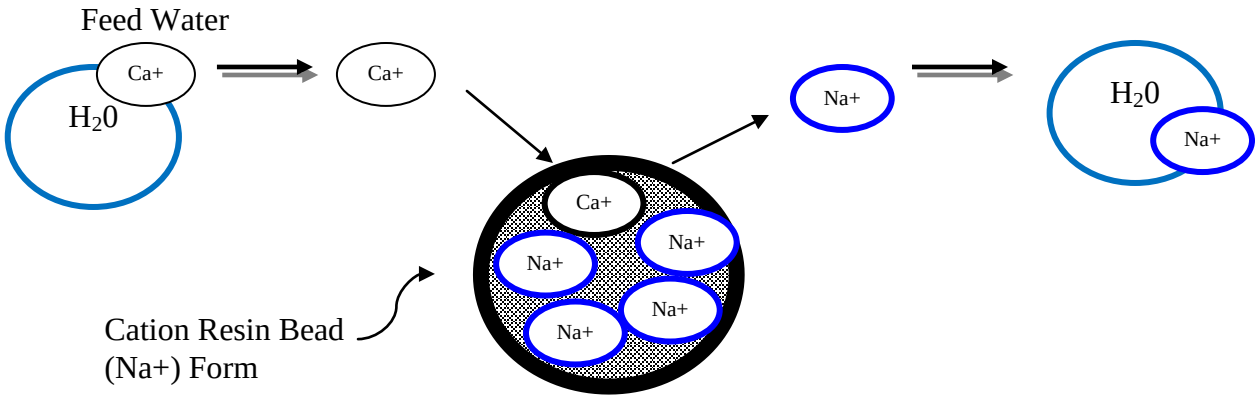
Basics of Water Softening By Ion Exchange

Water that contains calcium and magnesium ions is called “hard water” because calcium and magnesium can combine with other ions and compounds to leave a hard scale on the surfaces that they come into contact with. Hardness problems can be reduced or eliminated through the use of an ion exchange water softener that uses ion exchange resins to exchange hardness causing ions with a more desirable ion that does not cause scaling. Below is a diagram of how this works.



Starting from the left, the feed water contains hardness ions such as Calcium and Magnesium. In this example the calcium ion is attracted to the cation resin bead, which is a highly porous, amber colored, plastic bead loaded with “exchange sites”. These exchange sites have a fixed negative charge that attract positively charged hardness ions such as calcium. A properly regenerated cation resin bead used for softening has a sodium ion attached to the exchange site as well. The sodium ion has a positive charge and is attached to the fixed negative charge inside the resin bead. When a hardness ion such as calcium comes into contact with the resin bead, it has a greater attraction to the fixed negative charge than the sodium ion does, so it kicks the sodium ion from the exchange site and the sodium ion leaves the resin bead and combines with the water that exits the water softener. The water is now considered “soft” because most, if not all, hardness causing ions have been replaced by sodium, which does not form hardness causing scale for form.

It is important to note that a water softener will not reduce the Total Dissolved Solid content of the feed water like a demineralizer will. With a water softener, you have hardness causing ions coming in and you have sodium ions coming out. The sodium ions are conductive and as a result will give a TDS reading that is close to the feed water.

Feed water hardness is usually expressed in Grains whereas the soft water produced is expressed in parts per million or mg/l (1 grain equals 17.1 parts per million). Water that is less than 1 grain or 17 ppm is considered soft; however, many applications demand 0 ppm hardness.

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