Valencia Water Company Water Treatment Plant

Crystalactor® Zero Liquid Discharge Water Softening
Valencia Water Company

- Population served 113,000
- Water supply is 28.4 MGD
- Total Hardness ~ 350 mg/L
- Regional Water Quality Board requiring improvements to effluent water quality
- Issue is High chlorides in POTW effluent
- Home softening found to be the cause of high chlorides
add total water per day and hardness

Eric Fessler, 3/23/2012
Why Soften?

The basics
• Hardness is measured as calcium carbonate
• Many regions in California have hard water
• Over 50% of water quality complaints tracked in a 10 year period relate directly to hard water

Residential
• Minimize spots
• Use less soap and detergent
• Softer skin
• Extend the life of pipes and appliances

Industrial
• Reduce utility costs
• Reduce chemistry usage – anti-scalents
• Conserve water
The Problem With Point-of-Use Softening

- Add chlorides to the waste stream
- Chlorides are not removed from water at reclamation plants
- High chlorides can damage agricultural crops by causing leaf burn or drying of leaf tissues
- Add to consumer’s overall cost of delivered water
- Wastes water
Actual Chloride Levels in Discharge - Valencia

Chloride Concentration and Loading Profiles (Above Water Supply)
Valencia Water Company Demonstration Site

Chloride Concentration (mg/L)
Chloride Loading (lbs/hr)

Time of Day

Chloride Concentrations Above Water Supply (7/18-25/2006)
Chloride Loading Above Water Supply (7/18-25/2006)
Chlorides From Ion Exchange Softening

2005 Effluent Chloride Sources

- **Industrial**
  - 2% of total
  - 3 mg/L

- **Commercial**
  - 3% of total
  - 5 mg/L

- **Infiltration**
  - 4% of total
  - 5 mg/L

- **Liquid Waste Disposal**
  - 0% of total
  - 0.5 mg/L

- **Disinfection**
  - 4% of total
  - 6 mg/L

- **Water Supply**
  - 36% of total
  - 51 mg/L

- **Residential (Non-SRWS)**
  - 16% of total
  - 22 mg/L

- **Residential (SRWS)**
  - 35% of total
  - 49 mg/L

**2005 SCVJSS Effluent Chloride Concentration = 142 mg/L**

Source: Data provided by Los Angeles Sanitation Districts of Los Angeles County
Treatment Options

• Treat industrial, commercial and residential wastewaters at the POTW
• Soften the ground water before it goes to the community
• Engineering study was conducted by Kennedy/Jenks Consultants to determine best option
Treatment Options

- Meeting chloride discharge limits could be accomplished through treatment at the POTW
  - Would require a $500 - $600 million, large scale, advanced treatment facility
  - Would require brine disposal
  - Brine line estimated to cost VWC population $21.2 million/year
Treatment Options

• Soften the water for the community
• Eliminate or significantly reduce point of use softeners
  • Study indicated that softener use was anticipated to decline from 54 to 24 percent
• Technologies studied included:
  • Crystalactor
  • Ion Exchange
  • Membrane Processes
    • RO
    • Nanofiltration
    • Electrodialysis & Electrodialysis Reversal
Process Advantages

- Eliminates wasted water (no reject / back wash water)
- No sludge dewatering
- Reduce or eliminate chlorides and salts
- Higher efficiency RO
- Requires min. labor
- Fully automated
- Small foot print (ex. 8’ dia. = 2MGD)
Four Steps In One

Conventional

Feed → Coagulation → Flocculation → Sludge/Water Separation → Filtration → Effluent

Optional

10-20% of volume

Waste Sludge

Crystalactor®

Feed → Crystalactor® → Filtration → Effluent

Optional

Reusable Pellets
How it Works

Seed Material

Raw Water
Ca⁺² HCO₃⁻

Carbonate or Hydroxide

CO₃⁻² OH⁻

HCO₃⁻ + OH⁻ → H₂O + CO₃⁻²
Ca⁺² + CO₃⁻² → CaCO₃

Treated Water

Crystal pellets
Process Basics – Pellet Handling

- Pellets removed by simple opening of valve
- Pellets are 90-95% dry product
- Pellets are 80-90% CaCO₃
- Pellets contain 5-10% seed material
### Examples of Experience

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Valencia Water Company

- Water scarcity
- Hard water
- Wastewater high in conductivity (chlorides)
- Population 28,300
- Total Hardness 350 mg/L
- Goals:
  - Supply softened water to public
  - Eliminate resin softening (associated chlorides)
  - Enhance water supply by 15-20%
Installation

- Skid mounted or custom design
- Removes risk & time of installation
- Begin full operation quickly
Single Well Treatment (1.5 MGD)

- Less than 500 square meters of space
- Remote system monitoring
- Site labor 2-3 days/week
- Consistent soft water supply (hardness 50 mg/L)
- No wastewater water – zero liquid discharge
- Positive public response
- Reduced chlorides more than 1.5 million lbs/year
- Increased water supply volume 150,000-250,000 gallons per day
Results

- Insert chemical usage here
Pellet Handling

California community installing a desalter project – produced pellets will sell for $20 - $40 per ton.
Pellet By-Product Utilization

Local companies are interested in calcium carbonate pellets from water plant!

Pellets enhance concrete value increasing flow-ability!

Other uses include roofing material, soil amendment

2.5 MGD
1.5-1.9 TPD (1-1.5 cy/day)

5.0 MGD
3.0-3.8 TPD (2-3 cy/day)
Additional Applications
Softening Using Lime

- Water scarcity
- Hard water
- Wastewater high in conductivity (chlorides)
- Wastewater high in TDS
- Goals:
  - Supply softened water to public
  - Eliminate resin softening (associated chlorides)
  - Enhance water supply by 15-20%
Chemical and labor costs $0.20 per 1,000 gallons or $200 per day

Pellets produced: 2,500 – 3,000 lbs/day (1 cubic yard)
Traditional Lime Softening Comparison

Lime
770 – 1,026 lbs/day

0.75 - 1 MGD Feed

Coagulation

Flocculation

Sludge/Water Separation

Sludge Dewatering

Alum
194 – 257 lbs/day

10-20% of volume

11,700 – 15,800 gal/day

CO₂
270 – 360 lbs/day

Chemical / Disposal Cost
$255 - $340 /day ($0.34/1,000 gal)

Labor
$217 - $290/day ($0.29/1,000 gal)
$473 - $630/day ($0.63/1,000 gal)

Polymer
10 – 15 lbs/day

Waste Sludge
4 – 5 tons/day
90 – 120 ft³/day

*Sourced from EPA Handbook, modeling for infrastructure.
RO Brine Treatment – Approaching ZLD

- Regional scarcity
- Wasting nearly 2 MGD per day in brine water
- RO efficiency improved from 80% to >95%
# State-of-the-Art Reverse Osmosis Desalination

**10 MGD**

- **Raw Water**
  - Hardness: 550
  - Calcium: 340
  - Magnesium: 200
  - Silica: 40

**8 MGD to Distribution**

**2 MGD (Brine)**

- **RO Brine**
  - Hardness: 2730
  - Calcium: 1700
  - Magnesium: 1030
  - Silica: 200

Process efficiency is 80% - 2 MGD are wasted as brine!
Brine Treatment Performance

**RO Brine Inflow**
- Hardness: 2730
- Calcium: 1700
- Magnesium: 1030
- Silica: 200

**Reactor Effluent**
- Hardness: 885
- Calcium: 350
- Magnesium: 535
- Silica: 29

> Raw Water Quality!
Design & Results

10 MGD

8 MGD

2 MGD (Brine) 1.6 MGD

9.6 MGD vs. 8 MGD to Distribution

- 20% Supply Increase
- 80% Waste Reduction
- 96% Efficiency
- Approaching ZLD

2 MGD

0.4 MGD (Brine)
Let us show you!

- You provide water quality data
  - We provide modeling report
- Onsite pilot testing
  - Demonstrate hardness removal
- Measure chemical usage (operating costs)
- Validate design parameters and equipment capital cost
Zero Liquid Discharge Water Treatment

- **Softening**
  - Eliminate chlorides
  - Eliminate wasted water

- **Increase RO efficiency**
  - Recover more water
  - Lower cost

- **RO brine recovery**
  - Recover wasted water

Deliver more water from same supply