Utilization of Tubular UF Membranes in Zero Liquid Discharge Application

www.berghofmembranes.com
Summary

• Introduction

• Zero Liquid Discharge (ZLD)

• Chemical Resistant (CR) Tubular UF Membranes

• Case Study – Thermal Solar Plant, Mojave, CA

• Conclusions
Berghof Membranes
Think Outside the Box

Berghof Membrane Technology GmbH, part of the Berghof Group, is the leading manufacturer of tubular membranes for the filtration and separation of process streams and wastewater for industrial applications.
Berghof Membranes
The Leader in Tubular Membranes

Berghof Membrane Technology GmbH part of the Berghof Group, is the leading manufacturer of tubular membranes for the filtration and separation of process streams and wastewater in a variety of industries.
About Berghof Membranes
More than a membrane supplier

- **Tubular Membrane Modules**: 5 mm, 8 mm, Chemical Resistant
- **B-SMART** External Filtration System
- **B-CARE** Service and Support Program
Zero Liquid Discharge (ZLD)

- **ZLD** is a water treatment process in which all wastewater is purified and recycled and therefore leaving zero discharge at the end of the treatment cycle.
- **ZLD treatment** method includes ultrafiltration, reverse osmosis, evaporation/crystallization and deionization.
Zero Liquid Discharge (ZLD)

ZLD technologies help plants to meet discharge and water reuse requirements, enabling industries to:

- Meet stringent environmental discharge regulations
- Treat and recover valuable products from waste streams
- Improve management of produced water
- Transition from “Linear” to “Circular Economy”
Zero Liquid Discharge (ZLD)

- **Circular economy** is a global driver for water reuse applications (incl. ZLD) and new technologies

  In 2013 State Council said that 10 sectors & industry parks need to transition to a circular economy

  1. Coal
  2. Power
  3. Steel
  4. Nonferrous metals
  5. Petroleum & Petrochems
  6. Chemical
  7. Building materials
  8. Paper
  9. Food
  10. Textile

  ![Circular Economy Diagram]

  Note that these 10 industries complement the 10 industries identified in the The Made in China 2025 Plan

  Plan >> China's Water Challenges >> Thirsty Power >> HKH 16 vs. G20 >> Revamping Business

  >> Made in China 2025

Zero Liquid Discharge (ZLD)

Feed equalization tank

RO concentrate
(Stage 1)

NaOH

Reaction Tank Stage 1
pH~11

Mg(OH)$_2$↓

NaOH, Na$_2$CO$_3$

Reaction Tank Stage 2
pH~10.5

CaCO$_3$↓

Concentration tank

UF

Berghof B-SMART®
CR membranes

pH Adjustment Tank
pH~6.5

pH~10.5

Recycle retentate

2nd Stage

RO permeate

Recycle retentate

Filter press

Solids for disposal or recovery

Filtrate

Settler

Berghof
Tubular CR (Chemical Resistant) Membranes

- CR Membranes Polyvinylidene fluoride (PVDF)
Case Study
Thermo Solar Plant – Mojave, CA

Early 2015 LEFingenieros successfully completed the commissioning of both zero discharge plants
Case Study
Thermo Solar Plant – Mojave, CA

RAW WATER
(Well)
TDS 1.966 ppm
(Design: 2.200 ppm)
SDI<1

COMPLEMENTARY INSTALLATIONS
Chemical storage and dosage
MCC Supply
HTF Separator
Oily Water Pumping
Pumping to Pounds
Multimedia filters (pretreatment)

2 WTP PLANTS
1100 GPM

WTP α/β

POTABLE
1 RO 83.3% conversion

PRIMARY
(cooling towers)
3+1 RO 75.0 % conversion

MIRROR
(mirror cleaning)
1+1 RO 90.0 % conversion

DEMINERALIZED
(boilers & steam)
1+1 Mix Bed

ZERO DISCHARGE
Softening
Ultrafiltration
6+2 Cross Flow
Ultrafiltration
Concentration
3+1 RO 85.1%
conversion
Case Study
Thermo Solar Plant – Mojave, CA
## Case Study
Thermo Solar Plant – Mojave, CA

<table>
<thead>
<tr>
<th>Process</th>
<th>Volume [GPM]</th>
<th>[m³/day]</th>
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<td>Treatment</td>
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<tr>
<td>RO concentrate</td>
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<td>4922</td>
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<tr>
<td>Cooling tower blowdown</td>
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<td>2650</td>
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<td>Filter press recycle</td>
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<td>Recycled water</td>
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<td>UF permeate</td>
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<td>Evaporation pond</td>
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</table>
Conclusions

• **Zero Liquid Discharge** is a promising treatment process which is promoted by circular economy and stricter regulations on wastewater disposal.

• **Chemical Resistant membranes** stable at high pH were developed to meet ZLD process requirements.

• Since 2015, a thermal solar plant is operational with ZLD wastewater treatment process that **recycles each day approximately 1.7 million gallons**.
More than just a membrane supplier

**B²CARE®**
Service and Support Programs

**Tubular UF Membrane Modules**

**B²SMART®**
Intelligent Software & Engineered Systems