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Engineers: Don't Neglect Your Softener!

Facilities engineering and maintenance personnel constantly struggle with the negative effects that hard water has on all types of water handling and water using equipment. Hard water affects all types of equipment, from dishwashers and laundry equipment to boilers, cooling systems and process equipment.

Hardness is defined as the total of the calcium and magnesium salts dissolved in a water supply. The term "hardness" originally referred to these dissolved minerals making the water hard to wash in – the calcium and magnesium ions react with alkalinity in soap, making it harder to lather and rinse. Hard water requires more detergent to get dishes or clothes clean.

More critical and costly problems are caused by hard water used in boiler and cooling systems. In these systems, hardness precipitates out of solution and forms hard scale deposits in piping and heat exchange equipment. Scale deposits act as insulation, decreasing heat transfer efficiency and resulting in wasted fuel or electricity. In steam boilers, scale on boiler tubes causes over-heating of the tubes and often results in tube failures, requiring expensive repair or replacement. Scale and other hard water-related problems are estimated to cost business and industry upwards of a billion dollars per year.

Fortunately, hard water-related problems can be largely eliminated through the use of a water softener to remove hardness from a water supply. Water softeners use the principle of ion exchange to remove hardness, or "soften" the water. As hard water passes through a softener, calcium and magnesium ions are exchanged for sodium ions. The exchange process takes place on the surface of synthetic resin beads, which have been "regenerated" or rinsed with a concentrated solution of sodium chloride – common salt. In a properly operating softener, this exchange will be virtually complete – the hardness level in the softened water will be less than one part per million (ppm). This will be the case even when incoming water hardness levels are extremely high – 500 ppm or greater.

A softener system will save most facilities significant amounts of money in decreased detergent use in kitchens and laundries, decreased chemical and blowdown costs in boiler systems and decreased maintenance and repair costs in all types of water-using systems. And, softeners are relatively inexpensive to install and operate, and are trouble-free and reliable if correctly maintained.

A good softener maintenance program is based on two precepts: first, the regeneration procedure must be done correctly, and second, the softener resin beads must be clean and in good physical condition.

Most softeners today are regenerated automatically, based either on a time clock, or on how much water has passed through as measured by a water meter. The entire regeneration procedure consists of a backwash cycle, a brine cycle, during which the sodium chloride brine solution is passed over the resin bed, and slow- and fast-rinse cycles. A complete, correct regeneration procedure is accomplished if the flow rates in all the regeneration cycles fall within manufacturer's specifications, ***and*** the specified amount of totally saturated brine is drawn through the resin bed over the proper time span.

To assure correct regeneration is being accomplished, the facility engineer should have an elution study performed on his softener system. During an elution study, the brine concentration is determined, and backwash, brine draw and slow and fast rinse flow rates are measured. Based on this data, an elution curve is developed that indicates whether the regeneration procedure is correct, and, if not, what alterations need to be made to assure proper regeneration.

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The next step is to have the resin analyzed for physical condition and degree of fouling. Over time, the resin beads, which are small spheres, will become cracked or fractured and break down into smaller, irregularly shaped particles. In addition, the beads will become fouled with iron during the normal softening process. Both breakage and fouling decrease the resin's hardness removal efficiency and capacity, resulting in hard water leakage from the softener.

A laboratory resin analysis will identify the degree of both breakage and fouling, and will determine the resin's actual softening capacity. The analysis will thus show whether all or some of the resin needs to be replaced, or if it requires cleaning.

Under normal operating conditions, softener resin will remain in serviceable condition for five to ten years or even longer, so frequent replacement is not normally required. However, depending on the iron level in the incoming water, fouling is a normal occurrence. Fouling significantly reduces a resin's softening capacity, so it is important to keep the resin clean. Most water treatment chemical companies have resin-cleaning chemicals available that make cleaning fouled resin easy and inexpensive.

Heavily fouled resin should be cleaned off-line. For less heavily fouled resin, and for ongoing maintenance following an off-line cleaning, on-line cleaning can be conducted by adding the cleaning chemical to the brine tank, so the resin cleaner is drawn through the resin bed during regeneration. Used in this manner, the resin cleaner will maintain the resin in peak performance condition, and softening capacity and efficiency of the softener will be maximized. A program of regular resin cleaning is an effective and inexpensive way to help optimize a softener's performance.

A simple softener maintenance program, beginning with an elution study, monitoring the day-to-day operation of the softener to assure the normal amount of salt is being used, and regular cleaning of the resin bed will assure proper softener performance and service life, and help prevent costly hard water problems.