Our Goal
To Help You to Maximize Chloride/Salt Reduction from Your Water Softening Systems
Evaluating Water Softening Systems

- Automobiles & Water Softeners
  - Both Require Fuel To Operate
  - Both Are Mechanical & Require Periodic Maintenance
  - The Better You Maintain Them, The Better They Perform and Keep Operating At A High Efficiency
Water Softener Maintenance Considerations

- Installation Environment
- Regeneration Frequencies
  - More Frequent
    - Harder on the Resin
    - Wear & Tear On Internal Parts
- Verify The Water Hardness
  - Raw verses Programmed Hardness
Water Softener Maintenance Considerations

- Check Programmed Salt Settings
- Verify Salt Refill Levels
- Verify Overall Operation
- Replace Worn Parts
  - Car = Oil Change & Filter
  - Softener = Replace Piston, Spacers ...etc.
Water Softener Maintenance Considerations

- Residential Systems
  - PM Every 5 Years
- Commercial System
  - PM Every 3 Years
- Industrial System or Critical Application
  - PM Annually or More Frequent
Salt Settings

• Salt Efficiency = “MPG”
• Higher the Salt Efficiency
  ▫ Lower Operating Costs
  ▫ Less Salt/Chlorides Going To MMSD
• Good = 4,000 Grains/Lb. Salt
• Better = 4,500 Grains/Lb. Salt
• Best = 5,000+ Grains/Lb. Salt
Water Softener Life Expectancy

- 12 – 15 Years
- Requires Preventative Maintenance
- Resin – Loses 1 – 3% Efficiency Annually
  - Chlorine and Regeneration Frequencies
  - Larger Systems Have Your Resin Analyzed Every 8 – 10 Years
Water Softener Life Expectancy

- They Will Certainly Last Longer
  - Less Efficient
  - More Frequent Regenerations
  - Higher Operating Costs
    - Salt & Water
    - Higher Chloride Levels To MMSD
System Designs

• Time Clock – No Longer Allowed
• Good
  ▫ Single Tank, Metered or Sensor Operated
• Better
  ▫ Single Tank, Proportional Brining, Metered or Sensor Operated
• Best
  ▫ Twin Alternating or Multiple Tank Demand Recall, Metered or Sensor Operated
Single tank

Twin Alternating

Demand Recall
Alternative Technologies

• Antiscalants
  ▫ In some applications antiscalants can be used to pretreat the feedwater to commercial or industrial Reverse Osmosis Systems vs. using a Water Softener.
Optimization & Replacement Results

- 27% Reduction With Optimization
- 46% Reduction With Replacement Using High Efficiency Systems
  - 4,000 grains/lb. of salt or greater
- http://www.madsewer.org
Calculating the amount of water that can be softened in between regenerations

Softener capacity is determined based on:

• The Cubic feet of resin

• The Salt setting per cubic foot of resin = the “capacity/grains” that can be removed before it regenerates.
  • 6 lbs./1 ft³ = 22,926 grains of exchange capacity per cubic foot
  • 10 lbs./1 ft³ = 28,060 grains of exchange capacity per cubic foot
  • 15 lbs./1 ft³ = 30,000 grains of exchange capacity per cubic foot

• Capacity/Grains divided by the hardness = Gallons available between regenerations
Example Calculations

Example questions: using a 10 cubic foot system regenerating at 10 lbs./1 ft³.:

How many gallons will be softened by a water softening system programmed to provide 280,600 grains between regenerations and programmed for 30 grains of hardness?

• Softener capacity: _______________grains

• Water hardness: ______30_________ grains per gallon

→ 280,600 grains ÷ 30 grains per gallon = 9,353 gallons of water

If the actual hardness of the water is 25 grains per gallon, how much more water will be used between regenerations?

→ 280,600 grains ÷ 25 grains per gallon = 11,224 gallons of water or 20% / 1,871 gallons more!
Resin Evaluation

• The higher the chlorine level, the faster it degrades
• Rule of thumb: 10/ppm of free chlorine concentration = years of resin life
• Example: 10/1.5 ppm free chlorine = 6.7 yrs.
• Iron in water – Fouls Resin
• Increased salt use for older resin to minimize leakage and loss of capacity
Resin Evaluation - Good Condition
Resin Analysis

ResinTech Inc.

**ION EXCHANGE RESIN ANALYSIS**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Total Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Name</td>
<td>John Feller</td>
</tr>
<tr>
<td>Contact #</td>
<td>(208) 375-1814</td>
</tr>
<tr>
<td>E-mail Address</td>
<td><a href="mailto:jfeller@total-water.com">jfeller@total-water.com</a></td>
</tr>
<tr>
<td>Sample Description</td>
<td>Classen Quality Coatings Softener #1</td>
</tr>
<tr>
<td>Reported Problem</td>
<td>Short Run</td>
</tr>
<tr>
<td>Date Received</td>
<td>11/2/2016</td>
</tr>
<tr>
<td>Date Analyzed</td>
<td>11/3/2016</td>
</tr>
<tr>
<td>Tech Rep E-mail</td>
<td><a href="mailto:ogalletti@resintech.com">ogalletti@resintech.com</a></td>
</tr>
<tr>
<td>Tech Rep Phone</td>
<td>(708) 261-0931</td>
</tr>
</tbody>
</table>

**ANALYSIS AT A GLANCE**

- Type of Resin: Strong Acid Cation
- Chemical Condition: Poor
- Physical Condition: Poor
- Bead Integrity: High amount of dirt / beads are coated
- External Fouling: Visual evidence of iron
- Internal Fouling: Normal
- Screen Size Distribution: Replace
- Overall Recommendation: Replace

**ROUTINE ANALYSIS**

Based on Sodium Form 8% DVB Gel Cation Resin

<table>
<thead>
<tr>
<th>Results</th>
<th>Typical New</th>
<th>% of New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capacity meq/ml</td>
<td>1.01</td>
<td>2.0</td>
</tr>
<tr>
<td>Moisture % H2O</td>
<td>65.2%</td>
<td>45%</td>
</tr>
<tr>
<td>Percent Broken</td>
<td>9%</td>
<td>1%</td>
</tr>
</tbody>
</table>

**Comments**

One softener sample, approximately 15 years in age, was submitted for analysis. The customer is experiencing reduced service (shorter run times), and wants to determine the condition of the resin for future use. Testing indicates that the resin is in extremely poor condition, and its condition is causing the problem. It has lost approximately 46% of its total capacity, and its moisture is severely elevated. This suggests that the resin is oxidized, and at the end of its useful life. It is recommended to replace as soon as possible. ResinTech has several softeners readily available. Contact Carl Galletti for product information and quotes.
**RESIN ANALYSIS AT A GLANCE**

<table>
<thead>
<tr>
<th>Type of Resin</th>
<th>Strong Acid Cation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer &amp; Part #</td>
<td>Purolite SST (part # not listed)</td>
</tr>
<tr>
<td>Chemical Condition</td>
<td>Poor</td>
</tr>
<tr>
<td>Moisture</td>
<td>Severely Elevated</td>
</tr>
<tr>
<td>Physical Condition</td>
<td>Poor</td>
</tr>
<tr>
<td>Bead Integrity</td>
<td>Poor / Oxidized</td>
</tr>
<tr>
<td>External Foulants</td>
<td>High amount of dirt / beads are coated</td>
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<tr>
<td>Internal Foulants</td>
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<tr>
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**ROUTINE ANALYSIS**

Based on Sodium Form 8% DVB Gel Cation Resin

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<th>% of New</th>
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<tbody>
<tr>
<td>1.08</td>
<td>2.0</td>
<td>54%</td>
</tr>
<tr>
<td>65.2%</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>8%</td>
<td>1%</td>
<td></td>
</tr>
</tbody>
</table>

Total Capacity meq/ml
Moisture % H2O
Percent Broken
Resin Evaluation - Poor Condition

Comments One softener sample, approximately 15 years in age, was submitted for analysis. The customer is experiencing reduced service (shorter run times), and wants to determine the condition of the resin for future use. Testing indicates that the resin is in extremely poor condition, and its condition is causing the problem. It has lost approximately 46% of its total capacity, and its moisture is severely elevated. This suggests that the resin is oxidized, and at the end of its useful life. It is recommended to replace as soon as possible.
WATER SOFTENER EFFICIENCY

What Factors Increase Efficiency?

- Dosage, lower salting levels increase grains/lb.
  - 6 lbs./1 ft³ = 22,926 grains but 3821 grains of hardness reduced/lb.
  - 10 lbs./1 ft³ = 28,060 grains but 2806 grains of hardness reduced/lb.
  - **Use approximately 65% more salt = 24% more capacity**
  - 15 lbs./1 ft³ = 30,000 grains but 2000 grains of hardness reduced/lb.
  - **Use approximately 50% more salt = 11% more capacity**

- Countercurrent Regeneration
  - Upflow brining vs downflow service, upflow = water leaving tank passes through most highly regenerated resin last.

- Brine Contact Time, increase contact time increase capacity
- Twin Alternating Configuration - No Reserve
A good regeneration that uses a minimum of salt
Elution Study

Brine eductor draws too quickly, should be adjusted to draw brine slowly
Elution Study

Using more salt than necessary, reduce brine draw & perhaps decrease slow rinse time.
Water Softener Regeneration Cycles

**Backwash:**
- Reverses Normal Flow and Expands the Resin Bed

**Brine Draw and Slow Rinse**
- Uses an injector to create a vacuum that draws brine out of salt tank to recharge resin bed with sodium ions

**Rapid Rinse**
- Water flows downward to pack the resin down after backwash and brine/rinse

**Brine Tank Refill**
- Adds water to salt to create a saturated salt solution
Brine Reclaim

• Cost Saving Advances
  ▫ Divert a portion of the brine used to regenerate the softener back to the brine tank.
  ▫ Once the bed becomes regenerated, the “sweet” brine is just sitting in the tank, perfect for reuse.
  ▫ Reduce water consumption
  ▫ Save up to 25%
Brine Reclaim Elution Study

Calcium, Sodium Concentrations in Brine at Drain

Reclaimed Portion

Reclaiming the “Sweet Brine”
Brine Reclaim

Start of Brine Draw - Step 2A

Fresh Water
Concentrated Brine
“Bitter” Brine

Drain
Brine Reclaim

End of Brine Draw - Step 2B

- Fresh Water
- Concentrated Brine
- “Bitter” Brine
- “Sweet” Brine

Drain
Brine Reclaim

Divert - Step 2B

- Fresh Water
- Concentrated Brine
- “Bitter” Brine
- “Sweet” Brine

Drain
Brine Reclaim

Rinse - Step 2C

- Fresh Water
- Concentrated Brine
- "Bitter" Brine
- "Sweet" Brine

Drain
Aqua-Sensor

• Senses hardness in the resin bed
• Functions independently of the influent water hardness
• Compensates for hardness variations
  ▫ Municipal supplies with multiple sources
  ▫ Seasonal variations
  ▫ Usage variations
• Saves salt and water!
Aqua-Sensor Basics

- Unit is providing soft water
- Hardness front above the cells
- Both cells – ‘Sensing & Reference’ are in recharged resin & soft water
- “Balanced” condition
Aqua-Sensor Basics

- Hardness front reaches the ‘Sensing Cell’
- ‘Reference Cell’ still in regenerated resin & soft water
- Board notes signal “unbalanced” condition
- After 6 minutes of continuous unbalance, processor arms for regeneration
Aqua-Sensor Rinse-out Detection

- Senses when the brine solution is rinsed from the resin bed
- Ends slow rinse and advances to fast rinse/refill
- Saves water by rinsing only as needed
Aqua-Sensor

• Aqua-Sensors can monitor the state of the resin and only calls for a regeneration when necessary

• Because Aqua-Sensors constantly monitor the resin it notices any change in hardness and volume of water you’re using thus it can determine when it needs to regenerate.

• When an Aqua-Sensor regenerates, it uses smart technology, therefore, you get the most efficient regeneration cycle possible.
Other Technologies that are used to monitor the state of the resin in a water softener.

- There are many Hardness Analyzers that have the capability to measure the level of hardness in the effluent stream.
Replacement Considerations

• Look At The Salt Efficiency!
• Twin Alternating and/or Demand Recall Systems Are The Most Efficient Designs
Replacement Considerations

• Alternative Sizing Method State Plumbing Code
• Verify:
  ▫ Peak Flow - GPM
  ▫ Average Flow - GPM
  ▫ Daily/Weekly Water Usage
  ▫ Hardness
  ▫ Space
  ▫ Doorway Openings
Replacement Considerations

- Most Times Smaller Systems Can Be Used
  - More Efficient Designs
  - Lower Operating Costs
  - Smaller Capital Investment

- Examples:
  - MMSD Operations Building
  - Wisconsin State Capitol
MMSD Operations Before
MMSD Operations After
Wisconsin State Capitol Before
Wisconsin State Capital After
Case Study Results

- Stonewood
  - Full Line
  - 1.5” - 150,000 Grain Time Clock
  - H125-HE-14 Twin Alternating System
  - 12-Month Prior Salt Usage – 3,280 Lbs.
  - 12-Month Post Salt Usage – 1,360 Lbs.
  - 58% Savings
  - $336 Salt Savings/Year @ $7/40lb.
Case Study Results

• New Fountains
  ▫ 44 Unit Apartment, Hot Only
  ▫ 2.0” / 256,000 Grain / Time Clock
  ▫ H125-HE-14 Twin Alternating System
  ▫ 12-Month Prior Salt Usage – 6,960 Lbs.
  ▫ 12-Month Post Salt Usage – 2,400 Lbs.
  ▫ 65.5% Savings
  ▫ $798 Salt Savings/Year @ $7/40lb.
Case Study Results

• Forest Run
  ▫ 8 Unit Apartment, Full Line
  ▫ 2.0” / 150,000 Grain / Time Clock
  ▫ H125-HE-14 Twin Alternating System
  ▫ 12-Month Prior Salt Usage – 3,960 Lbs.
  ▫ 12-Month Post Salt Usage – 1,560 Lbs.
  ▫ 40% Savings
  ▫ $420 Salt Savings/Year @ $7/40lb.
Case Study Results

• Morning Side on the Green
  ▫ 24 Unit Apartment, Full Line
  ▫ 2.0” / 256,000 Grain / Time Clock
  ▫ H125-HE-14 Twin Alternating System
  ▫ 12-Month Prior Salt Usage – 6,760 Lbs.
  ▫ 12-Month Post Salt Usage – 1,920 Lbs.
  ▫ 71.5% Savings
  ▫ $847 Salt Savings/Year @ $7/40lb.
Case Study Results

- Maple Glen
  - 8 Buildings, Hot Only
  - 90, 120 & 150,000 Grain Metered Systems
  - H125-HE-12 Twin Alternating System
  - 12-Month Prior Salt Usage – 19,920 Lbs.
  - 12-Month Post Salt Usage – 13,600 Lbs.
  - 32% Savings
  - $1,106 Salt Savings/Year @ $7/40lb.
Case Study Results

- Arbor Lakes
  - 26 Apartment Buildings, Hot Only
  - 1.5” / 90 & 120,000 Grain Metered Systems
  - H125-HE-14 & HE-16 Single Tank
  - 12-Month Prior Salt Usage – 76,920 Lbs.
  - 12-Month Post Salt Usage – 31,400 Lbs.
  - 59% Savings
  - $5,313 Salt Savings/Year @ $7/40lb.
Case Study Results

- Riverwood
  - Hot Only
  - 2” - 150,000 Grain Metered Systems
  - H125-HE-14 Single Tank System
  - 12-Month Prior Salt Usage – 3,720 Lbs.
  - 12-Month Post Salt Usage – 1,400 Lbs.
  - 62% Savings
  - $406 Salt Savings/Year @ $7/40lb
Case Study Results

- Harbor Village
  - Hot Only
  - 2” 150,000 Grain Metered System
  - H125-HE-13 Twin Alternating System
  - 12-Month Prior Salt Usage – 3,320 Lbs.
  - 12-Month Post Salt Usage – 840 Lbs.
  - 75% Savings
  - $434 Salt Savings/Year @ $7/40lb
Case Study Results

- Wynwood Court Apartments
  - Hot Soft
  - 2” - 150,000 Grain Time Clock
  - H125-HE-16 Single Tank System
  - 12-Month Prior Salt Usage – 1,880 Lbs.
  - 12-Month Post Salt Usage – 1,320 Lbs.
  - 30% Savings
  - $98 Salt Savings/Year @ $7/40lb.
Key Takeaways

• Verify Hardness Settings
• Verify Salt Setting & Refill Level
• Understand Your Salt Efficiency Rating
• Understand the Benefits of Different System Designs
• Elution Studies
• Brine Reclaim Systems
• Case Studies – Real Results!
Working Together We Can & Will Achieve This!
Questions?