





Case study

Using PRO-XS2 membranes to separate Na<sub>2</sub>SO<sub>4</sub> salt from concentrated brine at a textile dyeing wastewater ZLD plant in China

## The PROBLEM

A textile industrial park in Foshan, Guangdong, China, started using the centralized dyeing wastewater treatment plant as a ZLD system in 2018. This is one of the leading ZLD projects that operated at 85% recovery. The feed to the ZLD plant came from an upstream wastewater treatment system high in salinity (~10,000 mg/l), alkalinity, temperature, and organics. The average water temperature was about 30°C, close to 40°C in summer. The plant sought to meet the discharge standards, good salt separation of brine and a long-term stable operation of the system.



The SOLUTION

Hydranautics studied the objectives of the plant and concluded that a good separation of NaCl and  $Na_2SO_4$  salts was required. We offered two trains of PRO-XS2 nanofiltration membranes as the first treatment step of the ZLD train to treat the upstream RO brine stream. The system configuration information is listed below in Table 1, a photograph of the actual system is in Figure 1 and the block diagram in Figure 2.

Hydranautics PRO-XS2 membrane separates NaCl and  $Na_2SO_4$  from brine – while NaCl goes to the permeate,  $Na_2SO_4$  gets concentrated in the reject. The by-product  $Na_2SO_4$  salt in solid form, obtained by evaporation and

crystallization, finds many uses, thus bringing significant economic and environmental benefits to industries.

The permeate from the PRO-XS2 membrane predominantly containing NaCl evaporates and crystallizes to convert to usable NaCl salt.

The Hydranautics PRO-XS series is a unique nanofiltration spiral wound membrane customized for challenging industrial applications. These membranes are based on Hydranautics high-performance membrane products, which have been specially designed to treat a variety of challenging industrial feed streams, including high fouling, high TDS, and having special ion separation requirements.

Parameter	Value
Feed water	RO brine
Permeate capacity,(m <sup>3</sup> /h)	180
Feed EC, (µS/cm)	16,000-20,000
Feed COD, (mg/l)	40-65
Flux, (lmh)	18.3

Parameter	Value
Recovery (%)	75
Array	24 x 12 x 8-6
Membrane model	PRO-XS2
Quantity per train	264



## The IMPACT

Both PRO-XS2 trains have been used since January 2021, completing two years of successful operation. The system has been stable and has shown a low-pressure drop during operation. The chemical cleaning frequency has been stabilized to once a month.

The customer compared three different manufacturers' nanofiltration membrane

sulphate passages. The data in Figure 3 shows that although all three manufactures membranes had initial sulphate passage of 0.7%, PRO-XS2 retained it to low levels, whereas it increased several folds in other membranes. The data confirmed the excellent salt separation performance and stability of PRO-XS2.



Hydranautics commissioned a third-party testing agency to conduct water quality analyses in June 2022. Figure 4 shows the feed water concentrations of  $SO_4^{2-}$  and Cl<sup>-</sup> to be 5,010 mg/l and 3,420 mg/l, respectively. The concentration of  $SO_4^{2-}$  in the permeate is only 310 mg/l, while the concentration of Cl<sup>-</sup> reached 3,970 mg/l, showing the minus rejection of Cl<sup>-</sup> (- 16.1%).

The data from the third-party agency and the customer confirmed that PRO-XS2 has good salt separation performance.

Figure 4. PRO-XS2 SO<sub>4</sub><sup>2</sup>/Cl<sup>-</sup> Concentration 16000 12000 8000 4000 0 Feed Permeate Brine  $SO_4^{2-}$   $Cl^-$ 

This plant recovered about 100,000 tons of  $Na_2SO_4$  annually. The savings correspond to about 60 million RMB, costing 600 RMB per ton of salt while simultaneously reducing

Combined with other nanofiltration membranes, PRO-XS2 can effectively separate monovalent and divalent salts and concentrate the brine simultaneously.

The operating loads on the evaporator and crystalliser have been reduced, and the purity of by-product salt has been improved. The  $Na_2SO_4$  solid salt recovered by the freezing crystalliser followed by a dehydrating evaporator and the crystalliser had 99% purity and could be reused.



the purchased quantity. These are significant benefits, not only monetary, but social and environmental as well.

## **Authors**

YUMING ZHANG Technical Engineer

PENGHUI WANG Technical Engineer

For more information about Hydranautics case studies, contact us at hy-marketing@nitto.com or visit our website at membranes.com.

## 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.



