

Toray's Membrane Technologies Achieve Zero Liquid Discharge in India's Special Economic Zone

BACKGROUND

Zydus Infrastructure operates the Pharmez Special Economic Zone (SEZ) near Ahmedabad, where a 'common effluent treatment plant' (CETP) collects industrial wastewater from 12 pharmaceutical sites, treating it via clarification, followed by a 750 KLD membrane bioreactor (MBR) process.

Due to ongoing operational issues, the MBR modules required replacement. However, a Zero Liquid Discharge (ZLD) process would be integrated to meet the increasing demand for clean water within the SEZ and compliance with environmental policies. The engineering firm Hasgak Water Pvt. Ltd. was selected to design and build the ZLD process system using Toray's reverse osmosis (RO), nanofiltration (NF), and MBR membrane technologies.



Figure 1 : MBR tank

MEMBRANE BIOREACTOR

In 2017, Hasgak commissioned a new MBR system with 1.5 MLD capacity using Toray's flat-sheet MBR modules. A year later, the existing 750 KLD MBR system expanded to 3.0 MLD to meet production capacity and ensure the continuous production of filtered water should one of the MBR systems require downtime for maintenance. Illustrated in Figure 2 is the complete ZLD system.

Toray MBR modules use durable PVDF microfiltration flat-sheets with uniformly sized pores (0.08 μm) densely distributed along the membrane surface. Toray MBR provided the following benefits to Pharmez SEZ:

- Enhanced fouling and chemical resistance;
- Elimination of a backwash process, simplifying maintenance and energy savings;
- Conversion from a suction pump to a gravity flow process further minimizing energy costs;

- Approximately 70% reduction in sludge.
- Before the MBR process, PVA (polyvinyl alcohol) gels are added to the aeration tank to reduce the volume of sludge, improve MBR outlet parameters, and minimize system footprint (Figure 3).

HIGH-RECOVERY RO/NF DESIGN

The MBR filtrate is chlorinated, treated by activated carbon, and dechlorinated before entering the RO system. Due to elevated levels of Chemical Oxygen Demand (COD) in the RO feed, the 1st-stage RO system uses Toray's "Durable" D-Family low-fouling RO membrane elements to combat membrane degradation and maintain performance for day-to-day operations and cleanings.

Toray's seawater RO membranes, designed to operate reliably under high salinity feedwater conditions, reduce the TDS content from 13,000 to 200 ppm in the 2nd-stage.

CSM™ membranes maximize water recovery by concentrating the brine from 75,000 ppm (4th-stage RO concentrate) to 92,000 ppm. Lastly, multi-effect evaporation crystallizes the salts and completing the ZLD process for a total water recovery of 97.1%.

The exponential increase of salt concentrations heightens the risk of membrane scaling within the high-recovery RO/NF system. As a result, the RO system is dosed with Toray's ROPUR RPI® antiscalants to prevent irreversible scaling, minimize system downtime, and optimize the membranes' recovery performance. Compared to the previously used antiscalant, only half the dosage is required with ROPUR RPI®, further contributing to cost savings.

Table 1 — Toray water treatment technologies

Technology	Model	Quantity
MBR	TMR140-200D	14
	TMR140-100S	36
Low-fouling RO	TML20D-400	96
Low-energy SWRO	TM820V-400	36
NF	NE8040-70	8
Antiscalant	RPI 3000A	

CASE STUDY

RO | UF | MBR | CHEMICALS

Toray's Membrane Technologies Help Achieve Zero Liquid Discharge in India's Special Economic Zone

Table 2 — Water Quality

Parameter	A: Feed influent	B. MBR influent	C. MBR filtrate	D. 1st stage RO feed	E. NF feed	F. Final RO permeate
Flow rate (KLD)	4,500	4,500	4,500	1,500	45	1,455
TSS (ppm)	280	100	<1	BDL		
Turbidity (NTU)		<50	<1			
BOD (ppm)	450	450	<3			
COD (ppm)	1,200	1,200	<25			
TDS (ppm)	2,000	2,000	2,000	2,000	75,000	<250

Figure 3 : Aeration and MBR tanks

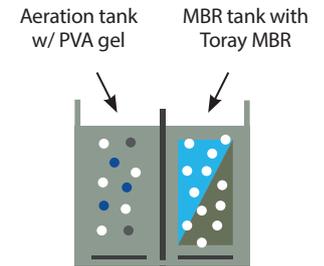
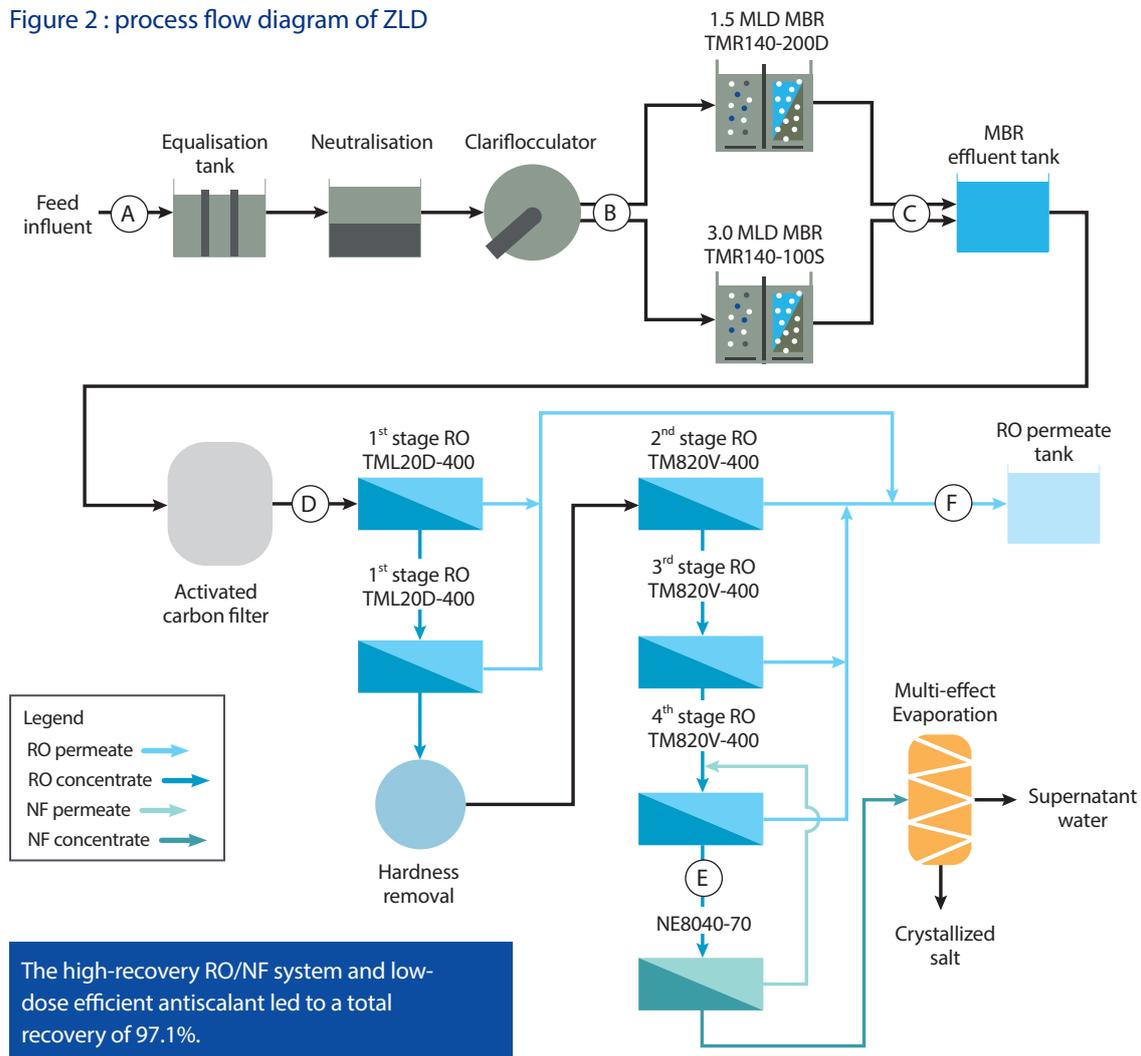


Figure 2 : process flow diagram of ZLD



TORAY INDUSTRIES, INC.

Head Office: Nihonbashi Mitsui Tower 24th Floor, 1-1, Nihonbashi-Muromachi 2 chome, Chuo-ku, Tokyo, 103-8666, JAPAN

www.water.toray

+81 3 3245-4540

[LinkedIn](#)

[YouTube](#)

Marks designated with a [™] or [®] are trademarks of Toray Industries, Inc.

All information presented herein is believed reliable and in accordance with accepted engineering practices. Toray makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. Toray assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products. © 2021 Toray Industries, Inc. Subject to change without notice.

TORAY
Innovation by Chemistry