

Solutions for Industrial Field

ZLD with HERO™

Overview

Water scarcity and pollution are persistent global issues. The most prudent solution is to recycle and reuse wastewater. Therefore, environmental authorities all over the world introduce ZLD^(*1) systems to industrial processes.

We, Toshiba, have a state of the art ZLD system based on HERO™^(*2) technology, which offers more efficient and superior treatment at lower life cycle cost than conventional systems.

(*1) ZLD: Zero Liquid Discharge

(*2) HERO™ is a trademark, a technology protected by a patent, and a proven technology with 150+ reference installations worldwide. Toshiba Water Solutions Private Limited as one of our group companies is a licensee of HERO™.

ZLD

The ZLD system can be introduced in cases where water resources are limited and environmental sustainability is prioritized.

The recycling system with RO^(*3) membrane generates reject water containing highly concentrated wastewater with TDS^(*4). In most cases, reject water cannot be discharged, thus an evaporator is installed after RO, to evaporate reject water and concentrate salts to dryness. Also due to the high cost of evaporators, it is a prerequisite to integrate a high efficiency RO system in the ZLD process so as to minimize the RO reject volume and optimize the size of the evaporator to be installed. This can be achieved by increasing the recovery across the RO system in the ZLD system based on HERO™ technology.

(*3) RO: Reverse Osmosis

(*4) TDS: Total Dissolved Solids



Four problems with ZLD system with conventional RO

There are scaling and fouling problems in the ZLD system with conventional RO, causing an increase in feed pressure, a decrease in permeate flow, lower permeate quality, frequent RO cleaning, longer downtime, and eventually frequent replacement of RO membranes.

1. Hardness scaling	Settlement of saturated calcium or magnesium salts, heavy metal sulfates, phosphates or carbonates on the membrane surface
2. Silica scaling	Settlement of reactive silica exceeding the solubility limit on the RO membrane surface while conventional RO is operated at neutral or slightly acidic pH
3. Organic fouling	Result of the deposition of organic matter on the membrane surface, usually on the feed/concentrate side
4. Biofouling	Growth of microbes on the RO membrane surface, causing permanent irreversible damage

For a conventional RO system, pH of feed water is lowered and antiscalant is dosed to prevent hardness scaling. But it does not work for higher recovery rates. In addition, lower pH decreases silica solubility, resulting in silica scaling. Some of the COD^(*5) remain in industrial wastewater even after biological treatment. In many cases, the conventional RO fails to operate in a sustainable manner at 80%+ recovery due to silica and residual COD in the feed water.

(*5) COD: Chemical Oxygen Demand

Solution for ZLD: HERO™ - High Efficiency Reverse Osmosis

HERO™ is a technology to eliminate all scaling and fouling factors (hardness, alkalinity, silica precipitation, organic fouling and bio-fouling) by ion exchange, degassing and RO system operation at high pH by maximizing recovery through the RO system.

In the HERO™ system, scaling and fouling are eliminated; therefore, the system can increase the RO water recovery rate to the maximum extent possible.

< Process description >

Equipment composition			
	Lime/caustic clarifier and/or ion exchange system	Degassing tower or membrane	High pH RO operation
Purpose	Hardness removal (Softening)	Alkalinity removal	Prevention of RO filter fouling Increase in water recovery rate
	To remove Ca, Mg and other heavy metals, which can potentially cause scaling in RO	To remove carbonic acid, which can cause carbonate scaling in RO	To improve silica solubility, prevent the adsorption of organic matter by RO, inactivate bacteria, and enhance the zeta potential between membrane and particles
	Solution for 1. Hardness scaling	Solution for 1. Hardness scaling	Solutions for 2. Silica scaling 3. Organic fouling 4. Biofouling

Comparison between ZLD with conventional RO and ZLD with HERO™

By virtue of high efficiency, low generation of reject and downsizing of the evaporator, the HERO™ system can reduce operation costs, compared to conventional RO systems.

	ZLD with conventional RO	ZLD with HERO™
Recovery rate	Low <ul style="list-style-type: none"> • Normal water recovery rate: 70 to 80% 	High <ul style="list-style-type: none"> • More than 90% recovery rate (depending on water conditions)
Initial cost	Moderate <ul style="list-style-type: none"> • The larger the evaporator size, the higher the initial cost 	Moderate <ul style="list-style-type: none"> • Cost increase due to additional pre-treatment systems (ion exchange, degasser) and high pressure RO system • Cost reduction through downsizing of the evaporator and boiler
Running cost	High <ul style="list-style-type: none"> • The higher the steam consumption, the higher the running costs 	Much lower <ul style="list-style-type: none"> • Significantly lower than normal RO system • Short-term recovery of initial investment
Daily inspection	Good	Moderate <ul style="list-style-type: none"> • Compared to conventional RO, • More equipment in need of checking • No special equipment in need of great care
Periodical maintenance	Moderate <ul style="list-style-type: none"> • More frequent RO CIP^(*6) for scaling and fouling • Frequent evaporator cleaning due to rich-hardness RO reject 	Good <ul style="list-style-type: none"> • Less frequent RO CIP and longer membrane life through prevention of scaling and fouling in HERO™ • Stable evaporator operation with low-hardness reject

(*6) CIP: Clean in Place

Available region

HERO™ is used in regions where Toshiba Water Solutions promotes sales except for the following industries.

- Microelectronics industry
- Power industry in the United States, Mexico, Canada and India
- Oil refining and petrochemistry plants owned by Reliance Industries Limited
- Coal-based chemical, gas and liquid production plants in China
- All industries in Korea except for specific non-microelectronics industries

Highlights of HERO™

More than 95 % water recovery rate

The recovery rate of conventional RO systems is limited to 70% to 80% depending on inlet water quality.

We offer the HERO™ system for ZLD, which can operate at a recovery rate of more than 95% in most cases.

Compared to conventional RO systems, the HERO™-based RO system can reduce the volume of reject water to 1/4 and provide significant operational savings.



Extension of reverse osmosis membrane life

Scaling and fouling factors are eliminated, leading to an extension of the RO membrane life, a reduction of the system shutdown time, and eventually a significant reduction in the life cycle cost of the system.



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Reference Project (HERO™)

Automotive Factory

Location	India
Launch	2016
Capacity	350 m ³ /day
Project Description	Wastewater treatment plant for automotive industry was built. ZLD was adopted in order to meet strict wastewater treatment requirements in India.
Scope	Design, engineering, supply, erection, installation, testing and commissioning
Solutions	We constructed ETP - ZLD system. The system consists of pre-treatment, anoxic - aerobic - MBR(*7) based treatment, HERO™ thermal based evaporator to provide treated water suitable for reuse in the production plant. The HERO™ evaporator is less than 1/4 of the conventional RO system in size. Accordingly, steam consumption can be saved by 75% and water recovery can reach 95%.



(*7) MBR: Membrane Bioreactor

Treatment Process



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