Basics of Water Softening

What is "hard" water?
Water described as "hard" contains high levels of dissolved calcium and magnesium. Groundwater obtains these metals by dissolving them from surrounding soil and rock.

What problems are caused by hard water?
Hard water can cause costly breakdowns in boilers, cooling towers and plumbing. Hard water can also lessen the effectiveness of soap. When hard water is heated, the carbonates precipitate out of solution, forming a scale in pipes and surfaces. This scale is composed of mostly calcium carbonate, calcium sulfate, magnesium carbonate and magnesium sulfate. The resulting scale can end up completely plugging pipes and restricting flow. In boilers the scale prevents efficient heat transfer and will have to use a lot of energy to provide hot water and can cause metal boiler components to overheat. Soap is less effective in hard water because it reacts to form the calcium or magnesium salt of the organic acid of the soap.

How is hard water treated?
Water is made soft by the use of a water softener using ion exchange resin. The troublesome calcium and magnesium ions in hard water are exchanged for sodium, which is much more soluble and does not precipitate out to form scale or interfere with soap.

Ion exchange resins are very small porous round plastic beads. For water softening applications, the polymer structure of the resin bead contains a fixed negative ion that is permanently attached. This cannot be removed. In simple terms, the resin bead has a fixed negative charge. Each negatively charged exchange site can hold a positively charged ion. In this case, sodium (which has a positive charge) is attached to the exchange site (negative and positive charges attract – think of magnets)! In the end you have a mobile sodium ion attached to each of the fixed negative charges on the resin bead.

When hard water is passed through the resin bead, the calcium and magnesium ions have a stronger positive charge than sodium does. As a result, the calcium and magnesium have a stronger attraction to the negatively charged resin bead than sodium does. The sodium ion is then 'kicked off' the resin bead as the calcium and magnesium take its place (and remains attached to the bead). As a result, the less desirable calcium and magnesium ions are exchanged for more desirable sodium ions. It is important to note that the salinity of the water does not change; it is simply an exchange of one salt for another.

Eventually, the resin beads become saturated with hardness such as calcium and magnesium and there are no more exchange sites left to produce soft water. The resin beads have reached exhaustion and must be regenerated.

How does regeneration work?
In simple terms, the ion exchange resin is soaked in a strong solution of sodium chloride (brine) where the sheer volume of brine solution causes the calcium and magnesium ions in the resin beads to become dislodged. At the same time, the sodium in the brine solution again becomes affixed to the resin bead. After regeneration, the excess brine and hardness causing ions are rinsed to drain and the resin beads are ready for use again.

For more information please contact Puretec Industrial Water at 800-906-6060 or visit us online at
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