

3D TRASAR™ Technology for Membranes Saves Water and Reduces Total Operation Cost of Waste Water Recycle Reverse Osmosis (RO) System in a Large Graphics Paper Mill



BACKGROUND

The Chinese Pulp and Paper industry today is faced with less fresh water availability, tightening discharge regulations in terms of water quality and volume. Also, the economic impact of withdrawal and discharge is becoming more and more critical to pulp and paper makers.

A large paper producer in China withdraws water from Yangtze River operating its three coated fine paper machines with a total production capacity of over 2.2 million tons per year. The combined effluent from papermaking and utilities, at an average flow rate of 45,000 m³/day, was treated by its wastewater treatment plant (WWTP), and discharged back to Yangtze River. In order to set an industrial benchmark for water saving and meet its water management goals, the mill commissioned a UF+RO plant in 2007 to recycle secondary clarifier

effluent 7,000-10,000 m³/day. 60% of permeate is used for boiler feed water and 40% for papermaking process.

The RO system contains 2 trains each producing 145 m³/h of RO water at 70% recovery rate. The feed water quality is unstable and often with high levels of COD, Alkalinity, Conductivity and Hardness, shown in Table 1. This resulted in high tendency of scaling and fouling and presented a challenge for the operation and maintenance of the RO system.

Table 1 - RO Feed Water Quality

Conductivity, us/cm	1330	pH	7.08
Ca Hardness (ppm CaCO ₃)	316	SiO ₂ (ppm)	9.1
Total Hardness (ppm)	341	Chloride (ppm)	228
M Alkalinity (ppm CaCO ₃)	198	Sulfate (ppm)	160
COD (ppm)	49	Iron (ppm)	<0.1

CUSTOMER IMPACT

Reduced fresh water intake by 268,836 m³ per year



ECONOMIC RESULTS

Saving \$43,013 per year

Extended cleaning cycle from 20 to 40 days and optimized antiscalant dosage through automation



Reduced total chemical cost of \$77,000 per year

Extended membrane life



Protect \$288,000 worth of membrane

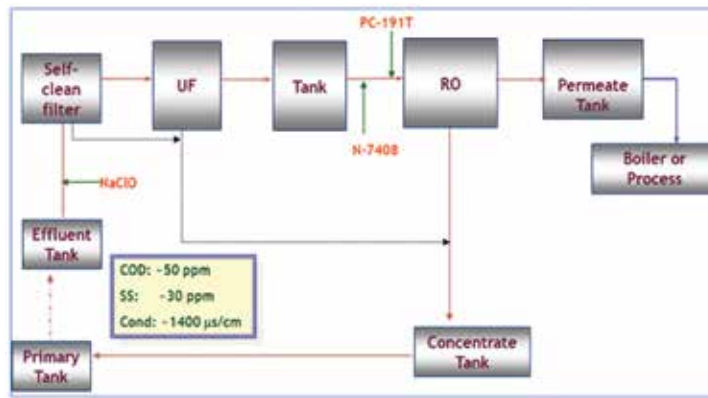


Figure 1 and 2 - UF + RO wastewater recycling system

BUSINESS SITUATION

After running for about 4 years, the membrane system had decreased in performance, and had difficulty recovering back to the normal level. NALCO Water was asked to recommend a solution to improve system performance.

NALCO Water conducted a thorough system survey in terms of Mechanical, Operational and Chemical. The problems were identified as below:

- Serious damage on ultrafiltration membranes which led to RO feed water not meeting quality requirements
- Uncontrolled ORP caused membrane oxidation by free residual chlorine.
- No monitoring and control for chemical dosage, leading to either insufficient scale prevention (underdose) or fouling by organic contaminants (overdose)

- Lack of operation data management (like normalization data) in the past. Key performance parameters are influenced by water temperature, pressure and feed water Total Dissolved Solids (TDS). Normalization is the way to compensate for the effect of these variables and standardize data, allowing comparisons and to see trends of the actual performance of the RO system.
- Severe scaling and fouling of RO membranes resulted in reduction in permeate production rate and frequent cleaning (every 20 days), which increased the operation cost significantly.
- Cleaning program was not effective to restore membrane performance from scaling and fouling
- 50% RO concentrate recirculating back to RO feed caused more severe membrane contamination

NALCO Water SOLUTIONS

NALCO Water proposed an integrated solution with a detailed action plan to address these issues, including:

- Stop sending 50% RO concentrate to RO feed to reduce scaling/fouling potential.
- Replace damaged UF membranes to optimize RO feed water quality.
- Apply NALCO Water high performance antiscalant.
- Design an enhanced Clean-In-Place (CIP) program to recover membrane performance and protect membrane life
- Implement 3D TRASAR Technology for Membranes to have better membrane performance management and provide online monitoring and control.
- Modify ORP meter sampling line to have accurate ORP readings and control.

3D TRASAR TECHNOLOGY FOR MEMBRANES

3D TRASAR Technology for Membranes is the RO automatic platform which not only improves the dosage control, but also is integrated with System Assurance Center to provide on-line monitoring of operation data and normalization of membrane performance instantly. With this innovative technology, the customer could obtain normalized RO performance data and system situation in time, and get alerts for any urgent system issues or Clean-In-Place (CIP) recommendations combined with professional operation advice from NALCO Water.

RESULTS

The customer took all recommendations and after a 12-month implementation, the performance of the wastewater recycle plant was significantly improved. A remarkable reduction in Total Cost of Operation (TCO) is achieved.

- The recommended cleaning program restored membrane performance, as shown in Figure 4, extending cleaning cycle from 20 days to 40 days. This led to extended membrane life and reduced labor, energy and water cost.
- Permeate water flow increased about 15%. Higher production of permeate water means lower consumption of fresh water. Under normal operation conditions, annual RO water production increased about 268,836 tons, equaling to fresh water cost saving of \$43,013 per year.

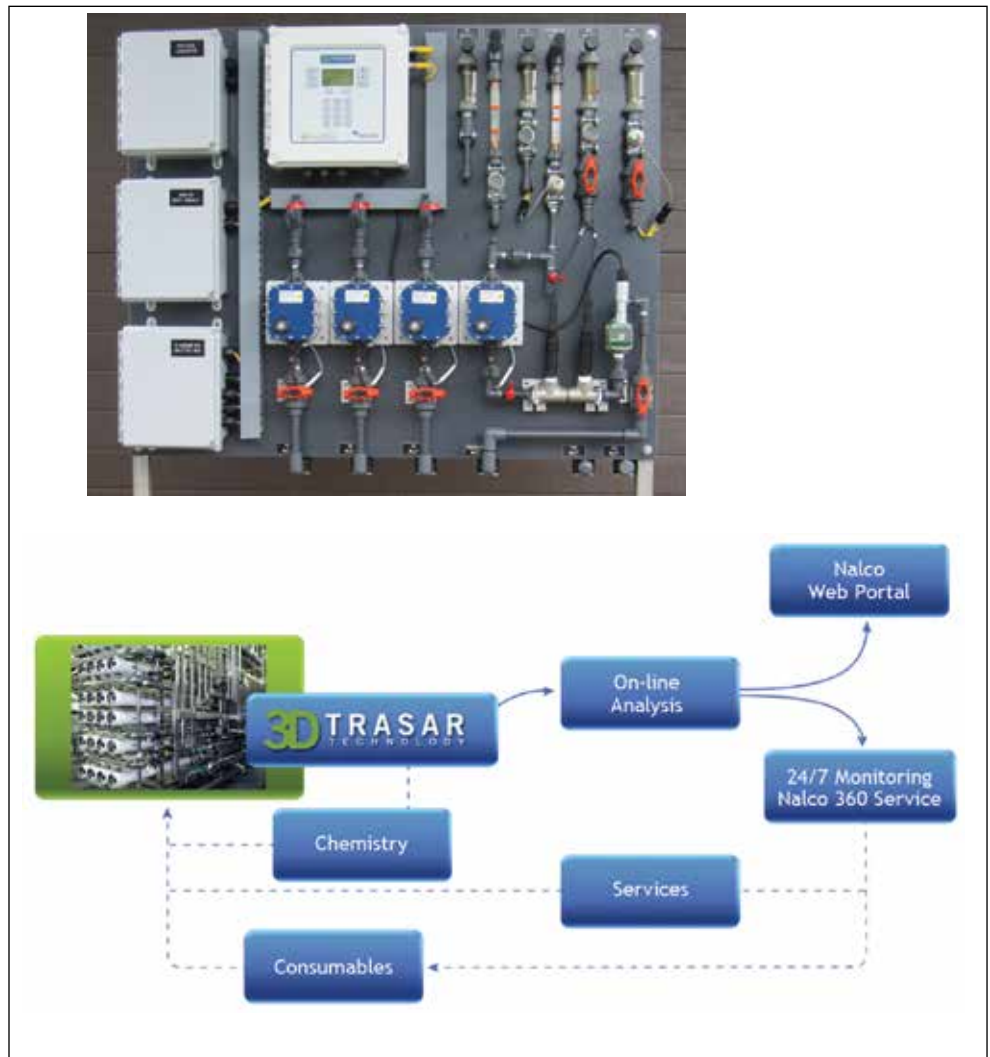
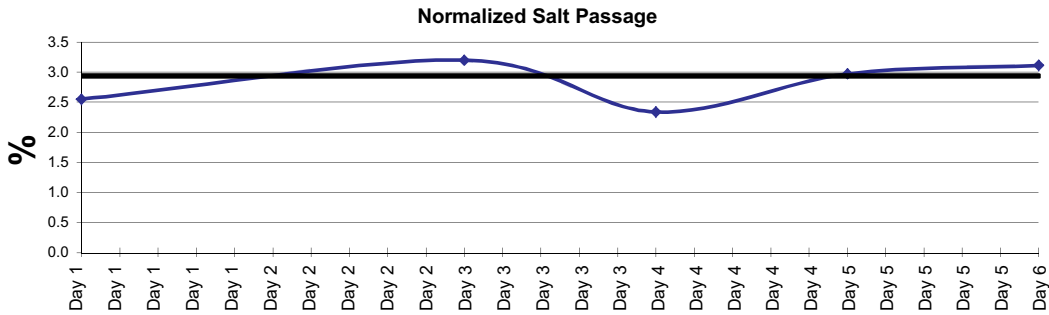
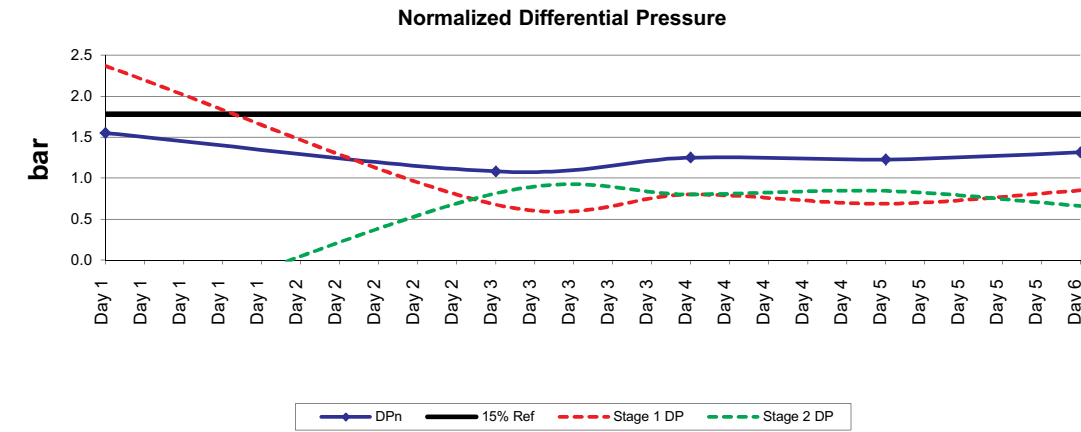
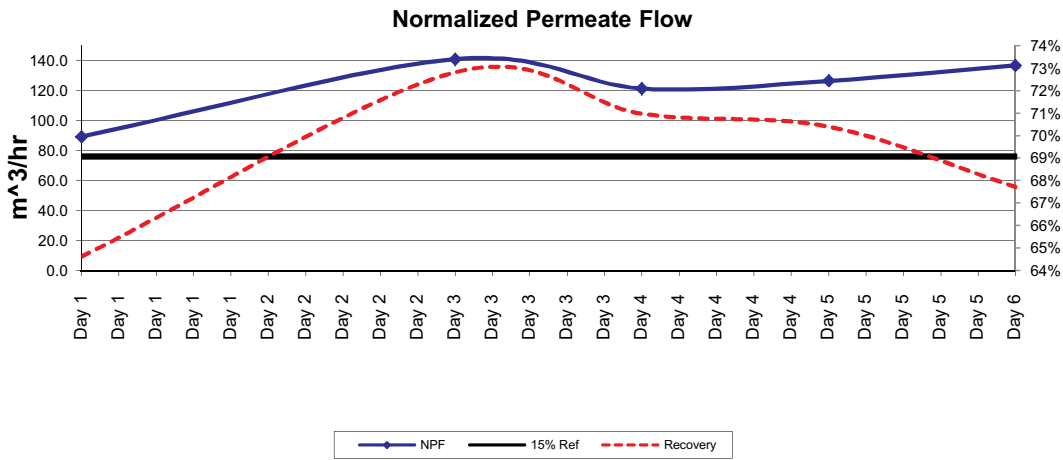


Figure 3 - 3D TRASAR for Membranes

- With 3D TRASAR Technology and System Assurance Center in place, ORP excursion was controlled seamlessly. As a result, \$288,000 worth of membranes was protected from chlorine damage.
- Optimized and accurately dosing approach and effective chemistry program help customer reducing chemical cost by \$77,000 per year.

CONCLUSION

With the unique Mechanical, Operational and Chemical (MOC) approach of problem solving by NALCO Water, combined with differentiated chemistry and leading edge automation technology - 3D TRASAR Technology for Membranes, the customer has achieved a significant reduction in Total Cost of Operation, reduced fresh water intake and discharge, and benefited substantially both economically and environmentally.



- After the recommended cleaning program by NALCO Water, normalized permeate flow increased to above 70%, ΔP (pressure) down 50%, salt rejection become stable @97%.
- 15% Ref line indicates 15% of the reference conditions. Membrane cleaning should be performed when operation has met this reference

Figure 4 - Normalized data generated by 3D TRASAR Technology for Membranes

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