CROWN SOLUTIONS
CUSTOMER NEWSLETTER

Water Softener Elution Studies

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Ion exchange is a physical process involving velocity, concentration, and time. Regeneration is a combination of the same three ingredients, and if one or two of the variables are askew, proper regeneration will not occur. Then each subsequent regeneration will result in steadily reduced throughput.

During softener regeneration, calcium and magnesium ions are "eluted" from the resin beads with a highly concentrated salt (NaCl) solution. This is one of the most critical steps in the entire ion exchange process and one of the first places for problems to pop up. Monitoring the parameters surrounding this "elution" step, or performing an "elution study," is a very effective and easy investigative tool for the water treatment engineer.

Tools

Tools required to perform an elution study include:

- **Salometer**: A specialized hydrometer that measures the percent saturation of a brine solution (0-100%).
- **250-mL Graduated Cylinder**: This is used as a hydrometer jar for taking the Salometer readings.
- **Timer**: Stopwatch, wristwatch, etc.
- **Graph Paper**: To record Salometer readings versus time.

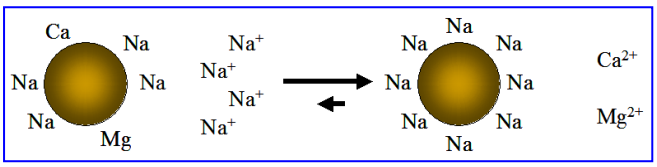
Sampling Points

There are two sampling points for an elution study:

- Brine tank
- Regenerant drain line going to the sewer.

Procedure

1. Measure the concentration of the brine in the brine tank using the Salometer. The brine tank should be 90% to 100% saturated (90 to 100 Salometer degrees) at room temperature.
2. When the softener is ready for a regeneration and has completed its backwash in the normal manner, make note of the time the brine cycle started.
3. Take a sample from the drain line as soon as the softener switches to the brine cycle.
   Note: Be sure the sample is taken at a point before water from a given softener unit has mixed with any other water source.
4. Transfer the sample to the 250-mL graduated cylinder, insert the Salometer, and take a reading.
5. Take samples every 2 to 3 minutes until the Salometer reading has dropped below 5 Salometer degrees.
6. Make note of the time the brine cycle was complete.
7. Make note of the time when the softener switches from slow rinse to fast rinse.
8. Plot the Salometer readings on graph paper with time (minutes) on the X horizontal axis and Salometer readings on the Y vertical axis.
9. Connect the data points to make a curve.
10. Draw a horizontal line at 30 Salometer degrees.



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Interpreting the Results

Ideally, there should be 25-30 minutes where the curve is above the 30 Salometer degree reading. This is known as the "30-30 Rule" where a solution of 30 Salometer degrees is in contact with the resin for 30 minutes.

There are a number of operational factors that may affect the appearance of the elution curve. Figure 1 illustrates various possibilities and states possible causes for the shape of each curve. Factors that can adversely affect the elution curve include:

- Not enough brine drawdown.
- Channeling of the resin bed.
- Restricted brine line or eductor resulting in a slow brine draw.
- Restricted distribution system.
- Improper adjustment of brine rinse flowrate.
- Unsaturated brine in brine tank.

Brine Usage

The brine usage can be calculated by measuring the diameter of the brine tank and the depth of the brine before and after the brine draw. You will need the following information:

- Volume = $\pi r^2 h$
  where π = 3.14, r = radius, &
  h = height of brine used.
- Assume a void space of 40% between the solid salt pellets.
- At 100% saturation, 1 gallon of brine contains 2.647 pounds of salt.

Conclusions

An unconventional elution curve may not be able to pinpoint the cause of a problem, but it can confirm that a problem exists. After a review of the operating procedure and perhaps an evaluation of a sample of resin has been completed, corrective action can be taken, and a second elution study can confirm that the efficiency of operation has been improved.

Figure 1: Interpretations of Elution

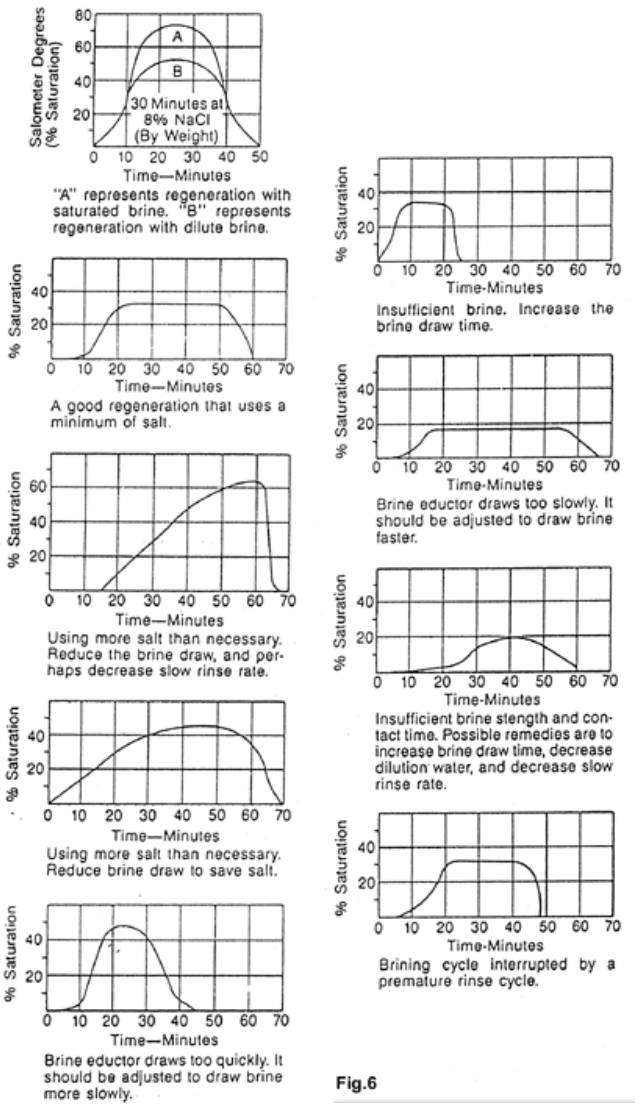

Fig.6

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- *Ion Exchange Manual*, *CROWN Solutions, Inc.*. 1997.

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