11 Years on the Road to (High) Recovery

The Chino Concentrate Reduction Story
Project Background

- Chino Basin Desalter Authority (CDA) is a Joint Powers Authority consisting of 8 members
- The CDA owns the Chino Desalters (I and II)
- Chino II Desalter began operation in 2006 (10-mgd)
- Expanded to 20.5-mgd in 2011
- Brine disposal costs, coupled with construction-related grant funding, prompted the CDA to move forward with brine reduction process
Brine Reduction and Mineral Recovery At the Chino II Concentrate Reduction Facility

**Project Drivers**

**Reduce Discharge To Brine Line**

- Allow for Expansion of Chino II Desalter
- Utilize Capital Project Specific Grant Funding

**Resource Recovery and Sustainability**

- Recover Additional Potable Water from Wellfield
- Produce Residuals That Have Beneficial Reuse (Economic and Environmental)
- Reduce Scaling Potential In Brine Line
The Concentrate Reduction Facility (CRF) Provides an Option to Purchasing Additional Brine Line Capacity

Expanded brine volume of 2.68-mgd exceeds current brine line capacity of 1.62-mgd.
The CRF allows Chino II to meet disposal goals and recover potable water.

A large portion of solid residuals have beneficial use value.

0.95 mgd < 1.62 mgd Available
Existing Chino II RO recovery is limited by hardness and silica concentrations

<table>
<thead>
<tr>
<th>Flow Stream</th>
<th>Chino II Concentrate</th>
<th>CRF Secondary RO Feed</th>
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<tbody>
<tr>
<td>Ca$^{2+}$ (mg/L)</td>
<td>679</td>
<td>7</td>
</tr>
<tr>
<td>Mg$^{2+}$ (mg/L)</td>
<td>102</td>
<td>4</td>
</tr>
<tr>
<td>Alkalinity (mg/L as CaCO$_3$)</td>
<td>1,145</td>
<td>302</td>
</tr>
<tr>
<td>Ca Hardness (mg/L as CaCO$_3$)</td>
<td>1,697</td>
<td>17</td>
</tr>
<tr>
<td>Mg Hardness (mg/L as CaCO$_3$)</td>
<td>420</td>
<td>16</td>
</tr>
<tr>
<td>Total Hardness (mg/L as CaCO$_3$)</td>
<td>2,116</td>
<td>33</td>
</tr>
<tr>
<td>TDS (mg/L)</td>
<td>3,319</td>
<td>2,718</td>
</tr>
<tr>
<td>Si (mg/L)</td>
<td>194.3</td>
<td>74.8</td>
</tr>
<tr>
<td>pH</td>
<td>7.61</td>
<td>9.47</td>
</tr>
</tbody>
</table>
Chemical softening removes scaling precursors in the primary RO concentrate.

Secondary RO recovery of 66% (and higher) achieved through:
- Calcium reduction
- Magnesium reduction
- Alkalinity reduction
- Silica reduction

**CHINO CRF TREATMENT GOALS**

<table>
<thead>
<tr>
<th>Silica</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 mg/L</td>
<td>1,700 mg/L</td>
</tr>
<tr>
<td>&lt;80 mg/L</td>
<td>&lt;40 mg/L</td>
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</table>
Pellet reactors were selected as the primary chemical softening configuration

**Basics**
- Upflow, fluidized bed
- Lime and/or caustic is injected at bottom of bed
- Seed (sand or CaCO₃) introduced to provide crystal growth sites
- Pellet blowdown frequency determines size

**Benefits**
- High rate (small footprint)
- Easily dewatered residuals
Dried pellets have marketable value and are easier to store and transport.

- Pellets are value-added products
  - Industrial applications: concrete block manufacturers, specialty mineral suppliers

- Convert waste stream to usable commodity
Based on past pilot data, the preliminary process was established.

Data from Arlington Desalter showed good silica removal and filterable softener effluent.
Chino II Desalter pilot study revealed treatment challenges not previously experienced

- High turbidity carryover from Ca-Mg-Si precipitate
- Poor filterability
- Did not meet Ca, Si removal goals
Clarification step moved from backwash treatment to pellet reactor effluent

- Allows for magnesium precipitation after the pellet reactor
- Process reaches equilibrium before media filters
- Dewatering added for non-pellet residuals
High rate solids contact clarifiers are used to treat pellet reactor effluent and backwash waste

- High rate sludge thickening clarifier/softener in single unit (small footprint)
- Combines internal and external sludge recirculation and tube settling clarification
- Footprint is 25-50% smaller than a conventional clarifier
- Loading rate up to 11 gpm/sq.ft
- Sludge concentration up to 20% solids
The addition of the clarifier dramatically improved filterability and solids loading on the filters.

Caustic Soda Dose = 1,280 mg/L
Lime Dose = 0 mg/L-Ca(OH)₂
Soda Ash = 0 mg/L
pH = 11.9
Silica removal goals achieved via magnesium co-precipitation

Magnesium chloride system included to increase silica removal, if required.
Calcium removal goals exceeded when softening at pH >11 was allowed.
Energy Recovery And Pelletized Softening

Solids Contact Clarification and Filtration

Solids Handling

Secondary RO
Facility Facts and Features

- **Capacity:**
  - Influent: Up to 2.47 mgd of primary RO concentrate
  - RO Permeate: >1.73 mgd
  - Brine and IX Waste: < 0.94 mgd

- **Influent Energy Recovery**, pelletized softening, solids contact clarification and media filtration

- **Secondary RO Recovery**: 66-85 Percent

- **Overall Facility Recovery**: >94 Percent

- **Solid Residual Disposal:**
  - Pellets: Sold to local specialty minerals distributor
  - Dewatered solids: Landfill with option for composting

- **Product Water Use**: Potable

*Completed 7-Day Performance Testing in May 2017*
Acknowledgments

- CDA
  - Curtis Paxton and Todd Minten
- JCSD
  - Ben Armel, Moustafa Aly, and the Chino II Ops Staff
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- Issam Najm and Alex R. (WQTS)
Questions?