All About Commercial Water Softeners

Technical Article CWT-19

Water softeners are used to remove dissolved minerals, mainly Calcium (Ca) and Magnesium (Mg), from an incoming water source. These are the minerals that are primarily responsible for the condition that is commonly referred to as "hard water". A water softener uses an ion exchange process to remove these minerals, and the softener system typically will use a brine (salt) solution to regenerate the ion exchange resin when it becomes saturated.

Hard water is problematic because it will reduce the efficiency of heat exchange systems, such as water heaters and boilers, by creating scale on the heat transfer components of those systems. Hard water will also constrict flow through pipes, cause valves to fail, and damage the finish on plumbing fixtures such as faucets and sinks.

An important consideration when evaluating water softeners is what type of control valve to use--timed or metered. For almost all applications, the metered valve will be more efficient and cost less to operate. A metered valve will regenerate only after a specified amount of water has flown through the system. Using a Timed Valve will usually result in more frequent regeneration cycles, which will consume more salt and more water than the metered alternative.

DESIGN AND OPERATION
Primary Components of Traditional Water Softener

Automatic Control Valve or Digital Controller (aka Controller)
- The most critical component of a softener
- Controls water flow for regeneration cycles
- Mounts on top of the resin tank
- Typically available with timed or metered regeneration

Resin Tank
- With Control Valve mounted on top, this is the most recognizable component of a Softener
- Tank holds the resin that is used to remove dissolved solids (Ca and Mg) from water

Cation Resin
- Cation resin in Sodium state is typically used for Softeners
- Requires regeneration with brine solution periodically to maintain softening capacity

Brine (salt) Tank
- Brine tank is used to produce solution for regeneration of cation resin
- Salt inside brine tank is consumable for softener system

Operation of Traditional Water Softener
Incoming hard water flows through the control valve and into the resin tank. Inside the tank, the cation resin absorbs the dissolved Calcium and Magnesium. This is the process that removes the "hardness" from the water. As the dissolved minerals attach to the resin, it will gradually become saturated. Back-flushing with a brine solution that is produced in the brine tank will regenerate the resin to restore the softening capacity of the system. The entire process (softening and regeneration) is controlled by the control valve.

Regeneration Cycles
- Backwash with high flow from bottom to top of resin tank
- Approximately 10-minute cycle time
- Causes dirt to rise and be removed from system
- Bottom to top flow helps to “fluff” the resin

Brine Rinse with Slow Flow from Top to Bottom of Resin Tank
- Approximately 60-minute cycle time
- Increased salt level of brine solution causes release of Ca and Mg that is attached to resin
- Brine solution with “freed” minerals is sent to drain

Rinse with High Flow from Top to Bottom of Resin Tank
- Approximately 10-minute cycle time
- Removes any excess sodium (salt) from the resin tank and "settles" in the resin bed

Brine Tank Refill with Soft Water
- Approximately 10-minute cycle time
- Soft water is sent to brine tank to produce brine solution for next regeneration
NOTE: Softening adds approximately 80 ppm of sodium to the water during the softening process

Water Softener System Sizing
As with any water treatment system, the first step for establishing the system requirements is to obtain a reliable water analysis. For a softener system the critical values are the parts-per-million (ppm) levels of Calcium (CA) and Magnesium (Mg) or Calcium Carbonate (CaCO3).

How to determine the appropriate softener size
Total Hardness = CaCO3 = (ppm Ca x 2.5) + (ppm Mg x 4.1)
Grains per Gallon (GPG) required = CaCO3 ÷ 17.1
Grains per Day (GPD) = Gallons of Water used per Day x GPG
Cubic Feet of Resin Required = GPD ÷ 30,000

Using this information it is possible to determine the appropriate size for a softener system. It is usually best to oversize, rather than undersize a system, and it is strongly recommended that an experienced water treatment specialist be consulted for designing and installing a water softener.

To learn more or for assistance with your water softener project, please contact a Clear Water expert by calling 844.429.8324 or emailing info@clearwatertech.com.
