



# HELPING COAL CHEMICAL ZLD PLANT TO REDUCE OPERATIONAL RISKS AND COSTS

*Case study*

*Using PRO-XR1 membrane to reduce operating costs  
in a coal chemical ZLD project in China*

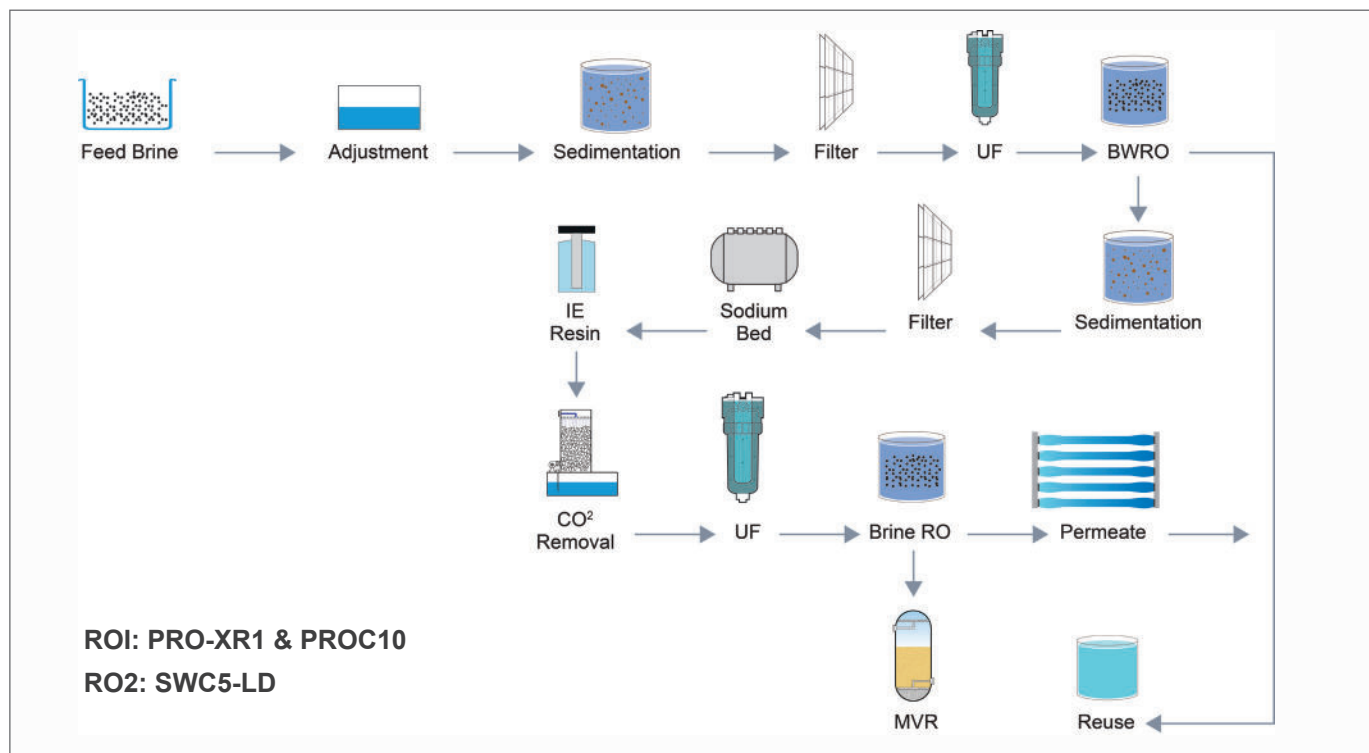
The **PROBLEM**

A coal chemical enterprise is located in the medium-temperature arid climate region of Ningxia province that has the characteristics of dryness, low rainfall, high evaporation, and long hours of sunshine. The enterprise built a Zero Liquid Discharge (ZLD) system in 2016 to meet the environmental standards applicable to coal chemical projects.

This ZLD system treats saline wastewater containing high hardness and organics at 2,800 m<sup>3</sup>/h. The system used Hydranautics brackish water RO (BWRO) and sea water RO membranes (Brine RO). Figure 1 shows the block diagram, and Figure 2 shows the photograph of the plant.



Figure 1: Block Diagram of the ZLD System



After passing through the clarification tank, variable pore filter, and ultrafiltration, the BWRO and the Brine RO system concentrated the wastewater.

There were ten BWRO and four Brine RO trains. The BWRO train had two stages, it operated at a recovery of 70% and produced 196 m<sup>3</sup>/h permeate.

After over two years of operation, the plant saw an increase in BWRO feed water COD and fluctuations caused by the mixing of circulating sewage and desalted brine. The salt rejection of BWRO membranes was reduced to 96%, and the chemical cleaning frequency increased twice monthly, increasing operating costs. The enterprise looked to upgrade the original system to reduce operational risks and costs.

**Table 1: BWRO Train Configuration**

Item	Value
Application	Coal chemical ZLD
Raw water	Saline wastewater
Capacity, m <sup>3</sup> /h	196
Feed COD, mg/l	>50
Feed Conductivity, μS/cm	5,500
Recovery, %	70
Flux, l/mh	14.8
Array	34 X 17 - 7
Membrane Quantity	357

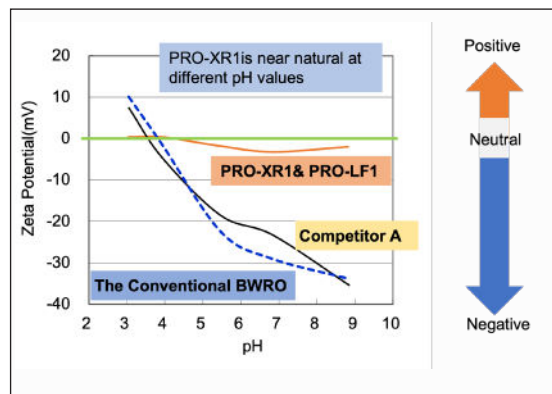
## The SOLUTION

In 2021, after a thorough review of the feed water quality and the fluctuations and characteristics of the organics in water, Hydranautics' team recommended using PRO-XR1 membranes.

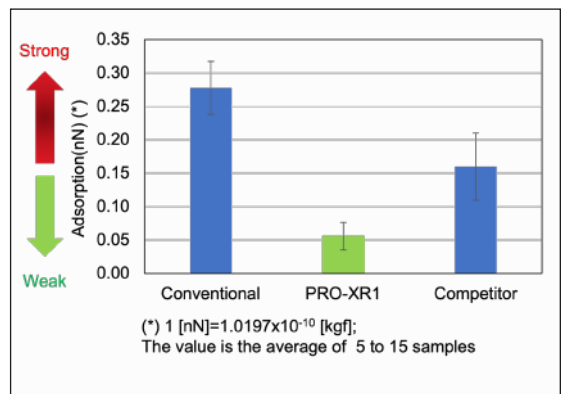
PRO-XR1 membranes are designed for ZLD applications in industries. It has an improved anti-fouling performance than

conventional membranes. The membrane surface is electrically neutral and does not readily adsorb positively charged substances (see Figure 3). The membrane surface has a low capacity for protein adsorption, making it less susceptible to contamination by organic matter or microorganisms (see Figure 4).

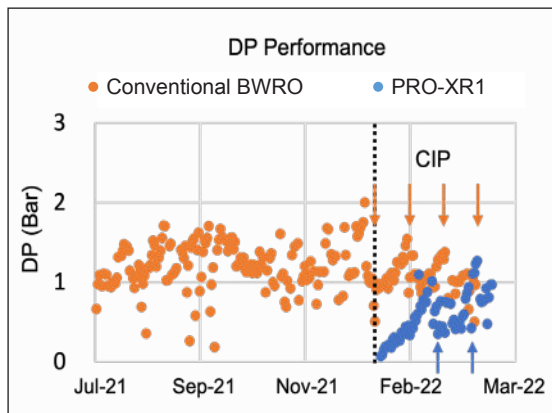
**Figure 3: Neutral Surface**



**Figure 4: Protein (BSA) Absorption Test**



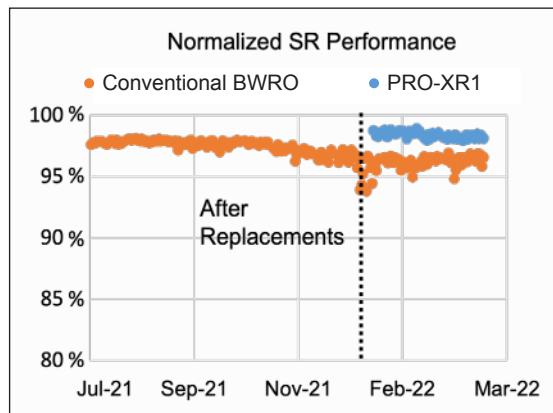
**Figure 5: Pressure Drop**



With the use of PRO-XR1 membrane, cleaning frequency decreased, operating life increased and operating costs reduced. Even after a few years of operation, it still continues to produce a high-class reuse water quality.

Figure 5 shows the pressure drop across the BWRO train. After installation of the

**Figure 6: Normalised Salt Rejection**



PRO-XR1 membranes, the pressure drop lowered, indicating reduced fouling of the membranes in spite of requiring less cleanings during this period. Figure 6 shows that the normalised salt rejection of the PRO-XR1 membranes remained higher than the previous BWRO membranes.

## The IMPACT

The following observations confirm the outperformance of PRO-XR1 membranes over the conventional membranes:

1. Lower differential pressure across PRO-XR1 indicated less fouling.
2. Higher than 98.5% salt rejection (SR) indicated better permeate quality.

3. A reduced chemical cleaning frequency meant PRO-XR1 would last longer.
4. All the above reduced the chemical cleaning cost of the ZLD plant by around 50%.

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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.