TECHNICAL MEMORANDUM
(used in Website)

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TOPIC: Why add salt to a water softener?
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Brining

Description. The resin in a water softener has limited exchange capacity, which must be restored periodically through a process known as regeneration. The regeneration process reverses the normal exchange reaction of calcium sodium by subjecting the resin to the high concentrations of sodium found in sodium chloride brine.

$RCa + 2Na^{+} \rightarrow 2RNa + Ca^{+2}$

Water softeners often initiate regeneration of the resin automatically. The frequency of regeneration is controlled by time or quantity of produced water. Separation of brining cycles and service flow is essential to avoid passing salt into the treated water.

Brine Making. Applying a high concentration of sodium to the resin reverses the ion exchange reaction. The high concentration of sodium is provided by a saturated sodium chloride (common table salt) solution.

$NaCl\ (solid) + water \rightarrow Na^{+} + Cl^{-}\ (aqueous)$

A brine tank is a plastic or fiberglass tank with a perforated salt platform about 12 to 18 inches off of the bottom. Pellet or granular salt is added to a brine tank. The brine valve keeps the tank filled with water to a preset level several inches above the salt platform. The solid salt is in contact with the water above the platform and thus dissolves in the water. A reservoir of saturated brine is created in the brine tank. Over a period of time, the solution will reach saturation implying that no more salt will dissolve in the water. Saturated brine is 26% salt by weight.

Brining. Although saturated brine would give the most complete regeneration, experience has shown that using a 10% brine solution minimizes salt usage. To create a 10% brine solution, the brine is mixed with fresh water through an eductor. The eductor is a venturi-type device or aspirator, which draws a vacuum as the flow, passes through an orifice or throat. The vacuum is used to draw brine into the eductor and mix it with fresh water creating brine that is less than 26% saturation. The injector on a water softener is designed to dilute saturated brine, initially at 26%, down to 10 to 14%. The water to brine ratio is 1 to 1.6 parts water to one part brine. The eductor must be matched to the softener size to create the correct flow rate of diluted brine.

Brine Application. The regeneration reaction is relatively slow and requires a significant contact time between the resin and the brine. Purolite suggests a brine flow rate of 0.25 to 0.9 gpm/ft3. This is about a tenth of the service flow rate. They suggest a duration for brining of 15 to 60 minutes applying 4 to 10 lbs of salt per cubic foot (ft3) during that time.

At such low flow rates, the brine must be evenly distributed over the surface of the resin bed. The brine enters softeners through the inlet distributors. On some larger units, the brine is applied through a separate brine distributor located only a few inches above the bed. The brine is allowed to flow slowly through the bed so that the brine travels as a plug or creates a front. Turbulence is avoided. The conversion efficiency is constant so the amount of resin regenerated is dependent upon the amount of brine or pounds of salt applied.

The quantity of salt applied is controlled by limiting the amount of saturated brine solution drawn from the brine tank. The Accumatic system works on a level float, which closes the brine valve after the specified amount of saturated brine has been drawn.