

# Solving Hard Water Problems

Your laundry comes out stiff and dingy. The china and glasses have more spots than sparkle. The bathtub has that telltale ring. And there are "rocks" in the teakettle. What's the problem? Chances are, it's hard water.

## What is hard water?

Water is called *hard* when it contains dissolved particles of calcium, magnesium, and (to a lesser degree) iron and manganese. The more minerals the water contains, the harder it is. Calcium and magnesium can cause problems in cleaning and cooking.

When you add soap to hard water, it combines with the hardness particles to form "curds," which make it difficult for the soap to remove soil. The curds leave rings in the bathtub and scum on clothing and dishes.

Another form of water hardness is the *precipitate* or "rocks" that form when you heat water. This problem is the result of calcium and magnesium bicarbonates that are dissolved in the water. When you heat this water, the bicarbonates form the "rocks" that fall to the bottom (this is the precipitate)—and they won't dissolve.

## What about water-borne bacteria?

Water hardness has no particular relationship to bacteria that live in water. A bacteriological analysis can determine the safety of your water. Private laboratories or your county health department can make the analysis.

If you decide to test your water, use a special sample bottle, *never* a household container. The laboratory or health department will provide the bottle and tell you how to collect the sample and pay the fee for this service.

## How hard is my water?

Generally, you can have your water tested for hardness without charge. Contact a local water-conditioning service company, appliance dealer, or water-treatment plant.

If you plan to use a water-conditioning service company (let's call it "Company X"), you can check on its record in two ways. The Financial Fraud Section of the Oregon Department of Justice has a "Consumer Line," either 378-4320 in Salem or 229-5522 in Portland.

Either office can tell you whether it has had any contacts with Company X (or similar companies) and whether it has taken any court action against it.

You can also phone the Corporation Division of the Oregon Department of Commerce, 378-4166. This office can tell you whether Company X is registered to do business in Oregon (and in what counties), who its officers are, when it incorporated, and (assuming Company X has been around a few years) whether it's considered to be a company in good standing.

If you get your water from a municipal water company, the water plant operator will know how hard the water is.

Some water softener equipment dealers and soft water service operators provide kits with instructions to help you determine the approximate hardness of water in your home.

How do I take the sample?

When you collect a sample to determine water hardness, first let the water run from the faucet for several minutes. (If you plan to test the water yourself, follow the kit instructions from this point.)

Use a clean bottle that will hold at least one pint of water. Rinse the container several times with the water to be sampled, then fill the container.

Cover the container tightly with a nonmetallic lid. Label the container. Write on it the date, time, location, source of sample, and your name and address. Give the water sample to an organization qualified to test it.

How do we measure water hardness?

Chemists identify the hardness of water by the amount of minerals it contains. They report the amount of calcium and magnesium that causes hardness as grains per gallon (gr/gal) or parts per million (ppm).

(A grain is 1/7000 of a pound. If your water is rated 1 gr/gal, for example, this means that your water contains 1 grain of calcium carbonate in 1 gallon of water.)

Attitudes toward water hardness depend on what people are used to. Although some families tolerate reasonably hard water, those that are accustomed to soft water

will usually demand soft water. People accustomed to 20- or 30-grain (per gallon) water may regard 5-grain water as soft. On the other hand, people accustomed to 1- or 2-grain water may consider 5-grain water quite hard.

There are different ways to classify water: soft, moderately hard, hard, very hard, or extremely hard. However, water with 5 or more grains hardness is considered too hard for most household uses. If water is 10 grains or more hard, a softener is highly desirable.

Why is soft water easier to work with?

A water softener can solve most hard water problems—rings in the bathtub, grayish laundry, spotted dishes. In addition, soft water will:

- make shampooing easier and reduce irritation to sensitive skin;
- extend the life of your fabrics from 20 to 40 percent;
- reduce the amount of soap and detergent you'll need;
- reduce mineral buildup in water pipes; and
- increase the service life of your water heater (hard water flowing through your water heater leaves a buildup that can increase your fuel costs and force you to make expensive replacements).

How much will I save?

It's difficult to estimate savings if you purchase a water softener. More importantly, consider convenience and satisfaction.

Soft water needs less soap or detergents. Soap manufacturers base recommendations on these average washing conditions: a 5- to 7-pound load of clothes, moderate soil, moderate water hardness (4 to 9 gr/g), and average water volume (17 gallons for a top-loading washer). With soft water, you'll need less detergent.

A softener can also save time. Household cleaning chores take less time with soft water because you don't have to live with calcium and magnesium in your water.

Any other effects?

Softened water will probably taste different (it probably has more sodium than you're used to). Because taste preference is a habit, you'll probably learn to like soft water. If a family member is on a low-sodium or sodium-free diet, be sure to check with your physician about the increased sodium you'll absorb through drinking and cooking with your softened water.

A water softener may remove some visible iron rust (oxidized iron) in the water because of its simple straining function; however, this is no guarantee it has removed *all* the iron.

If your water contains soluble (invisible) iron, the softener may be less effective. As iron rust coats the water-softening material, its efficiency is reduced. If your water has a high level of iron, you will need an iron-removal filter added to your softener.

How do I soften water?

There are several ways: adding chemicals, distilling, freezing, boiling, or adding soap. Most municipal water plants use chemicals to soften water. Our concern here is

*home* water-softening equipment and packaged chemical softeners.

Usually, the most economical and quickest way of softening water is to remove the calcium and magnesium from the water through the ion-exchange process with water softening equipment.

Your plumbing system will have to be adapted for use with a water softener. You need to soften only hot and cold water you use for cooking or in cleaning with soap or detergent.

It isn't necessary to connect toilets or outdoor water faucets to the soft water system. And *always* bypass outside sprinklers—your grass and flowers can't take the increased sodium.

How do I select water-softening equipment?

An ion-exchange softener exchanges hardness minerals for sodium from the resin in the softener. The sodium, now in the water, doesn't cause hardness problems. Salt pellets supply the sodium to the resin.

In time (how long depends on how much you use the equipment), the resin in an exchange softener will become saturated with calcium and magnesium ions. When this happens, the resin can't continue to soften your water, and it must be regenerated.

The regenerating process adds a highly concentrated salt solution (brine) to the ion-exchange material. This forces the calcium and magnesium out of the exchange resin—leaving it ready to start softening your water again. The regeneration steps are backwash, brining, slow rinse, and fast rinse.

An ion-exchange water softening unit has one or two resin tanks, a brine tank, and valves and piping to control the operation. Basic differences between models include the softening capacity of the unit and the degree of automation.

**Capacity.** Look on the tank nameplate for the unit's capacity in *total grains of exchange*. Softening capacity indicates the volume of water that the unit can soften before it needs regeneration. Capacities range from small softeners (10,000-grain capacity) to large commercial units (more than 100,000-grain capacity).

Although the nameplate seldom tells you the type of exchange material, the operating instructions should state which material is in the tank. See table 1.

Table 1.—Characteristics of ion exchange materials

Material	Color	Capacity (grains/gallon)
Styrene polyvinyl resin	amber or white	187,000
Sodium aluminosilicate (synthetic zeolite)	white or yellowish white	89,760
Sulfunated coal (carbonaceous zeolite)	black	74,800
Natural greensand zeolite	green	22,440

**Automatic or hand-operated?** How automatic the equipment is often determines how much you'll pay for it. With less expensive, hand-operated, one-tank units, you must add the required salt to the tank for each regeneration, cycle it through the softener, and operate the valves by hand.

Follow the instructions provided with your softener. Regeneration usually takes about 30 minutes.

Most people prefer automatic units. Various degrees of automatic operation are provided with the more expensive one- and two-tank models.

In two-tank models, one tank contains the softening material, and the other stores enough brine and salt to last several months. When regeneration is necessary, valves automatically operate in a routine sequence so that the resin is back-

washed, regenerated, rinsed, and returned to operation.

Partially automatic units are available. With one of these, you only have to start the regeneration routine. You don't need to return to the tank (a timing device completes the process).

These units are more convenient if they provide soft water for at least three days between regenerations. This amount, of course, depends on how much water *your* household uses.

Fully automatic units supply soft water with a minimum of effort. You set a clocklike mechanism attached to the tank, and regeneration automatically begins according to the schedule you set. However, you *will* have to add salt to the brine tank, as needed. These units may regenerate as often as once a day.

Another fully automatic type has a sensing device that continuously monitors water for hardness. When it detects hardness coming from the softener, it automatically triggers the regeneration sequence. With this type, however, regeneration may begin at an inconvenient time for you!

Should I buy or rent equipment?

You have two choices for equipment to soften your home water supply:

**Buy a household water softener.** Numerous appliance and service dealers carry many makes and models of fully automatic, semiautomatic, or manually operated softeners in several capacities.

**Rent a portable exchange or automatic unit.** The dealer installs a *portable exchange* softener and exchanges the resin tank for a fresh one at regular intervals.

How frequently this happens depends on how hard your water is and how much soft water you use. You pay a small installation fee, but you have no investment in the equipment.

*Automatic rental units* remain in your home for a monthly or yearly charge. The dealer provides salt for regeneration and complete care of the unit.

**To compare the costs** of a purchased household water softener and a rental softener, figure the annual cost for each. For example, use Worksheet 1 to figure annual cost of a purchased softener and Worksheet 2 to figure rental costs.

To figure your costs, assume you will soften all your hot and cold household water. If your water is metered, obtain the volume used in a month or year from the water utility or your water bills.

If it's not metered, estimate the amount used (typical indoor household use ranges from 40 to 100 gallons per person per day). For this illustration, suppose you soften 200 gallons of household water each day. Therefore, the grains of hardness to be removed each day are approximately 4,200 (200 gallons per day x 21 grains per gallon).

Soft water service dealers will need to know the water hardness and the quantity to be softened per day before they can estimate a unit for purchase or rental. They will also help you determine the frequency of portable tank exchange for your water hardness and water consumption.

Your phone book yellow pages list dealers under "Water—Rental and Purchase, Softening and Conditioning Equipment, or Water Softening Service."

Select equipment

Some companies make spectacular claims for water softening without chemicals—claims they can't live up to. *There are no shortcuts*. If you want to economically soften your home water supply, you must use chemicals.

Choose your equipment wisely. The Water Quality Association (477 E. Butterfield Road, Lombard, IL 60148) will send you a list of reputable manufacturers.

Check with other water-softener owners for their recommendations before you choose a manufacturer and dealer. Compare prices and claims before purchasing or renting.

After selecting a dealer, study the literature. Reputable dealers will usually service the equipment they sell, but be sure to ask about servicing *before* you purchase or rent.

After you examine your needs, evaluate the costs, and consider the requirements of owning or renting, you can make an informed decision.

Packaged softeners

Another method of softening water is to add packaged softeners to your wash water. There are a number of products that do this. They come in two types.

One type dissolves calcium and magnesium salts, which form a precipitate. If you don't remove this dissolved matter, the water appears cloudy, and these chemicals can attach themselves to dishes or fabrics. Examples are washing soda and Borateem.

The second type (called *nonprecipitating*) keeps the magnesium and calcium in solution in a way that they cannot react with soap to form curds. Calgon is an example.

Nonprecipitating water softeners are routinely added to laundry detergents to combat water hardness. Both types of packaged water softeners reduce the amount of soap or detergent you'll need.

While packaged chemical water softeners may be satisfactory for treatment of small volumes of water, they are expensive for use in large volumes of water. They do im-

prove cleaning results when you use them in automatic washing machines, however.

Examine all the costs involved in softening your household water be-

fore you make any costly decisions. The more informed you are, the better your choice will be.

Worksheet 1. Cost factors for buying a water softener	Annual Costs <sup>a</sup>	
	Example	Your cost
<i>Salt:</i> remove 3,600 grains of hardness daily; 4 lb of salt per regeneration. Annual salt requirements would be 384 lb of salt × \$.10 per lb.....	\$38.40	_____
<i>Water costs for regenerations:</i> 8 times per month × 12 months × 60 gallons per generation = 5,760 gallons. 5,760 gallons × \$.00053/gallon = .....	1.73	_____
<i>Sewer costs:</i> Given as 7.7 water units × \$.54 per unit.....	4.15	_____
<i>Electricity to operate:</i> 3 to 4 watts.....	1.60	_____
<i>Maintenance costs:</i> Most have a 5 year warranty for any repairs, costs given as \$12.00 per year on the average.....	40.00	_____
<i>Total annual cost of softener</i> .....	97.88	_____

Worksheet 2. Cost factors for renting a water softener		
<i>Rental price:</i> on an annual basis for a portable exchange unit 3,600 grains per day capacity.....	\$156.00	_____
<i>Installation fee</i> (this is a one-time cost. If the service will be used for 10 years, the annual cost is 1/10th of the installation fee).....	5.00	_____
<i>Annual cost of portable exchange service</i> (for conditions specified).....	161.00	_____

<sup>a</sup>Based on 1984 figures from Corvallis, Oregon, merchants.

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