

TREATING TANNERY WASTEWATER USING ULTRA HIGH PRESSURE RO

Case study

*Using PRO-XP1 membranes to reduce the cost
of achieving ZLD at a CETP in India*

Treating and reclaiming tannery wastewater in India is both challenging and costly, especially when the goal is to achieve Zero Liquid Discharge (ZLD). Based on the type of leather being processed, tannery effluent TDS can range from 15,000 ppm to 25,000 ppm. COD levels can range from 1,000 mg/l to 8,000 mg/l. Multiple tanneries in one region dispose effluent to a Common Effluent Treatment Plant or CETP with capacities between 600 KLD to 4000 KLD (26,000 gpd to 160,000 gpd).

The wastewater entering a CETP undergoes numerous pretreatment processes before going to the multi stage RO to reduce the TDS, COD and BOD. After the multi stage RO and other membrane-based processes recover 65% to 70% of the wastewater, the remainder is treated with an evaporator and crystallizer to produce solids. The operational cost of an evaporator is 8 times higher than the operational cost of the RO membranes.



The challenges associated with using membranes to treat these highly contaminated effluents and achieve ZLD includes heavy fouling, frequent cleanings, solids disposal, and high operating and maintenance costs associated with the final evaporative steps. Evaporators consume 20-25 kWh of power per m³ of water treated while crystallizers consume 52-66 kWh of power per m³.

The evaporative technologies consume significantly more energy when compared to the reverse osmosis system at 1.5 to 6.0 kWh of power per m³. The current technology for treating the last portion of the RO brine before the evaporator is limited, costly, and requires high maintenance. A more efficient ultra-high-pressure RO option, based on standard RO technology, was developed to bridge the gap between existing standard RO and the final, thermal steps.

Parameter	Feed	PROXP1 Permeate	PROXP1 Reject
Source / Application	From existing 2 nd stage RO reject	Reuse for tannery process	Feed to evaporator to achieve the ZLD
TDS mg/l	53770	338	89160
Calcium as Ca mg/l	962	3.2	1563
Magnesium as Mg mg/l	437	2	802
Chloride as Cl mg/l	26899	58	42880
Alkalinity as CaCO ₃ mg/l	240	8	280
COD mg/l	3106	27	3815
Flow m ³ /h	1.29	0.44	0.85
Operating Flux		13.2 lmh	

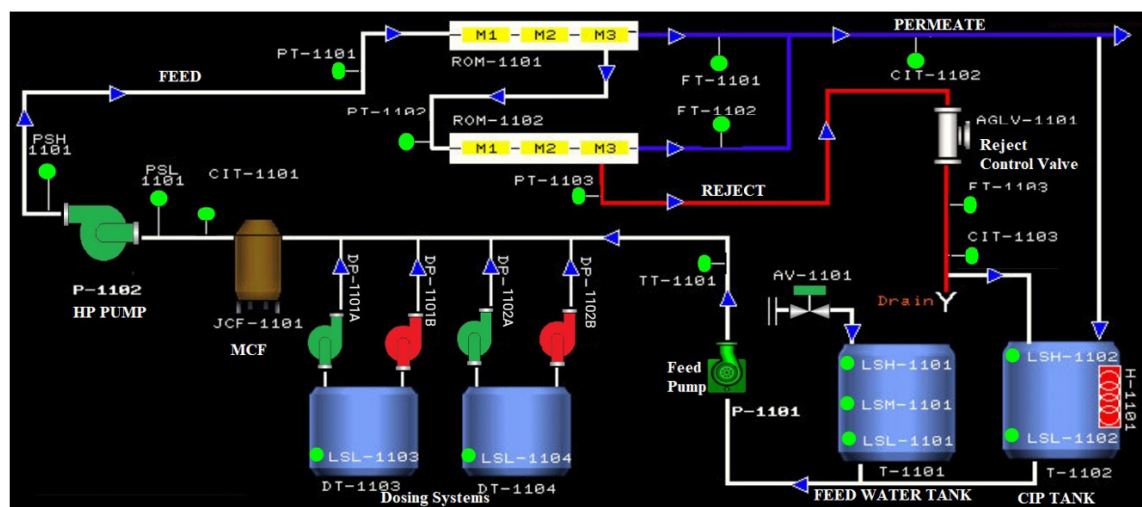
The SOLUTION

Standard SWRO elements are limited to a maximum feed pressure of 83 bar (1200 psi) at 25°C. This pressure limitation decreases as temperature increases. This limits the standard RO elements from concentrating the TDS to beyond 60,000 mg/l. Hydranautics developed the PRO-XP1, the ultra-high pressure membrane, that can operate up to 124 bar (1800 psi) at 25°C. The membrane allows the RO system to concentrate the TDS up to 130,000 mg/l or higher.

To demonstrate the feasibility of this new membrane, a pilot study was conducted for eight months at a Tannery CETP in India. Six PRO-XP1 elements were installed in two pressure vessels in series. The pilot operated at the element's maximum pressure of 95 bar at the wastewater's temperature of 35°C.

The recovery ranged between 34% and 40% while fluxes ranged between 7 lmh and 13 lmh. The TDS in the feed was 53,700~60,000 mg/l and the COD level was 3,100 mg/l. To maintain a stable performance, the system was flushed daily and received a CIP every 2 to 4 weeks. TDS was consistently reduced to 300 mg/l while COD was reduced to less than 30 mg/l. The pilot demonstrated that the PRO-XP1 can be used to further concentrate the salts and can reduce the flow to the evaporator by 40% while producing a high quality permeate over an extended period of operation.

Full scale ultra-high pressure RO was designed to operate at a flux of 11 lmh and 40% recovery. This required a single stage system with six pressure vessels each containing six PRO-XP1 elements.



The

IMPACT

The thermal system, originally designed to treat 40 m³/h could be reduced in capacity by 40% to treat only 24 m³/h. Including a PRO-XP1 ultra-high pressure RO system after the existing multi-stage RO reduces the flow to the evaporator and crystallizer by 40%. The corresponding reduction in the size of the evaporator / crystallizer reduces both capital and operating costs.

The pilot study successfully demonstrated the ability of the PRO-XP1 membranes to concentrate the tannery wastewater at a pressure up to 95 bar and a temperature of 35 °C. These membranes can significantly reduce the total water cost for achieving ZLD at the tannery. The PRO-XP1 membranes can be used for any high salinity, high fouling wastewater. Apart from tanneries, these membranes can also be used in industries such as textile, pulp & paper, oil & gas, and food & beverage etc.

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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.

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