



WASTEWATER TREATMENT FOR POWER PLANT COOLING TOWERS

Case study

*Recovering wastewater and reducing operational costs
of a power plant in China using PROC30® membranes*

PROBLEM

A power cogeneration company located at a mining site in Liaoning province, China is operating for more than 100 years. It has an installed capacity of 2x150 MW heat and a 2x150 MW power generation system. Due to the lack of fresh water resources in the region, in the early stage the mining well drainage was

used the water resource of the boiler make-up water. But later, it changed to the combination of the mining drainage and the cooling tower blowdown from 2010 to 2016.

Starting from 2016, all feedwater changed to cooling tower blowdown as the water resource.



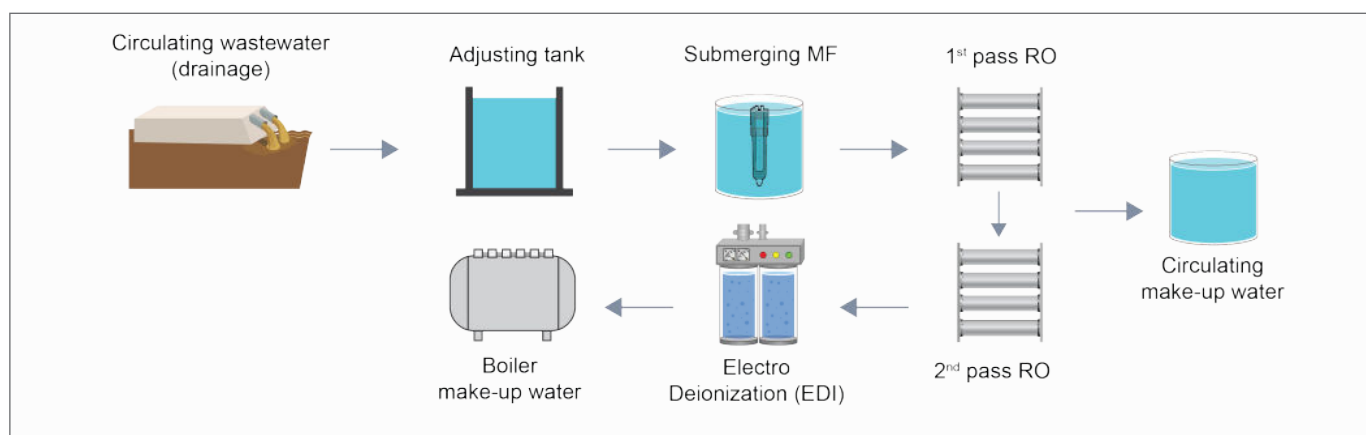
This is one of the power plants in the northern region which uses all-membrane process for water treatment in the early years. The 2-pass Reverse Osmosis treatment plant was built in 2006 that used Hydranautics membranes.

The treatment plant comprised of submerged MF pre-treatment followed by 2 pass RO, and EDI. Treated water quality met the requirements of the boiler feed make-up water.

After 10 years of successful operation, the plant replaced one train membranes (replacement rate of only 1.4%). At the end of 2017, the other two sets of the pass 1 RO membranes were replaced.

After a decade of steady performance, the customer requested for technologically advanced membranes that can decrease their OPEX.

Chart 1: Wastewater Treatment Process



Based on customer's requirements, Hydranautics recommended to replace PROC10® with new PROC30® membranes from the PROC® series.

PROC® is an anti-fouling series of membranes, which are specifically developed considering the wastewater features and applications required in China. The membranes have the 34 mil feed spacer LD technology, combined the patented air-vent ATD, to make it fouling resistant and robust.

The membrane surface has been improved with better characteristics. Under the same conditions, the flow has increased by around 10% and the salt passage has been reduced by around 20%. The below diagram shows the membrane system.

These PROC30® membranes were replaced in two of the 7 trains of first pass of the RO plant in the year 2017. The Table 1 shows the membrane array before and after membrane replacements.

Table 1: Pass 1 RO – Before and After Replacement

Details	Before	After	
Design flow (m ³ /h)	172.5 x 7 sets	172.5 x 5 sets	172.5 x 2 sets
Design recover (%)	80	80	80
Array	(20:9) x 7	(20:9) x 7	(20:9) x 7
Membrane Model	PROC10®	PROC10®	PROC30®

A few months after startup, the performance of the membranes monitored. The feed pressure increase and the permeate flow reduction are shown in figures 2 and 3 respectively. After cleaning with alkali and acid, the performance could be recovered. Only 3 cleanings were conducted in a span of 30 months. The average cleaning time was reduced by 50% compared to PROC10®, which saved 15,840 RMB/year on cleaning chemicals.

The average feed pressure of PROC30® was 0.92 MPa, comparing with the 1.08 MPa of PROC10® within the same period. This represents a saving of about 14.8% energy.

And calculating by local power price, PROC30® saved 22,800 RMB/year. The total cost of chemicals and power saved by PROC30® is 38,640 RMB/year/set, which met customers' requirements to lower the OPEX.

Even after 2.5 years of using PROC30® membranes, the normalized salt passage remained below 1%, that is normalized rejection rate was above 99%, (see figure 1) and the permeate quality continued to be outstanding. The typical feed water quality of RO 1 (pretreated cooling tower blowdown) is given in the Table 2.

Table 2: Typical feed water quality, in mg/l

Item	Value	Item	Value
Turbidity, NTU	<0.2	HCO ₃ ⁻	146.45
SDI	<3.0	SO ₄ ²⁻	486.80
pH	8.15	Cl ⁻	268.00
COD _{Mn}	4.48	NO ₃ ⁻	82.83
Ca ²⁺	242.48	PO ₄ ³⁻	1.98
Mg ²⁺	44.96	Solved SiO ₂	23.60
Na ⁺	97.20lk	TDS	1416.40

Fig 1: PROC30® system normalized salt passage

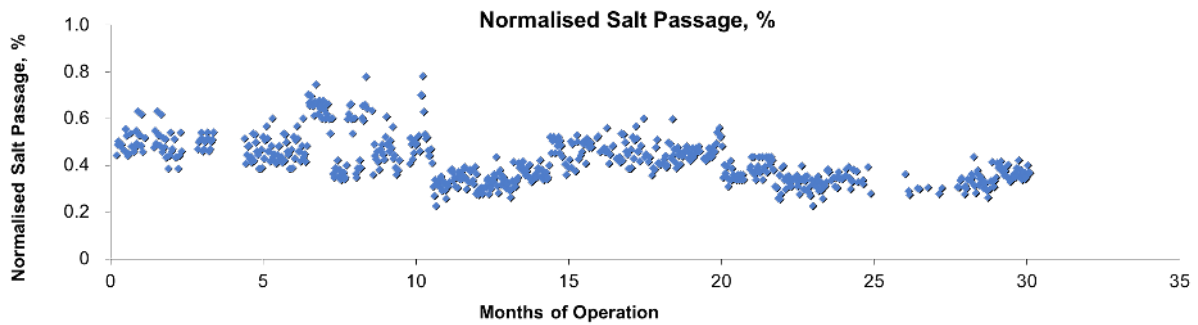


Fig 2: PROC30® system feed pressure

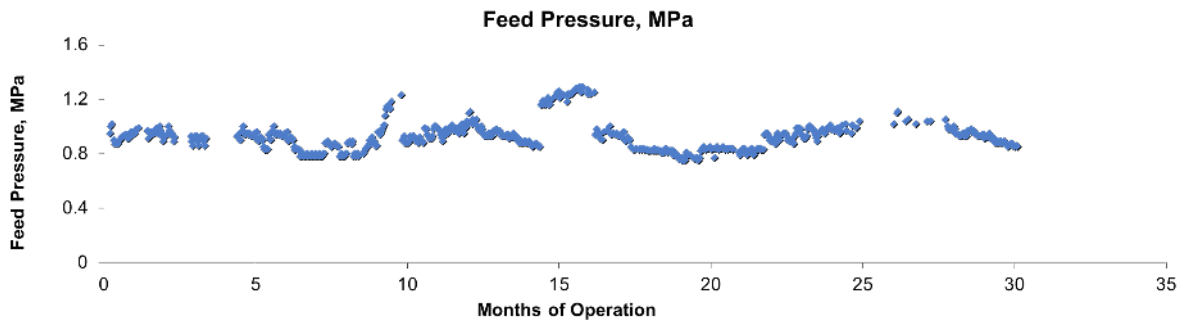
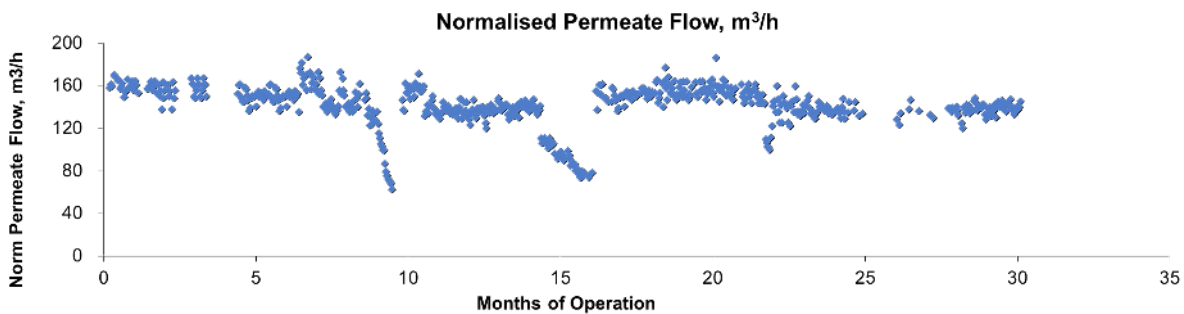


Fig 3: PROC30® system normalized flow rate



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About Hydranautics

Since our founding in 1963, Hydranautics has been committed to the highest standards of technology research, product excellence and customer fulfillment. Hydranautics entered the Reverse Osmosis (RO) water treatment field in 1970 and is now one of the global leaders in Integrated Membrane Solutions. Hydranautics became a part of the Nitto Group in 1987. Nitto is Japan's leading diversified materials manufacturer. The group offers over 13,000 high value specialty products worldwide including optical films for liquid crystal displays, automotive materials, reverse osmosis membranes for desalination and transversal drug delivery patches.

As leaders of high quality membrane solutions, we believe our commitments extend beyond manufacturing and selling our products. Our skilled staff of technicians, engineers and service professionals assist in designing, operating and maintaining a robust, reliable and efficient membrane system to meet your requirements and exceed your expectations.