



Using Elution Studies to Troubleshoot Dealkalizers

Technical Bulletin 4-007 Pretreatment

Efficiency and Capacity

In the operation of dealkalizers, both efficiency and capacity must be addressed.

Alkalinity removal efficiency is a measure of how completely the alkalinity is removed from the softened water.

Regeneration efficiency is a measure of the amount of salt required per kilograin of alkalinity removal. The lower this ratio, the greater the regeneration efficiency.

Capacity is a measure of the capability to dealkalize water before regeneration is required. It is expressed in kilograins of alkalinity removal per cubic foot of resin or in total gallons of water that can be dealkalized by a unit.

Elution Studies

Since there are many factors that influence the efficiencies and capacity of a dealkalizer, locating the cause of the problem can be difficult. Elution studies are an effective means of pinpointing certain problems and should be considered as an initial troubleshooting measure. Once corrective actions are taken, a second elution study can be used to confirm operation has been improved.

Elution Study Procedure

1. Sodium chloride salometer, ungraduated cylinder, stopwatch, and tape measure are required. A salometer measures percent saturated salt solution.
2. Obtain samples from the dealkalizer drain line before it mixes with any other water.
3. Obtain the first sample when the dealkalizer switches to the brine draw position of the regeneration cycle (after the backwash cycle).
4. Transfer the sample to the ungraduated cylinder and take a salometer reading. The salometer has a graduated scale that measures between zero and 100% brine saturation. Measure the salometer reading at the water line. Record the reading and time.
5. Continue to draw samples every three minutes until the test is complete.
6. The test is complete when a sample is obtained in which the salometer reading descends below 5% saturation.
7. Record the inches of brine draw, the length of time for brine draw, and the brine tank diameter to determine how much brine was added during the regeneration. Also record the total time for backwash, brine draw/slow rinse, and fast rinse steps.
8. Use the blank graph on the Elution Study Report Form (TB4-008) to plot the salometer readings obtained at the three minute intervals. Connect the data points to form a curve.
9. Refer to the information below for guidance in interpreting the elution curve produced.

Interpreting Elution Curves

For proper regeneration, the concentration of the brine passing over the resin should be 5% by weight for at least 20 minutes. Since a 26.4% by weight sodium chloride solution is 100% saturated, 5% of Sodium Chloride and 0.25% by weight of Sodium Hydroxide solution is equivalent to a salometer reading of about 19% saturation ($5\% \div 26.4 \approx 19\%$). Consequently, a properly operated dealkalizer produces an elution curve that shows a salometer reading of at least 19% for at least 20 minutes.

The desired 5% brine strength is achieved using an ejector to create a suction, which pulls brine from the brine tank. The amount of brine pulled from the tank and the flow rate of the dilution water through the ejector determines the brine concentration being used for regeneration.

Causes of Unconventional Curves

An unconventional elution curve can be caused by several factors including

1. **Improper adjustment of the brine and slow rinse flow rates:** if the brine and slow rinse flow rates exceed 0.5 gpm per cubic foot of resin in the unit, there can be an appreciable reduction in capacity. An elution curve that has a 19% salometer reading for less than 20 minutes could be caused by high flow rates. Flow rates of less than 0.5 gpm per cubic foot of resin do not appreciably increase capacity and can cause channeling.



2. **Improper brine concentration:** if the concentration of the brine passing through the resin bed is not 5% by weight salt, this will be reflected in the elution curve. Causes of improper brine strength include insufficient brine draw, unsaturated brine in the brine tank, or the ejector drawing too slowly or too quickly. See the interpretation curves included in the Elution Study Report Form (TB4-008) for examples of each situation.
3. **Channeling:** refers to the uneven distribution of water or brine flow through the resin bed. It looks like cracks in dried mud and can be caused by poor backwashing, plugged distributors, or insufficient brine draw/slow rinse flow rates. If the resin bed is channeling, the brine will take the path of least resistance and not flow evenly over the resin. An elution curve that spikes quickly to a high percent saturation could be the result of channeling.

Other Factors

Factors that can negatively impact capacity and efficiency but will not be reflected in the elution curve include

1. **Organic fouling:** reduces capacity by physically blocking the ion exchange sites. However, since it generally does not impede flow through the resin bed it is not reflected in the elution curve. A laboratory analysis of the resin can verify whether organic fouling is the cause of reduced capacity and efficiency.
2. **Insufficient resin bed depth:** regardless of the quantity of resin in a dealkalizer unit, the bed depth must be at least 35 inches for efficient alkalinity removal. If less than 35 inches is present, additional resin should be added after checking for the cause of the resin loss.