Understanding Your Options for Brine Management:

Treatment Technologies and Application in Design

Chapter Meeting
9 October 2018

Presented by:
Alan Bracewell
Kennedy/Jenks Consultants
Staff Engineer
Overview of Today’s Presentation

1. Reasons for Managing Brine
2. Advanced Water Treatment Train
3. Brine Treatment Technologies
   1. Recovery Rates
   2. Pros/Cons
   3. Example Facilities
4. Evaluation of Brine Minimization Technologies
   1. Non-Cost Factors
   2. Cost Factors
5. Take-Aways
Reasons for Managing Brine

• Maximize existing water supply
  ▪ As population increases, water quality and availability decreases
  ▪ Do more with less

• Applicable to multiple source waters
  ▪ Wastewater effluent
  ▪ Ground water
  ▪ Brackish water
  ▪ Ocean desalination
Advanced Water Treatment Train

Secondary or Tertiary Effluent → MF/UF → RO → AOP → Stabilization → Purified Water Equalization → Potable Reuse

Ozone (optional) → MF/UF → RO → AOP → Stabilization → Purified Water Equalization → Potable Reuse

Sewer System → Brine Line
Advanced Water Treatment Train

Secondary or Tertiary Effluent

Ozone (optional)

Sewer System

MF/UF

RO

AOP

Stabilization

Purified Water Equalization

Potable Reuse

Brine Line
Brine Minimization Technologies

1. Two–Stage Reverse Osmosis (No Minimization)
2. Multi-Stage Concentrator
3. Closed Circuit Reverse Osmosis
4. Electrodialysis Reversal
## Brine Minimization Technologies

1. Two-Stage Reverse Osmosis (No Minimization)
2. Multi-Stage Concentrator
3. Closed Circuit Reverse Osmosis
4. Electrodialysis Reversal
   - Brine Concentrators
   - Forward Osmosis
   - High-Efficiency Reverse Osmosis (HERO)
   - Capacitive Deionization
   - Vibratory Shear-Enhanced Processing
Brine Minimization Technologies

1. Two-Stage Reverse Osmosis (No Minimization)
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   • Thermal Brine Concentrators
   • Forward Osmosis
   • High-Efficiency Reverse Osmosis (HERO)
   • Capacitive Deionization
   • Vibratory Shear-Enhanced Processing

• Zero Liquid Discharge
  ▪ Evaporation Ponds
  ▪ Solar Ponds
  ▪ Crystallizers
  ▪ Spray Dryers
  ▪ Wind-Aided Intensified Evaporation
  ▪ Salt Recovery
  ▪ SAL-PROC
  ▪ Dewvaporation
Two-Stage Reverse Osmosis (No Minimization)

• Recovery: 75-80%
  ▪ 50% each stage

• Pros
  ▪ Low capital cost
  ▪ Low energy usage
  ▪ “Dilute” RO concentrate

• Cons
  ▪ Disposal of large volume of RO concentrate required
  ▪ Low recovery rate
Example Facility for Two-Stage RO: Pure Water Monterey

• 5 MGD Facility (in construction)
  ▪ Feed: 4.94 MGD
  ▪ Permeate: 4.0 MGD (81%)
  ▪ Brine: 0.94 MGD

• Brine to be mixed with WWTP effluent ocean outfall
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Multi-stage Concentrator

• Recovery: 85-90%
  ▪ 50% each stage

• Pros
  ▪ Medium capital cost
  ▪ Increased recovery/reduced brine
  ▪ Familiar technology

• Cons
  ▪ Increased energy usage
  ▪ Requires careful operation to protect 3rd stage RO
Closed Circuit Reverse Osmosis

- Recovery: 75-95%
  - 50% first two stages
  - 50% to 88% at CCRO
- Pros
  - Flexible recovery rate
  - Lower energy consumption
  - Reduced antiscalant usage
- Cons
  - Proprietary technology (Desalitech)
  - Increased capital cost
Example Demonstration Facility for CCRO: Padre Dam

- Planned 12 MGD facility
  - Extra 1 MGD from secondary CCRO discharged to Santee Lakes
- RO waste to be blended with MF waste and sent to sewer system
Electrodialysis Reversal

- Typical recovery: 70-90%
- Pros
  - High recovery rate
  - Reduced particulate fouling
- Cons
  - Only removes cations/anions
  - Does not provide a “physical barrier”
    - Permeate must return to head of plant
# High-level Comparison of Brine Minimization Technologies

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### Example Life Cycle Costs and Cost Ranking
#### 7.4 MGD Facility with Brine Line

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Key Take-Aways

• Each technology has its own strengths/weaknesses
• Costs are very site dependent
  ▪ Access to brine line or ocean outfall
  ▪ Water needs of the service area
  ▪ Available land for construction
• Numerous emerging/niche technologies

• Never too early to consider brine minimization
  1. Feasibility level: consider non-cost and cost factors
  2. Demo best technologies during drafting of preliminary design report (PDR)
  3. Apply learnings from demonstration plant for final design
• Never too late!
Thank you.

Questions?

Presented by:
Alan Bracewell
949.567.2102
alanbracewell@kennedyjenks.com
Kennedy/Jenks Consultants
Staff Engineer