

## What Makes Water Hard & How Can It Be Improved

The most common water quality problem reported by consumers throughout the U.S. is hard water. A U.S. Geological Survey indicates that hard water is found in more than 85 percent of the country. So then, what makes water hard and what can consumers do to treat this problem?

### Hard Water

Because more than 60 percent of the earth's water is groundwater, it travels through rock and soil picking up minerals, including calcium and magnesium along the way. These two contaminants produce what is commonly referred to as "hardness" in water. Generally speaking, hardness is measured in grains per gallon (gpg). For example, if a water test indicates a range of 1.0 to 3.5 gpg, the rating for that water is considered slightly hard. If, on the other hand, the measurement is more than 10.5, the rating on that water supply is considered very hard.

Hard water is detected very easily through personal hygiene routines, such as hair washing, or through appearance of fixtures and appliances or changes in heating costs:

- ▶ Clogged pipes and/or appliances could be a sign of hard water. Hard water minerals can form in coffee makers and can build up in pipes or plumbing equipment. A consumer may notice a reduced water flow as well as an increase in the amount of calls to the repairman.
- ▶ Consumers may notice a film on their bathtubs or shower tiles, and even themselves. The film that is left often results in additional scrubbing and scouring of the bathtub and other fixtures. The film that is left on the body can leave the skin dry and hair dull and limp.
- ▶ A consumer's water heating costs could increase as a result of hard water. When hard water is heated, the minerals can precipitate and form scale. Besides buildup, mineral deposits can form an insulation barrier inside the water heater.

▶ The calcium and magnesium in hard water act on many soaps and detergents to reduce their sudsing and cleaning capabilities. The soapy residue they form can be abrasive and reduce the life of clothes.

In areas where the source of water is hard or very hard, the local water utility may soften the water to about five or six gpg. This figure is still considered moderately hard, and consumers may still wish to soften the water further. The most common option for consumers is ion exchange water softening in the home. Domestic softening makes economical sense because it only softens the water to be used for laundering, cleaning, and other home uses. Softening at the central treatment facility is costly because it softens all water, including that used for fighting fires and cleaning streets.

### Water Softening

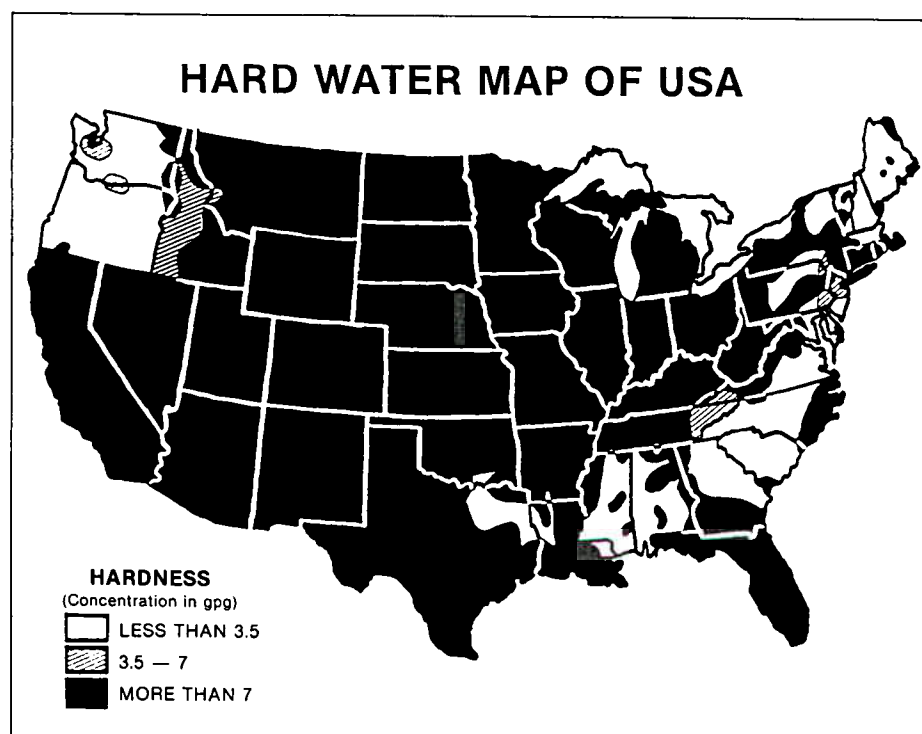
There are many different types of softeners, each with their own benefits. The method used most often in homes

is cation exchange, the principles of which are simple. An ion is an electrically charged atom or group of atoms. A cation is a positively charged ion. The water is softened when the hardness ions (magnesium and calcium) are exchanged with sodium ions. This exchange occurs in the resin bed during the softening cycle.

Three main parts make up most water softeners:

- ▶ Resin Tank - contains the resin bed
- ▶ Resin Bed - This is made up of tiny bead-like material often made of styrene and divinylbenzene. The beads attract and hold positively charged ions such as sodium, but will exchange them whenever the bead encounters another positively charged ion, such as calcium or magnesium
- ▶ Brine Tank - This tank holds the dissolved salt solution that is necessary to regenerate the resin.

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## Hard Water

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Regeneration refers to reversing the ion exchange operation. The magnesium and calcium ions are driven off of the resin beads and replaced by positively charged sodium ions. The regeneration occurs when the resin beads are washed with a strong salt water solution. The salt forces the calcium and magnesium ions to be released, and they are then discharged as waste during the backwashing cycle. The beads are ready to once again attract hardness contaminants from the water. Many installed water softeners are fully automatic. An automatic unit regenerates according to a preset clock for example (every third night at 3 a.m.) Other systems may use an electronic sensor that regenerates the system according to the water usage.

### Size and Type Considerations

When water softeners were first manufactured, manual and semi-automatic models, where the regeneration process was started "manually" by the homeowner, were the most common types sold. Today, the two main types on the market are automatic and demand initiated regeneration (DIR) water softeners. Automatic softeners regenerate on a schedule regulated by a timer. DIR softeners are the most sophisticated. They contain a hardness sensor or water meters which trigger regeneration as needed.

There are several factors that a person must take into consideration before purchasing a softener, including the number of people in the home, how much water is used, and the hardness of the water.

Determining the size of the softener is rather simple. Multiply 75 (average gallons per day used per person) by the number of people in your household. For example, four people in the home would use 300 gallons per day. Then multiply the 300 gallons times the number of grains per gallon of hardness. For example, 20 gpg gives you a figure of 6,000 gpg total per day. The typical water softener capacity is between 18,000-30,000 grains per regeneration.

### The Sodium Issue

For some consumers, the fact that sodium is used to soften water raises concern about their drinking water and a potential health risk. However, what many people may not know is that when doctors and researchers discuss salt and

its effects on a person's health, they usually refer to sodium chloride, not sodium bicarbonate which is the result of softening.

Further, according to Dr. Andrew Zweifer, Director of the Hypertension Clinic at the University of Michigan, "Drinking water represents a very small part of sodium intake in most persons. Even water softening systems using salt don't introduce enough salt to be of concern." Similar views were expressed in the *New England Journal of Medicine* and by the U.S. EPA.

If consumers do not want to add any additional sodium to their diet, or if they are on a medically prescribed diet, they may choose to connect their water softener to the hot water line only, thus leaving consumers able to drink and cook with unsoftened cold water. Or, they can install a reverse osmosis or distillation system and have the full benefits of both technologies in their home.

### Benefits of Softened Water

Even for those whose water is slightly hard, significant benefits can result from using softened water:

- ▶ Water heating efficiencies on systems using softened water may be increased up to 29 percent if heating with gas and 22 percent with electricity (Source: *New Mexico State University*).
- ▶ The life of the plumbing system may increase because clogging from scale within pipes will be reduced.
- ▶ Many appliances may last longer and perform better.
- ▶ Soapy residue on clothes is reduced so they may look and wear better.
- ▶ Skin and hair can be rinsed more completely making hair look shinier and skin cleaner.
- ▶ Film on tubs and shower tiles may be reduced, as will scratching to bathroom fixtures and sinks.

A final tip: Look for the WQA Gold Seal on home water treatment systems. This recognizable symbol gives the consumer the assurance that the equipment has been tested against industry performance standards, has successfully passed these tests, and has been validated for performance capabilities.

To receive more information about water quality issues, please write to:

**Water Quality Association**  
Post Office Box 606  
Lisle, IL 60532. □

## Consumers Ask...

**Q.** We recently moved to a small rural community in Arizona and have been informed that the water from our private well contains an excessive amount of fluoride. Can you tell us what causes this condition? What are its harmful effects to our family's health? Could you also advise us on the most reliable and cost effective methods of treatment?

**A.** Fluoride may occur naturally in groundwater that contains fluoride-bearing minerals, often found in igneous, plutonic, or metamorphic rock. Higher levels of fluoride are often found in the Northern Plains states and in the Southwest region of the U.S. as well as other parts of the country.

Research has indicated that fluoride in relatively small doses may result in tooth fluorosis, kidney damage, or skeletal aberrations. Source: *N.S.F. Final Report (R-29), Water Processing (E-19)*.

Treatment techniques that have proven effective at reducing fluoride include reverse osmosis, distillation, and activated alumina filters. These techniques may also reduce other contaminants in the water. □

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*For local information you may contact:*

