Hardness

Hard water is one of the most common water quality problems in the United States. In the past, hardness was measured by the amount of soap that had to be added to water to produce a lather. It is now measured as the concentration of dissolved calcium and magnesium compounds (expressed as calcium carbonate).

There is no firm dividing line between hard and soft water. However, for most household uses, a hardness of between 50 and 150 milligrams per liter (mg/1) is acceptable. Hardness may sometimes be expressed as grains per gallon (gpg) instead of mg/l. 1 gpg is equal to 17.1 mg/l.

CAUSE:

The amount of naturally occurring calcium and magnesium compounds dissolved by the water as it filters through the earth will determine its hardness. Hardness varies with location and the types of minerals and rocks in the earth.

EFFECTS:

Despite all of the problems it causes, hard water is not considered to be a health hazard. Moderate amounts of hardness are desirable because of the protective coating it produces on exposed metal surfaces. Excessively hard water, however, will cause a hard, chalky scale (boiler scale) to form when the water is heated. Water heaters are especially affected by hardness. The boiler scale will accumulate on the heating elements, reducing their heating capacity, and eventually causing them to burn-out.

Hard water will form a white, powdery residue on plumbing fixtures, and will cause spots on dishes. Because calcium and magnesium compounds are not very soluble in cold water, ice made from hard water may contain white particles. Vegetables cooked in hard water may be tough.

More soap must be added to a hard water to produce a lather. With very hard water, soap will form a sticky “curd,” which is difficult to remove from fabrics and containers. Laundry washed in hard water will be stiff and dingy. Hair becomes dull and limp when washed in hard water.

TREATMENT:

The minerals that cause water hardness can be removed by a water softener. Water softeners use an ion exchange process to replace the calcium and magnesium that cause hardness with an equivalent amount of sodium, which does not contribute to water hardness.

With use, all of the sodium in a softener will eventually be replaced by calcium and magnesium. When this occurs, the softener must be regenerated to maintain its softening ability. In regeneration, the softener is filled with a concentrated salt solution. The sodium in the salt solution replaces the calcium and magnesium in the softener, restoring it to its

original condition. Most manufacturers offer either a manual or an automatic regeneration cycle in their softeners.

Ion exchange softeners produce a water with near zero hardness. Because a moderate amount of hardness is desirable, some individuals choose to soften a portion of the water and blend it with unsoftened water to produce a final hardness of 50 to 100 mg/1.

NOTE: WATER SOFTENING INCREASES THE SODIUM CONTENT OF THE WATER BY AN AMOUNT EQUAL TO ONE-HALF OF THE HARDNESS REMOVED. PEOPLE WHO MUST RESTRICT THEIR SODIUM INTAKE FOR MEDICAL REASONS SHOULD CONSIDER THIS ADDED SODIUM IN THEIR DIET. ADVISE YOUR DOCTOR OF THE CHANGE IN THE SODIUM CONTENT OF YOUR WATER BEFORE DRINKING OR COOKING WITH THE WATER.

In cases where the water hardness exceeds 200 mg/1 or where elevated levels of chlorides are present, softening may produce a salty taste in the water. In these instances, a by-pass line can be installed from before the softener to a kitchen faucet; or a point-of-use treatment device can be used (see below).

If excessive iron and manganese are present, it may be necessary to remove these metals prior to softening. While water softeners will remove small amounts of iron and manganese, excessive amounts will foul the water softener. As a rule of thumb, the total amount of iron and manganese should not exceed 1.0 mg/l for every 140 mg 1 (8 gpg) of hardness.

1. **Point-of-Use Devices:** Where the taste of the water or the increased amount of sodium due to softening is a concern, a point-of-use device may be used to produce a limited amount of water per day for drinking and cooking. These devices are small, multi-step treatment system designed to fit under the kitchen sink. They produce up to 15 gallons per day of treated water. The treated water is stored in a small pressure tank, piped to a special faucet on the sink. Each of the treatment steps is in a cartridge form and requires periodic replacement.

2. **Laundry Water Softening:** Water for laundry may be softened in the washing machine by using a group of chemicals known as non-precipitating water softeners. This group includes borax, washing soda, trisodium phosphate, and ammonia. Always follow the manufacturer's instructions in using these chemicals. Under no circumstances should these chemicals be used for softening drinking water.