

1. Hard water

1.1 What is hard water?

When water is referred to as 'hard' this simply means, that it contains more minerals than ordinary water. These are especially the minerals calcium and magnesium. The degree of hardness of the water increases, when more [calcium](#) and [magnesium](#) dissolves.

Magnesium and calcium are positively charged ions. Because of their presence, other positively charged ions will dissolve less easily in hard water than in water that does not contain calcium and magnesium.

This is the cause of the fact that soap doesn't really dissolve in hard water.

1.2 Which industries attach value to hardness of water?

In many industrial applications, such as the drinking water preparation, in breweries and in sodas, but also for cooling- and boiler feed water the hardness of the water is very important.

2. Water softening

2.1 What is water softening?

When water contains a significant amount of calcium and magnesium, it is called hard water. Hard water is known to clog pipes and to complicate soap and detergent dissolving in water.

Water softening is a technique that serves the removal of the ions that cause the water to be hard, in most cases calcium and magnesium ions. [Iron](#) ions may also be removed during softening.

The best way to soften water is to use a water softener unit and connect it directly to the water supply.

2.2 What is a water softener?

A water softener is a unit that is used to soften water, by removing the minerals that cause the water to be hard.

2.3 Why is water softening applied?

Water softening is an important process, because the hardness of water in households and companies is reduced during this process.

When water is hard, it can clog pipes and soap will dissolve in it less easily. Water softening can prevent these negative effects.

Hard water causes a higher risk of lime scale deposits in household water systems. Due to this lime scale build-up, pipes are blocked and the efficiency of hot boilers and tanks is reduced. This increases the cost of domestic water heating by about fifteen to twenty percent.

Another negative effect of lime scale is that it has damaging effects on household machinery, such as laundry machines.

Water softening means expanding the life span of household machine, such as laundry machines, and the life span of pipelines. It also contributes to the improved working, and longer lifespan of solar heating systems, air conditioning units and many other water-based applications.

2.4 What does a water softener do?

Water softeners are specific ion exchangers that are designed to remove ions, which are positively charged.

Softeners mainly remove calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions. Calcium and magnesium are often referred to as 'hardness minerals'.

Softeners are sometimes even applied to remove iron. The softening devices are able to remove up to five milligrams per litre (5 mg/L) of dissolved iron.

Softeners can operate automatic, semi-automatic, or manual. Each type is rated on the amount of hardness it can remove before regeneration is necessary.

A water softener collects hardness minerals within its conditioning tank and from time to time flushes them away to drain.

Ion exchangers are often used for water softening. When an ion exchanger is applied for water softening, it will replace the calcium and magnesium ions in the water with other ions, for instance [sodium](#) or [potassium](#). The exchanger ions are added to the ion exchanger reservoir as sodium and potassium salts (NaCl and KCl).

2.5 How long does a water softener last?

A good water softener will last many years. Softeners that were supplied in the 1980's may still work, and many need little maintenance, besides filling them with salt occasionally.

3. Softening salts

3.1 Which types of salt are sold for application in a water softener?

For water softening, three types of salt are generally sold:

- Rock salt
- Solar salt
- Evaporated salt

Rock salt as a mineral occurs naturally in the ground. It is obtained from underground salt deposits by traditional mining methods. It contains between ninety-eight and ninety-nine percent sodium chloride. It has a water insolubility level of about 0.5-1.5%, being mainly calcium sulphate. Its most important component is calcium sulphate.

Solar salt as a natural product is obtained mainly through evaporation of seawater. It contains 85% sodium chloride. It has a water insolubility level of less than 0.03%. It is usually sold in crystal form. Sometimes it is also sold in pellets.

Evaporated salt is obtained through mining underground salt deposits of dissolving salt. The moisture is then evaporated, using energy from natural gas or coal. Evaporated salt contains between 99.6 and 99.99% sodium chloride.

3.2 Should we use rock salt, evaporated salt or solar salt in a water softener?

Rock salt contains a lot of matter that is not water-soluble. As a result, the softening reservoirs have to be cleaned much more regularly, when rock salt is used. Rock salt is cheaper than evaporated salt and solar salt, but reservoir cleaning may take up a lot of your time and energy.

Solar salt contains a bit more water-insoluble matter than evaporated salt. When one makes a decision about which salt to use, consideration should be given to how much salt is used, how often the softener needs cleanout, and the softener design. If salt usage is low, the products could be used alternately.

If salt usage is high, insoluble salts will build up faster when using solar salt. Additionally, the reservoir will need more frequent cleaning. In that case evaporated salt is recommended.

3.3 Is it harmful to mix different kinds of salt in a water softener?

It is generally not harmful to mix salts in a water softener, but there are types of softeners that are designed for specific water softening products. When using alternative products, these softeners will not function well.

Mixing evaporated salt with rock salt is not recommended, as this could clog the softening reservoir. It is recommended that you allow your unit to go empty of one type of salt before adding another to avoid the occurrence of any problems.

3.4 How often should one add salt to a softener?

Salt is usually added to the reservoir during regeneration of the softener. The more often a softener is regenerated, the more often salt needs to be added. Usually water softeners are checked once a month. To guarantee a satisfactory production of soft water, the salt level should be kept at least half-full at all times.

3.5 How come water sometimes does not become softer when salt is added?

Before salt starts working in a water softener it needs a little residence time within the reservoir, since the salt is dissolving slowly. When one immediately starts regeneration after adding salt to the reservoir, the water softener may not work according to standards.

When the water softening does not take place it could also indicate softener malfunction, or a problem with the salt that is applied.

4. Softening costs

4.1 How much does a water softener cost?

Some softeners are more efficient than others and as a result the prizes may differ. There are time operated softeners and water meter-controlled softeners available. The water meter-controlled units produce the softest water per pound of salt. Some softeners work on electricity, but some more recent water softeners use waterpower. Costs of a water softener greatly depend upon the type of water softener and the type of energy that is used, but also upon the hardness of the water that needs softening and the water use. When the water is very hard and it is used heavily, the costs of softening will rise.

Generally the costs of a water softener can vary between € 0,20 and € 0,40 a day. The costs of water softeners are usually far outweighed by the benefits and cost savings obtained, through using softened water.

4.2 How much does a water softener cost during operation?

The running cost is merely the cost of salt. This is likely to be around € 1,95 per person in the household in a month.

5. Softening drinking water

5.1 Do water-producing companies always produce softened water?

Although water-producing companies do have the opportunity to produce softened water, they will not always do so. A water producing company only has to add a water softener in its water purification system, to produce softened water cheaply. But than consumers would not be able to have the choice to drink un-softened water.

Hard water problems are most likely to occur when water is heated. As a result, hard water causes few problems to the water supplying companies, especially when only cold water runs through their pipes.

5.2 Is softened water safe to drink?

Softened water still contains all the natural minerals that we need. It is only deprived off its calcium and magnesium contents, and some sodium is added during the softening process. That is why in most cases, softened water is perfectly safe to drink. It is advisable that softened water contains only up to 300mg/L of sodium. In areas with very high hardness the softened water must not be used for the preparation of baby-milk, due to the high sodium content after the softening process has been carried out.

5.3 Can salt from softening installations enter drinking water?

Salt does not have the opportunity to enter drinking water through softening installations.

The only purpose of salt in a water softener is to regenerate the resin beads that take the hardness out of water.

5.4 How much sodium does one absorb from softened water?

The sodium uptake through softened water depends on the hardness of the water. Averagely, less than 3% sodium uptake comes from drinking softened water. Estimates say that a person consumes about two to three teaspoons of salt a day, from various sources. Assuming a daily intake of five grams of sodium through food and the consumption of three quarts of water, the contribution of sodium (Na⁺) in the water from the home water softening process, is minimal compared to the total daily intake of many sodium-rich foods.

5.5 Will softening drinking water deprive it of essential minerals?

Softening will not deprive water of its essential minerals. Softening only deprives drinking water of minerals that cause the water to be hard, such as calcium, magnesium and iron.

6. Softeners maintenance

6.1 When does a softener resin need replacement?

When the water does not become soft enough, one should first consider problems with the salt that is used, or mechanical malfunctions of softener components. When these elements are not the cause of the unsatisfactory water softening, it may be time to replace the softener resin, or perhaps even the entire softener. Through experience we know that most softener resins and ion exchanger resins last about twenty to twenty-five years.

6.2 Does a softener brine tank need cleaning?

Usually it is not necessary to clean out a brine tank, unless the salt product being used is high in water-insoluble matter, or there is a serious malfunction of some sort. If there is a build-up of insoluble matter in the resin, the reservoir should be cleaned out to prevent softener malfunction.

6.3 What is 'mushing' and why should we avoid it?

When loosely compacted salt pellets or cube-style salt is used in a resin, it may form tiny crystals of evaporated salt, which are similar to table salt. These crystals may bond, creating a thick mass in the brine tank. This phenomenon, commonly known as 'mushing', may interrupt brine production. Brine production is the most important element for refreshing of the resin beads in a water softener. Without brine production, a water softener is not able produce soft water.

7. Softener operational questions

7.1 Can brine from softeners damage a septic tank?

The Water Quality Association has performed studies on this subject. These studies have indicated that a properly placed septic tank that works adequately cannot be damaged by brine that is discharged from a water softener. And softened water can sometimes even help reduce the amount of detergents discharged into a septic tank.

7.2 Can a water softener be used with lead pipes?

Lead pipe systems have to be replaced, before softened water can flow through them. Although lead pipe systems in hard water areas may not cause a problem, it is advisable to replace them anyway. When naturally or artificially softened water ends up in these lead pipe systems, it may cause the pickup of lead.

7.2 Can one measure water hardness inline?

Yes, although the measurement system is mainly applied in industrial water softeners.

8. Softening in households

8.1 Can a water softener be taken along during moving?

With modern water softeners, it is very possible to take them along during moving. Installation techniques involve quick fitting connections, similar to those used for laundry machines.

All that has to be done is closing off the inlet and outlet valves of the softener and open up the bypass valve, allowing hard water to flow to the storage tank and household taps. After that the softener can be disconnected, moved to its new location and placed there.

8.2 Can waste from a water softener be discharged directly in the garden?

As brine alters the osmotic pressure that plants rely upon to regulate water needs, direct discharge of either sodium or potassium chloride brine should be avoided.

8.3 Is softened water any help for dry skin conditions?

There are cases to be noted, in which people with dry skin conditions have benefited from water softening, because soft water is kinder to the hair and skin.