



Annual water reduction of 7600 m³

3D TRASAR™ Technology delivers the next level of membrane performance management

NALCO Water
An Ecolab Company

CASE STUDY - MANUFACTURING
CH-1192E



Nalco Water reports Environmental Return on Investment (eROI) values to customers to account for contributions in delivering both environmental performance and financial payback.

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SITUATION

A bottling plant was concerned with oxidised membranes, water consumption, and total cost of operation. Operational issues and poor Reverse Osmosis (RO) permeate quality had plagued its system since it was installed. Because of these issues, the customer management team expressed concern about the condition of their membranes. The team believed that the membranes were being damaged by repeated exposure to chlorine in the feed water. Excessive exposure to chlorine leads to premature membrane deterioration and results in costly membrane replacement. Because of this, the plant had budgeted for membrane replacement prior to this new equipment installation. From a corporate standpoint, water use reduction and water quality are key business drivers. A firm understanding of the root cause of poor performance issues is paramount to optimising output.

ENVIRONMENTAL RESULTS	eROI™	ECONOMIC RESULTS
Reduced RO feed water by 3% or >5600 m3 per year	 WATER	Savings of €5200 per year in water costs
Decreased RO reject water by 27% or >7700 m3 per year		Savings €4000 per year in sewer costs
Reduction of 67% in chemical feed	 ASSETS	Savings of €11400 per year
Premature membrane replacement was avoided due to excessive salt passage		Savings of €29100 for membrane replacement
Feed pressure for desired output dropped 22%	 ENERGY	Savings of €1060 per year in energy costs
Permeate water conductivity dropped 29%	 WASTE	Decrease in product quality issues and discarded product.

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

PROGRAMME

Chemical Optimisation: Upon installation of 3D TRASAR Technology for Membranes onsite, the periodic PC-191T non-feed was noted due to mechanical issues in the feeding design. Figure 1 shows that feed was lost multiple times, the first being a short period of time after monitoring with 3D TRASAR Technology for Membranes began. The issue was addressed and the PC-191T feed control remained with the customer’s PLC for approximately six weeks.

During this period, typical PC-191T feed dosage was 15.57 (+ 9.3) ppm with non-feed an unpredictable, recurring issue. Of greater concern than short periods of non-feed is the period starting on day 48 and ending on day 63 which led to major issues in maintaining permeate flow for process use, see Figure 1.

After the extended non-feed period, control of the PC-191T product was then placed with the 3D TRASAR Technology for Membranes controller. As a result of moving to a superior method of control, the average dosage dropped closely to the targeted dosage rate of 5.0 ppm to 5.06 (+ 2.5) ppm. Even with periodic and frequent spot checks using a drawdown column or by looking at chemical usage, this anomaly would have been difficult, if not impossible to detect.

Membrane Performance Optimisation: As discussed, during the installation process, the customer expressed concern over the condition of their membranes referring to the low water quality. The customer believed that the cause of this poor permeate water quality was oxidation of the membranes from prolonged, repeated exposure of chlorine. However, by way of feeding in a proper and consistent dosage of PC-191T, a marked improvement was observed in the permeate water quality.

From the period of non-feed to proper PC-191T feed, the normalised salt passage (NSP) decreased from 9.5%

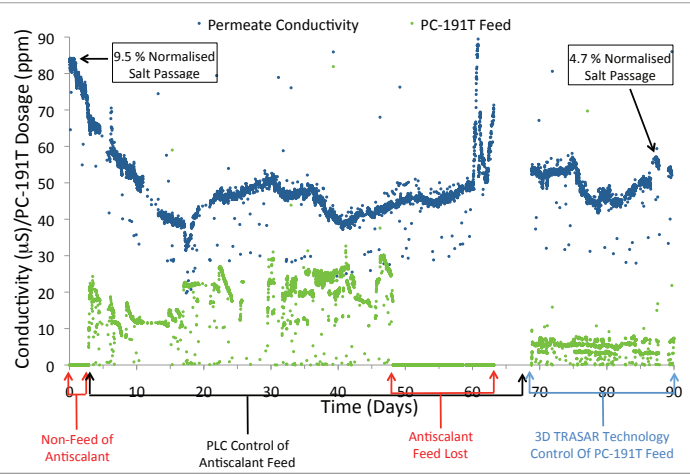


Figure 1 – Plot of Permeate Conductivity and PC-191T Feed as a function of time, with sources of control, periods of non-feed (PC-191T), and data points for normalised salt passage labeled.

to 4.7% (51% improvement) which is noted in Figure 1. This system was designed with low pressure membranes at high recovery. It was designed to achieve 5.0% salt passage or better. Initially, this system was operating at double the maximum expect salt passage. With 3D TRASAR Technology for Membranes controlling the antiscalant, the normalised salt passage is operating within the expected range for reverse osmosis membranes and is stable.

Improved Water Quality: During the non-feed period, the permeate conductivity was 68 ↔S. After the proper dosage of PC-191T was achieved by way of 3D TRASAR Technology, the permeate conductivity decreased to 45 ↔S, which is a 34% improvement in permeate quality, which is shown in Figure 1. Improving permeate water quality leads to decreased product quality issues, which has not been quantified here.

Energy and Water Savings: These improvements extend beyond improvements in permeate water quality and performance optimisation. The system runs based on a constant permeate flow by running the high pressure pump on a variable frequency drive. When scale deposits on the surface of the membrane, higher pressures are required to get the same flow. In addition to a higher required feed pressure, scale on the membrane surface leads to decreased flux and therefore lower recovery of the feed water into permeate water. By addressing the scaling issues associated with underfeeding, the driving pressure required to achieve the desired permeate water flow was decreased from 206 psi to 159 psi (23% lower) resulting in energy savings.

By removing and limiting the deposition of scale, other improvements were observed including a decrease in the required feed flow and waste water discharge. During the period of antiscalant non-feed the recovery was approximately 84%. With proper antiscalant dosage being controlled by 3D TRASAR Technology for Membranes, the system was able to maintain a recovery of 88%. Based on annual production water needs for this plant of 155000 m³ per year, this will result in 8300 m³ per year saved.

ENVIRONMENTAL/ECONOMIC RESULTS

Total Cost of Operations
Improvements: A total annual operating cost improvement of €21600 is based on conservative assumptions.

Environmental Impact Enhancements: In addition to the savings in total cost of operation, the customer sends 8300 m³ per year less to sewer to produce the same amount of product water (at higher quality) owed to improved PC-191T feed.

Capital Expenditures Avoided: The 3D TRASAR Technology for Membranes platform determined that the membranes were in working order and replacement was not required which is a clear demonstration of extended operational life. The customer’s system uses 66 membranes in this RO, which cost approximately €440 each for replacement cost of €29100.

The charts below detail the environmental (Table 1) and economic (Table 2) savings summarised here.

CONCLUSION

The damaging effects of scale are well known and non-feed, interrupted-feed, and poor dosage control of PC-191T is of great concern to RO operators. 3D TRASAR Technology for Membranes is credited with enabling the capture of the data required for this level of operational improvements. Ultimately, the 3D TRASAR platform proved that perceived oxidation of membranes can be costly and has saved the customer capital expenditure of €29100 for membrane replacement. These savings coupled with the improvements in the Total Cost of Operation of €21600, results in a total savings of €50700.

Table 1 – Details of Environmental Impact Enhancements.

Environmental Impact Enhancements	Reject Flow Decrease
per year	7760 m³ per year

Table 2 – Details to Improvements in Total Cost of Operations.

Annual Operating Costs	Savings
Water*	€5200
Sewer*	€4000
Power*	€1060
Chemical*	€11400

*Running 35% of the time; Power Cost €0.05/kWh; Water €2.52/3.8 m³; Sewer €1.82/3.8 m³