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# **LESSONS LEARNED FROM PRODUCED WATER TREATMENT**

## **Vapor Compression Base Technology**

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# Outlines

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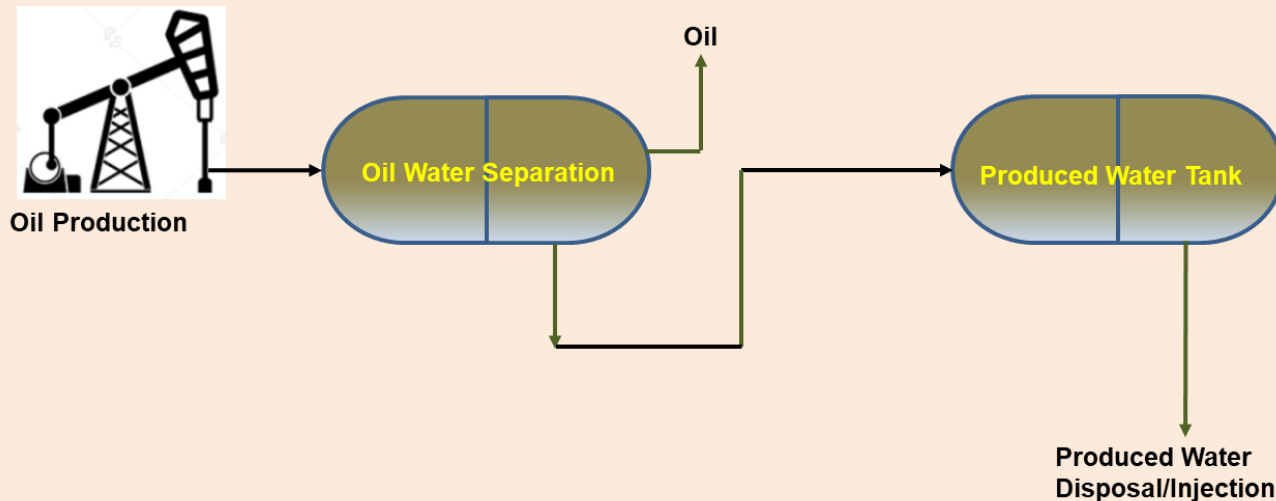
- Produced water treatment challenges
- Vapor Compression technology: Field pilot test
- Summary & lessons learned
- Needed Criteria of Technologies
- Potential Future Studies



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# PRODUCED WATER TREATMENT CHALLENGES

# Produced Water... Challenges



- Oil Content, VOC, NORM
- High Salinity, 250,000 ppm
- High metals (iron, potassium, barium, strontium ...etc)
- Fouling & Corrosion Potentials (TSS, sulfur, phosphorous ... etc)
- H<sub>2</sub>S, CO<sub>2</sub> & Ammonia

# Produced Water Treatment ... Challenges



**Pretreatment**



Remove TSS  
Remove Oil  
Remove H<sub>2</sub>S  
Anti-Scalant  
Softening



**Problem**



Fouling/Scaling  
and Corrosion



# Technologies in the Market

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Technologies are based on

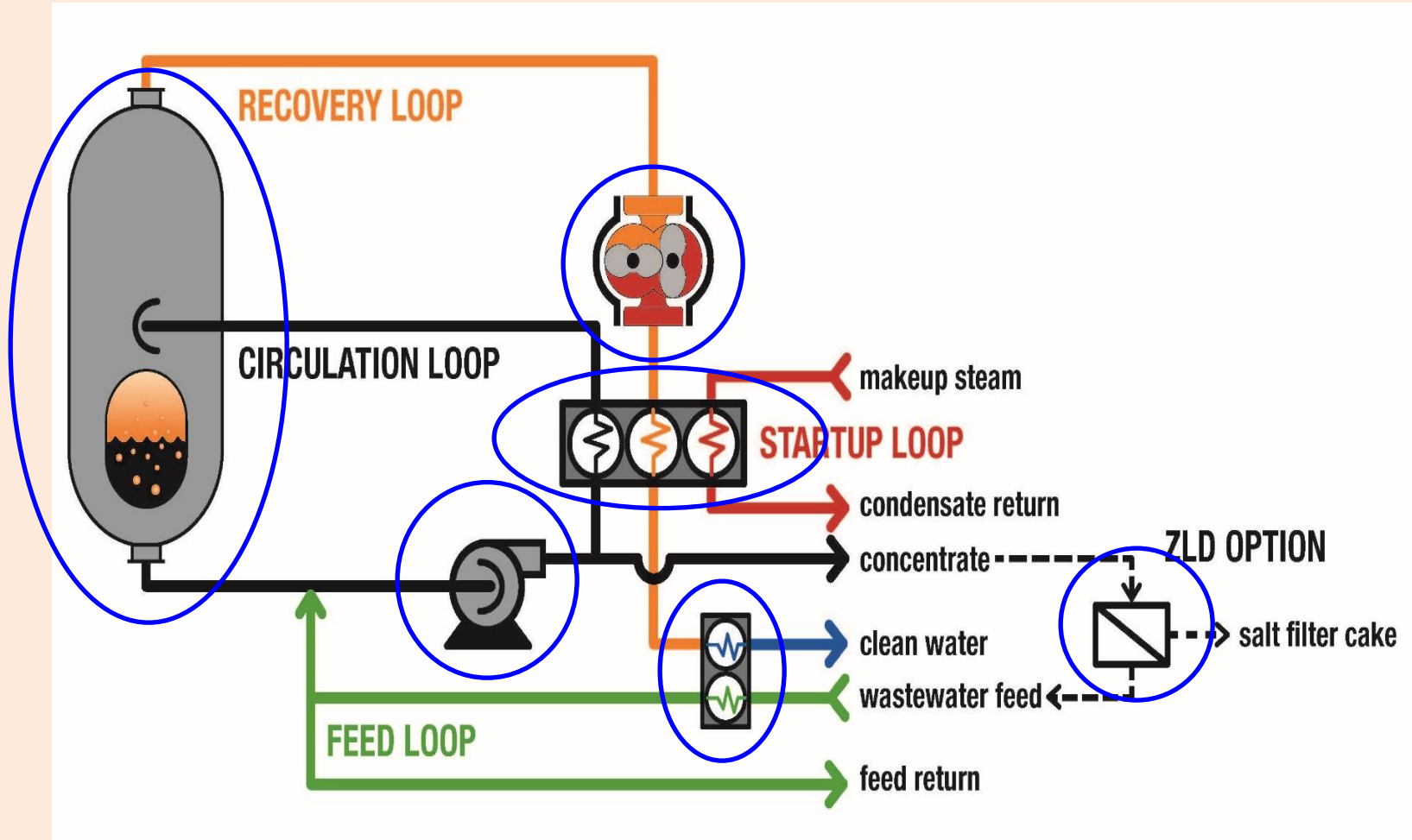
- Membrane, i.e. RO & FO
- Evaporation, i.e. VC, HDH, Dyvar
- Electrochemical, i.e. Electrocoagulation



# VAPOR COMPRESSION TECHNOLOGY

Field Pilot Test

# Vapor Compression Technology





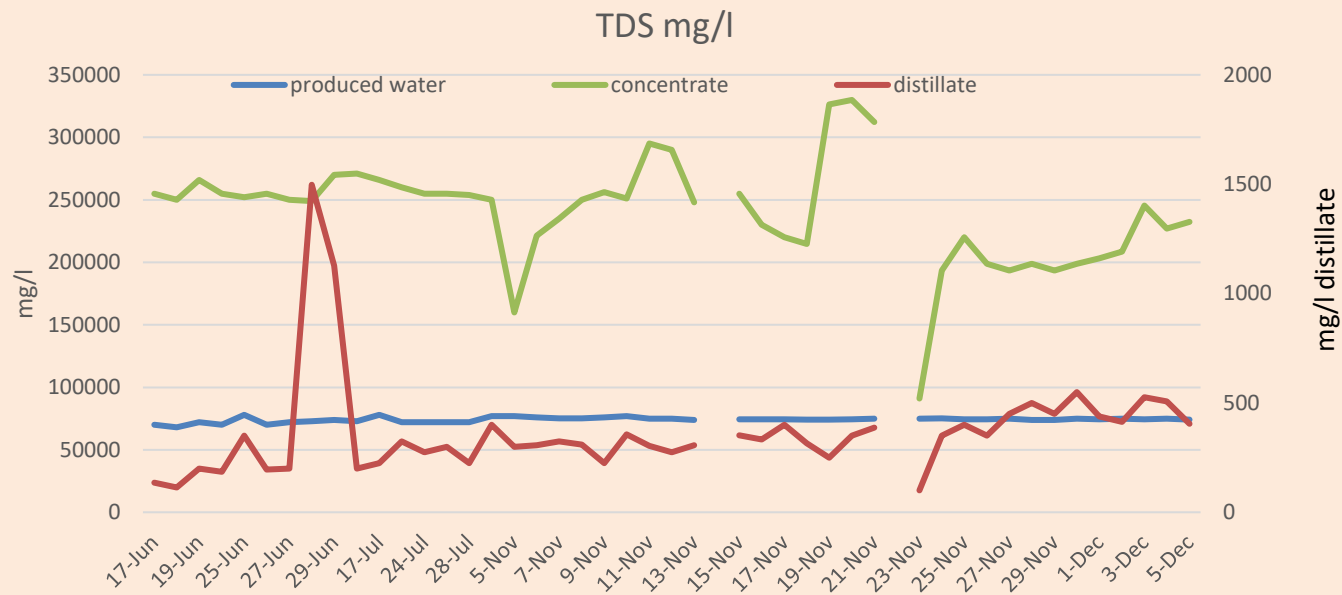
# Vapor Compression Technology



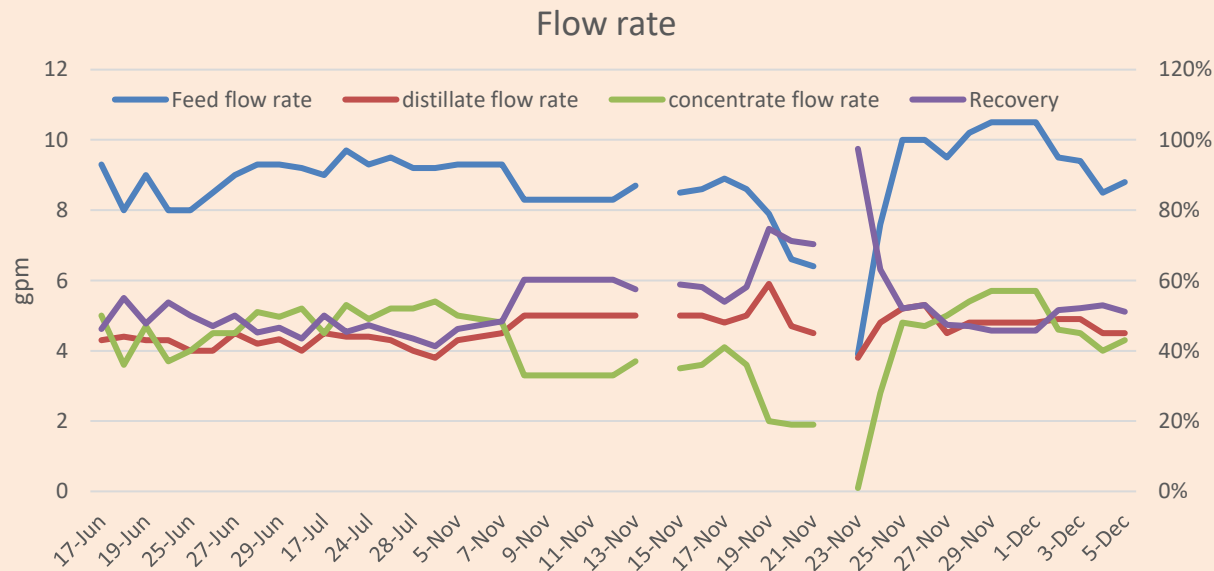
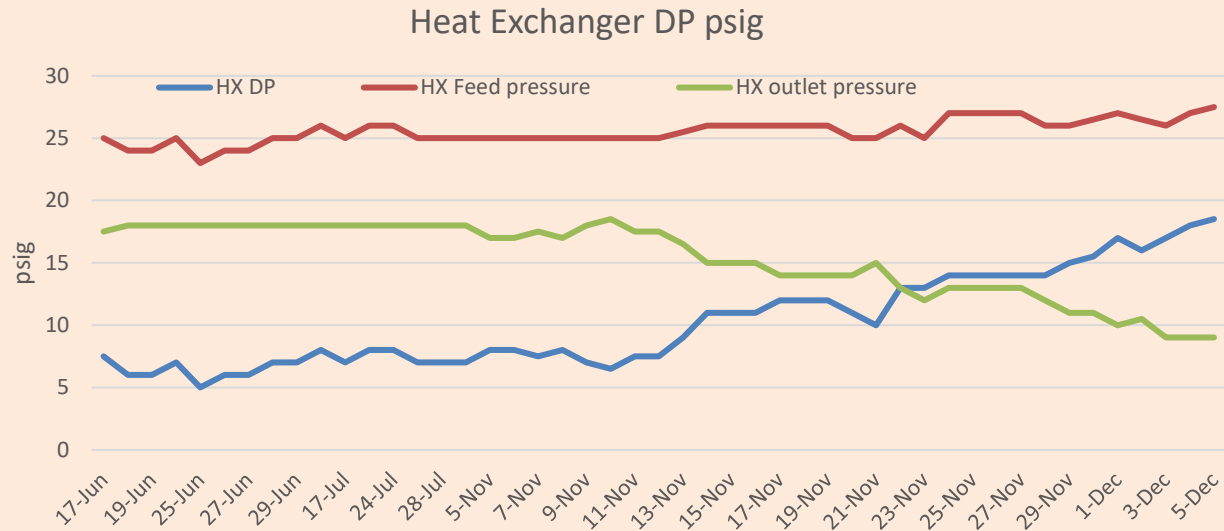
PW Concentration and Crystallization in a Single System with No Pretreatment Requirements



# Field Test Results



# Field Test Results



# Summary ... Lessons Learned

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- Vapor compression (VC) technology is robust and can be used in treating high saline water at one step
- VC can be modular but capacity of each module is limited due to size and cost of materials
- High energy consumption; therefore, there is a need for alternative low energy sourcing
- Due to corrosivity nature of the produced water, the system requires high grade materials in case of high temperature operation
- Gas stripping prior to the distillation process is required
- Control system is important for auto flushing the system
- Solid management becomes important in case of ZLD



# NEEDED CRITERA OF TECHNOLOGIES

# Technologies Criteria ... Needed

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- Low energy
- Low fouling & corrosion resistant
- Low cost of material selection
- Minimum use of chemicals
- Simple operation, and robust
- Less numbers of processing steps
- Scalable Small footprint
- Solid waste handling

# Potential Future Studies

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- Integration of VC with multi-effect distillation to reduce energy and increase technology capacity
- Integration of VC with Adsorption Desalination to reduce energy
- Characterization of distillate (product water)
- Selecting proper post-treatment



# THANK YOU

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