructure.

To prevent internal corrosion and to increase the lifetime of piping and storage tanks, water needs to be treated carefully. Inlet water is typically filtered, softened and has low oxygen content. Impurities are removed during the initial filling of the system; however, water is also needed to feed the recirculation system that is used to compensate for any water loss during operation or seasonal fluctuations. As part of this refilling system, Jotem Waterbehandeling BV installed Liqui-Cel® membrane contactors for O₂ removal at a Netherlands power station.

Liqui-Cel® Membrane Contactor Technology

The technology behind Liqui-Cel® Membrane Contactors is based on Henry's Law, which states that gasses will dissolve in water relative to their partial pressure above the liquid. The solubility constant (Henry's Constant), which is different for each gas, also depends on temperature. Water below atmospheric standard conditions (20° C, 1bar) and in contact with ambient air, contains up to 8-9 ppm (mg/L) of oxygen.

Water flows through the contactor on the outside (shellside or liquid side) of the hollow fiber

membrane. Because the membrane is microporous and hydrophobic only the gas molecules are able to pass through the membrane. Applying a vacuum or using an inert sweep gas on the Lumenside will lower the partial pressure of the gas that needs to be removed and excess gasses will be carried away into the vacuum.

System Design

The goal was to achieve an O₂ specification of < 10ppb for filling the storage water tanks and to maintain a constant fill level. For an inlet water flow of 30 m³/h, Jotem installed four 14-inch Liqui-Cel® Contactors connected in series. To achieve the low O₂ requirements, the system operates in N₂-vacuum (combo) operation. The vacuum pump pulls vacuum through a parallel connected manifold from the bottom gas ports, while the N₂ sweep gas enters the contactors through the top gas ports. The O₂ content is reduced through each membrane step.



Figure 1: Oxygen removal system at Dutch power station

The necessary 2.2 m³/h of total nitrogen sweep gas (0.55 m³/h for each module) is produced in a separate N₂-generator with a pressure swing absorption technique. This generator constantly creates N₂ gas with a purity of > 99.99% (100ppm of O₂) from ambient air. For each cubic meter of N₂, about 6 m³ of compressed air (at 6 bar) is required.

The nitrogen can be stored in pressurized tanks during system stand-by.

The vacuum level of 66mbar absolute (50 torr) is created by a liquid ring vacuum pump with an external water cooling system. The service water is recycled to about 50% by a gas/water separator.

Results

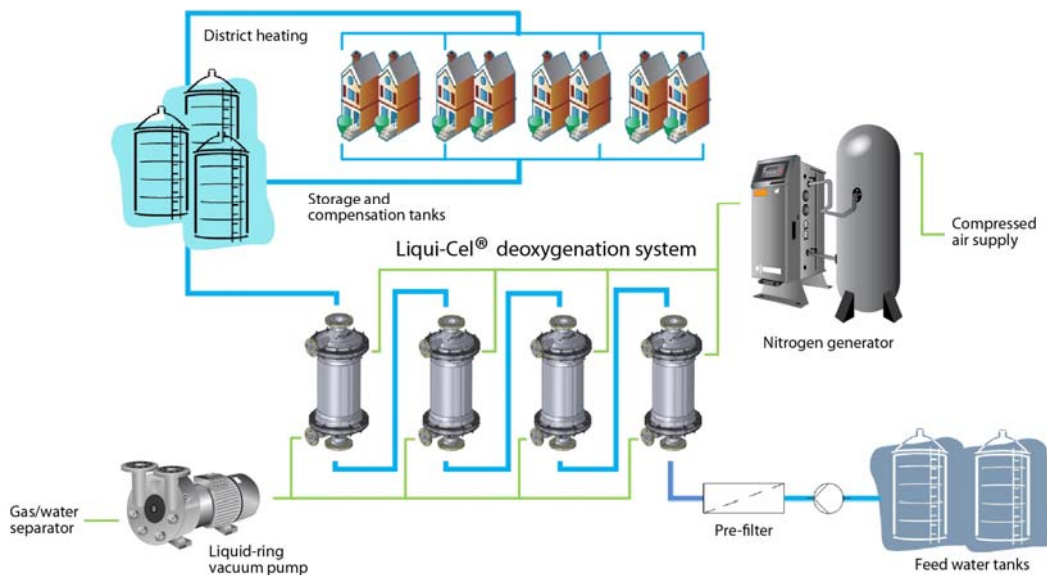
The system exceeded expectations, achieving oxygen removal down to 5ppb. The main advantage of the Liqui-Cel® Membrane Contactor system compared to conventional degassing technology is its small footprint. This allowed Jotem to install the O2 removal system close to the point-of-use at the

power station's storage tanks, saving additional piping and space costs.

The chemical free, deoxygenation system without an external N2-supply, provided an excellent water treatment solution with low energy demand and operating costs.

For more information about Liqui-Cel® Membrane Contactors or a detailed system sizing, please contact your Membrana representative or visit us online at www.Liqui-Cel.com

For more information about the on-site system integration, please visit www.jotem.nl.



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