



# UNDERSTANDING HARDNESS IN WATER

**W**ater “hardness” is one of the important properties or characteristics of drinking water. This property results in the home treatment of water and possibly enters into the decision to drink and cook with bottled water that does not have “all that stuff” that is in the water provided by the public water supply.

Hardness causes scale to form in boilers and hot water systems. Hardness can build up in a household water heater over time, requiring periodic flushing to extend the life of the heater.

Hardness can leave a precipitate on cooking utensils, in dishwashers, and on bathroom fixtures. Hardness can also react with some soaps to form an insoluble sticky precipitate requiring more soap for cleansing action; this does not happen with synthetic detergents.

Water hardness is caused almost exclusively by calcium and magnesium in the water. Iron and manganese in the water cause very little hardness due to their relatively small amounts compared to calcium and manganese. The sources of calcium and magnesium are calcium and magnesium minerals in the soil and geological formations.

## Household treatment

Many Kansas households have installed salt-regeneration water softeners or reverse osmosis (RO) units to remove the hardness in the water. One can choose to soften the whole household water use or soften just the hot water used in washing.

Water softeners use an ion exchange resin to remove calcium and magnesium from the water by “exchanging” or substituting sodium or potassium into the water.

Reverse osmosis units soften the water by removing all the total dissolved solids (that is, all the “stuff”) in the water, including all calcium and magnesium.

The hardness of water for each Kansas public water supply can be found on KDHE’s Drinking Water

Watch (DWW) website. Here is the link: [https://dww.kdhe.ks.gov/DWW/DWW\\_login.jsp](https://dww.kdhe.ks.gov/DWW/DWW_login.jsp). This website provides an extensive database with information and data for decades for each Kansas public water supply. If you are a water supplier and are interested in using and finding water quality data on DWW and discussing what is important to your water supply, I would be pleased to take your email or call. Please email me at [pat@krwa.net](mailto:pat@krwa.net).

## How water hardness is reported

The data on the hardness of water quality is reported as total hardness in mg/l as calcium carbonate. The hardness is reported as if all the calcium and magnesium were in the carbonate form. The total hardness can

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| Public Water Supply | A              | B                | C              | D            | E              | Popular          | Popular          | F1 (raw)       | F2 (treated)   |
|---------------------|----------------|------------------|----------------|--------------|----------------|------------------|------------------|----------------|----------------|
| Well Location       | Central Kansas | Southwest Kansas | Central Kansas | North Kansas | Central Kansas | Bottled Water #1 | Bottled Water #2 | Central Kansas | Central Kansas |
| Total Hardness      | 762            | 836              | 1,500          | 44           | 260            | 10               | 7                | 268            | 87             |
| Calcium             | 231            | 202              | 450            | 14           | 42             |                  |                  | 85             | 27             |
| Magnesium           | 45             | 84               | 94             | 3            | 2              | 3                |                  | 14             | 5              |
| Sodium              | 91             | 70               | 38             | 8            | 28             |                  |                  | 55             | 150            |
| Potassium           | 10             | 5                | 2              | 1            | 2              |                  |                  |                |                |
| Iron                | 0              | 0                | 0              | 0            | 0              |                  |                  |                |                |
| Manganese           | 0              | 0                | 0              | 0            | 0              |                  |                  |                |                |
| Sulfate             | 141            | 687              | 1,200          | 20           | 31             | 10               |                  |                |                |
| Chloride            | 355            | 76               | 38             | 3            | 42             | 4                |                  |                |                |
| Alkalinity          | 340            | 241              | 290            | 60           | 200            |                  |                  | 248            | 250            |

Note: All values are in mg/l

Total Hardness and Alkalinity are in mg/l as calcium carbonate

Magnesium plays many crucial roles in the body, such as supporting muscle and nerve function and energy production. Low magnesium levels usually don't cause symptoms. However, chronically low levels can increase the risk of high blood pressure, heart disease, type 2 diabetes and osteoporosis.

Some studies suggest that calcium and vitamin D may have benefits beyond bone health: perhaps protecting against cancer, diabetes and high blood pressure. But evidence about such health benefits is not definitive.

be obtained by multiplying the calcium in mg/l by 2.5 and multiplying the magnesium in mg/l by 4.1. The products of the two multiplications are added together to obtain the total hardness as calcium carbonate.

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Many plumbers and others in the household water treatment equipment business report water hardness in grains per gallon (gpg) concentration rather than mg/l. The formula is that 7,000 grains equal 1.0 pound. To convert gpg to mg/l, multiply gpg by 17.1; to convert mg/l to gpg, divide

mg/l by 17.1. Thus, a hardness of 15 gpg equals 257 mg/l.

### Water hardness in Kansas

Kansas waters vary significantly in hardness. The nearby table shows the selected analyses of several water wells in Kansas concerning hardness and other common inorganic analytes. The wells chosen were to show the extremes in harness in Kansas drinking water wells.

Waters A, B, and C are very high in hardness compared to the average range of 150 – 350 mg/l of total hardness as calcium carbonate of public drinking water in Kansas. Water D is one of the lowest wells in hardness. Well E shows typical analyses of good water supply concerning hardness.

**Well F1** is a water supply far before it is treated with ion-exchange softening treatment to remove arsenic. **Well F2** shows the hardness reduction after treatment and before blending. In this softening some of the well water receives ion-exchange treatment and some of the well water is bypassed around the treatment and blended back with the treated water. Some of the

water was bypassed around treatment because if all the water was treated, then the 100 percent treated water would have zero hardness, be very corrosive, and treatment costs would be proportionally higher.

The table also shows the analyses for two popular bottled waters from the bottlers' websites. Both these waters have been treated with reverse osmosis and then had minerals added to the water for "taste". Popular minerals added are most likely some combination of potassium chloride, magnesium sulfate, and sodium chloride. All are in very small amounts.

If you have questions about your public water supply water quality, water quality problems, or using KDHE's Drinking Water Watch database, email me at pat@krwa.net or contact other KRWA staff.

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