Advantages and disadvantages of applying Zero Liquid Discharge (ZLD) Concept

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Abstract

Continuous growth of population, expansion of industry and infrastructures resulted in accelerated depletion of the natural water supplies and created water stress regions around the world.

Moreover, with more and more stringent environmental regulations being enforced, waste water discharge is becoming a real concern.

It is a must to apply new concepts in water management to overcome water scarcity and find new disposal alternatives to comply with the more stringent discharge regulations.

Zero Liquid Discharge (ZLD) is a new concept in waste water treatment that totally eliminates waste water discharge to water bodies. Evaporation and crystallization technologies are essential steps in any ZLD application. These steps involve expensive technologies and energy intensive processes. Accordingly any good process design shall consider a high recovery pretreatment process to recover (and reuse) as much as possible of the wastewater, prior to commencing the evaporation and crystallization of a concentrated wastewater feed.

Egyptian Ethylene and Derivatives Company (ETHYDCO) is building a Utility Plant to provide its Ethylene and Derivatives Complex with different utilities Such as Demin water, cooling water, potable and utility water, air…etc.
Cooling water demand is 32000 m3/hr which requires about 3000 m3/hr as makeup water. This enormous amount of water is not available and hence the need for water recycle/reuse is necessary.

Coupled with compliance with stringent Egyptian Environmental laws lead to use ZLD concept.

This presentation explores ZLD advantages/disadvantages through reviewing the utility plant consumptions with and without applying the ZLD


WASTE WATER TREATMENT
APPLYING
ZERO LIQUID DISCHARGE
(ZLD)

MOTIVATION FOR WATER MANAGMENT

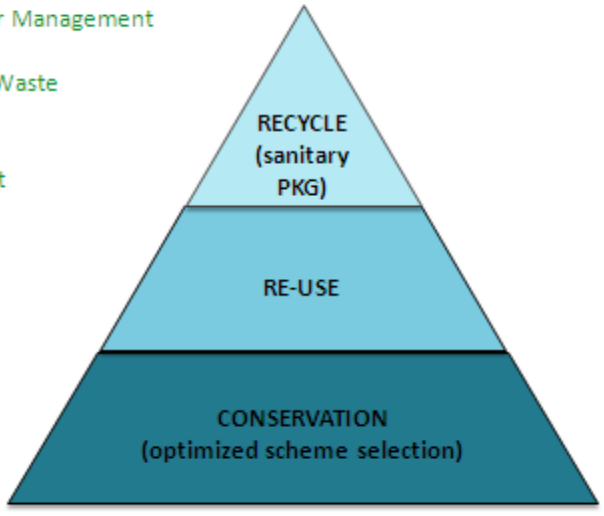
- ✓ Shortage of fresh water supply
- ✓ More stringent environmental regulations on waste water discharge

WATER MANAGEMENT OBJECTIVES

- ✓ Minimize raw water consumption
- ✓ Minimize waste discharge to environment
- ✓ Optimize cost

WATER USE MINIMIZATION PYRAMID

- Total Water Management
- Minimum Waste Discharge
- Cost Impact



WASTE WATER DISPOSAL ALTERNATIVES

- ✓ Discharge to surface water
- ✓ Underground injection (disposal wells)

OR

- ✓ Zero Liquid Discharge

Where discharge is constrained or restricted

WHAT IS ZLD?

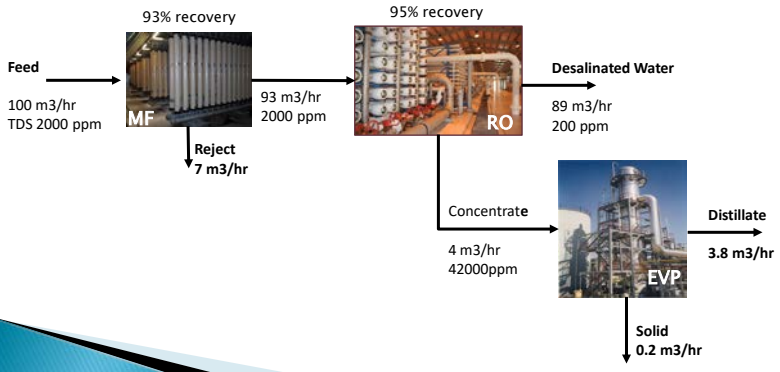
ZLD is a new generation of waste water treatment concept that totally eliminates waste water discharge to water bodies in an environmental friendly way.

ZLD recovers all the concentrate (brine in most cases) as distillate and salt product.

ZLD is often integrated with:

- ✓ Micro/ Ultra filtration (MF/UF)
- ✓ Reverse Osmosis (RO)

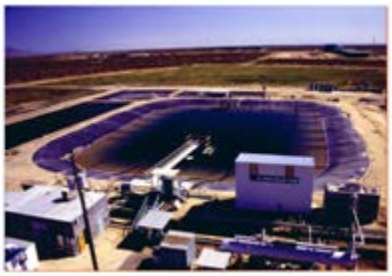
In order to produce much smaller waste stream that will be evaporated



ZLD IS APPLICABLE FOR:

Any waste water that is not acceptable for discharge to water streams such as:

- ✓ Cooling tower blow down
- ✓ Boiler blow down
- ✓ Reverse osmosis (RO) reject
- ✓ Demineralization wastes
- ✓ Metal finishing waste water



HOW TO ACHIEVE ZLD?

Evaporation Pond

OR

Thermal Evaporation

EVAPORATION POND DESIGN PARAMETERS

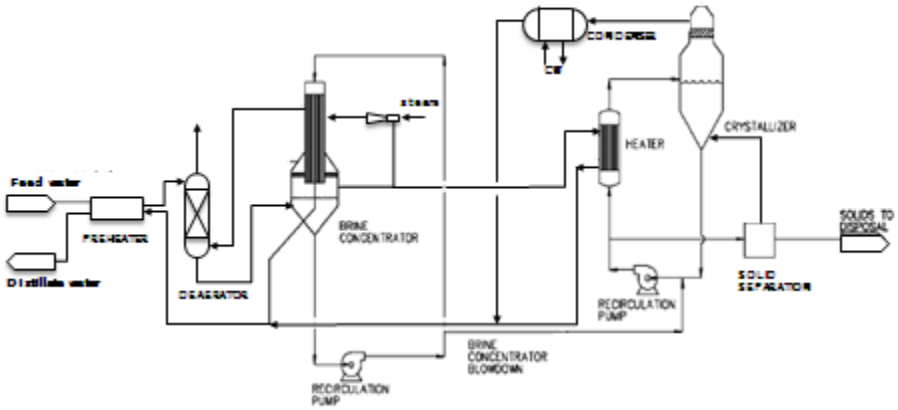
- ✓ Ambient temperature
- ✓ Humidity
- ✓ Wind
- ✓ Rain
- ✓ Solar energy intensity

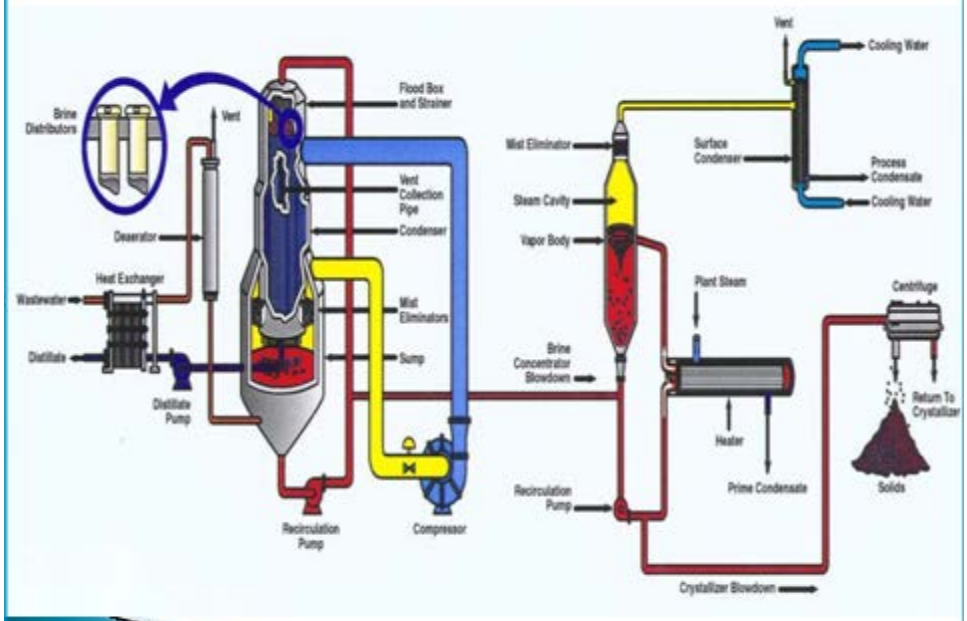
THERMAL EVAPORATION

Equipment involved:

- ✓ Brine Concentrator (Falling Film Evaporator)
- ✓ Crystallizer
- ✓ Solid Recovery

THERMAL EVAPORATION PFD





DESIGN CONSIDERATIONS

- Alternatives for energy input:
  - ✓ MVR -either using blowers, turbo fans or centrifugal compressors
  - ✓ TVR (Thermo Vapor Recompression) using steam
- Evaporators increase the brine concentration to around 14%
- Crystallizers "concentrate" the brine to around 60%
- Solid drying produce 85% -90% dry solids

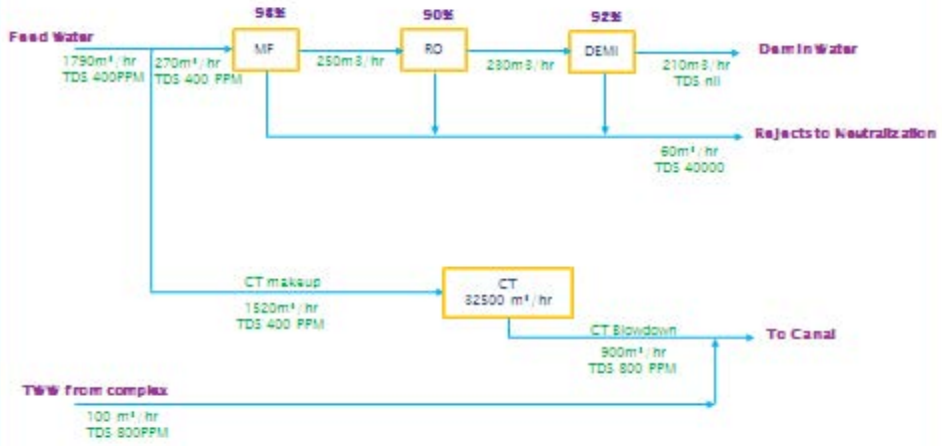
COMPARISON

	NATURAL EVAPORATION	THERMAL EVAPORATION
Plot area	**Large** (For 1m³/hr, 3800 m²)	**Compact** footprint
CAPEX	**High** Due to extensive earth work	**Higher** (Ti, duplex st.st)
OPEX	**Minimum**	**High** LP Steam (0.37 T/T) Cooling water (15 T/T) Chemicals (Unit capacity: 26 m3/hr, Feed TDS: 30000 ppm)

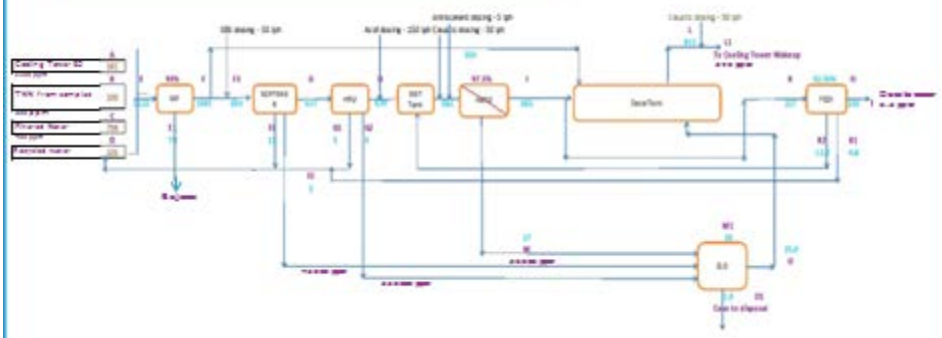
CASE STUDY

- ✓ CASE 1: utility plant without ZLD
- ✓ CASE 2: Utility plant applying ZLD

CASE 1: UTILITY PLANT WITHOUT ZLD



CASE 2: UTILITY PLANT APPLYING ZLD



COMPARISON

	CASE 1	CASE 2
FEED WATER FLOWRATE	1790 m³/hr	765 m³/hr
CT MAKEUP	1520 m³/hr	813 m³/hr
CT BLOWDOWN	900 m³/hr to Canal	160 m³/hr For Reuse
No. OF CC	2	5
CAPEX	Low	Higher
OPEX	Variable, based on scheme requirements, current prices of feed and utilities (case by case study)	

CONCLUSION

- ✓ Water management is a must
- ✓ Maximize water recycle
- ✓ Minimize waste quantity
- ✓ Study alternatives for waste discharge
- ✓ ZLD is the last resort


Thanks for your
Attention!!
Save
Each Drop Of Water.