Well Educated

Applying knowledge to improve water quality
Northern Plains & Mountains Regional Water Program
A Partnership of USDA NIFA & Land Grant Colleges and Universities

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Corrosivity

What is Corrosivity?

Corrosivity is a measure of how aggressive water is at corroding pipes and fixtures. Corrosive water can mobilize lead and copper from pipes into drinking water and can eventually cause leaks in plumbing.

Corrosive potential of water is increased by:

- → **pH** (lower than 6.5 or higher than 8.5)
- → **water flow rate** (faster flow)
- → **water temperature** (higher temp)
- → **dissolved gases** (more dissolved gas)
- → **conductivity** (higher conductivity)
- → **dissolved solids** (high dissolved solids)
- → **certain bacteria** (more bacteria)
- → **suspended solids** (more sediment)
- → **chlorine** (more chlorine)

Determining Corrosivity

One common index of corrosivity is the Langelier Index (LI). The LI is calculated using pH, temperature, total dissolved solids, alkalinity, and total hardness. The LI is a measure of the balance between pH and calcium carbonate ($CaCO_3$). As the LI value becomes more negative, the water is increasingly under-saturated with $CaCO_3$ and therefore has increased corrosion potential. As the LI value becomes more positive, the water is increasingly over-saturated with $CaCO_3$. Over-saturation results in $CaCO_3$ precipitation which can coat and protect pipes from corrosion but can cause scaling in pipes, hot water heaters, and fixtures. While not a perfect analytical tool, the LI serves as a useful guide for assessing corrosive ability of well water.

Langelier Index	Description	General Recommendation
-4	Severe Corrosion	Treatment Recommended/Consider Lead/Copper Test
-3	Moderate Corrosion	Treatment Recommended/Consider Lead/Copper Test
-2	Moderate Corrosion	Treatment May Be Needed/Consider Lead/Copper Test
-1	Mild Corrosion	Treatment May Be Needed/Consider Lead/Copper Test
-0.5	None-Mild Corrosion	Probably No Treatment
0	Near Balanced	No Treatment
0.5	Some Faint Coating	Probably No Treatment
1	Mild Scale Coating	Treatment May Be Needed
2	Mild to Moderate Coating	Treatment May Be Needed
3	Moderate Scale Forming	Treatment Advisable
4	Severe Scale Forming	Treatment Advisable

Adapted from Wilkes University Center For Environmental Quality;
Corrosion, Saturation Index, Balanced Water in Drinking Water Systems

Controlling Corrosion

Corrosiveness may be increased by installing water softeners, aeration devices, increasing hot water temperatures, chlorinating water or improper matching of metal pipes. Corrosion control options include pretreatment systems, installation of non-conductive unions, reducing hot water temperature, and replacing metal piping with CPVC. Pretreatment systems include neutralizing tank filters and caustic liquid treatment. These systems change the pH, hardness, and/or alkalinity to achieve a less corrosive water chemistry.

Additional Resources:

Corrosion in Drinking Water Systems; Wilkes University Center for Environmental Quality
http://www.water-research.net/corrosion.htm

Lead and Copper Fact Sheet; MSU Extension Water Quality
http://waterquality.montana.edu/docs/homeowners.shtml (listed under "Drinking Water")

Household Drinking Water Protection and Treatment; MSU Extension Service
http://waterquality.montana.edu/docs/homeowners.shtml (listed under "Drinking Water")

Northern Plains and Mountains Regional Water Program– Drinking Water Initiative
http://www.region8water.org

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Hardness

What is Hard Water?

Water is considered hard when it has a relatively high concentration of calcium and magnesium. Hard water received this name because it requires more soap for a good lather, making the water "hard" to clean with. In addition to making washing more difficult, hard water can cause spotting on glasses, deposits in hot water heaters, and scaling on sinks and fixtures. This can lead to reduced water pressure and shorter hot water heater life. Benefits of hard water include reduced risk of pipe corrosion and, within limits, a better taste. There is also some evidence that harder water could reduce risk of cardiovascular disease.

Classifying Your Water

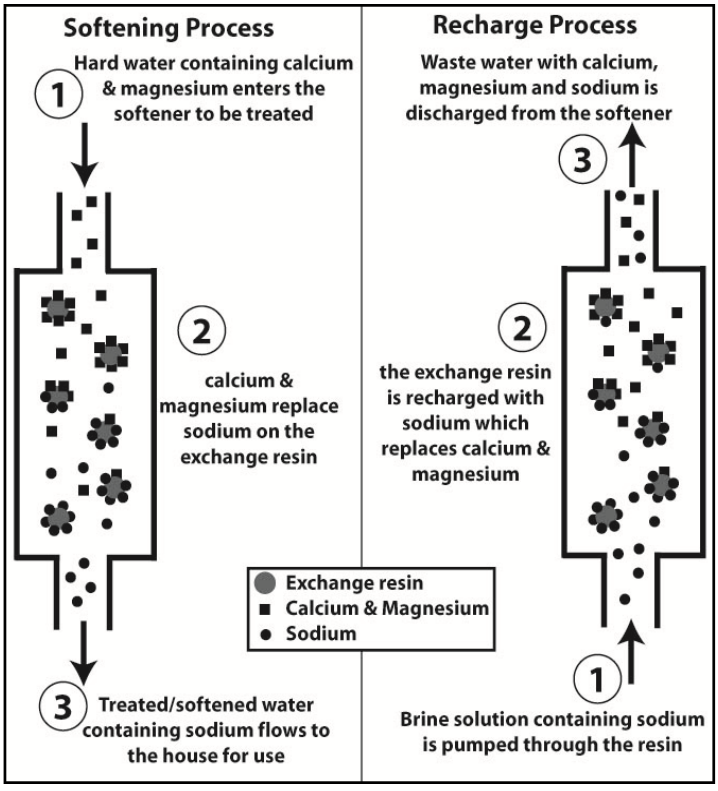
Hardness as mg/L $CaCO_3$	Hardness in grains per gallon	Classification of Water
0-60	0 - 3.5	Soft
61-120	3.6 - 7.0	Moderately Hard
121-300	7.1 - 17.5	Hard
over 300	over 17.5	Very Hard

Hardness can be reported in milligrams per liter (mg/L), parts per million (ppm) which is equivalent to mg/L, or grains per gallon (1 grain = 17.1 mg/L)

Treating Hard Water

Water softening is the most common treatment for hard water. It is possible to install a water softener on a washing machine or dishwasher and some new dishwashers come with a water softener. To treat the water for the entire house a water softening system can be installed. Water softeners exchange calcium and magnesium with another ion which does not contribute to hardness. Traditionally sodium has been used in water softeners but potassium is also available.

Water softening does not reduce total dissolved solids, it simply exchanges the calcium and magnesium for sodium or potassium. In some cases, people choose to soften the main household water supply, but bypass the softener with a separate drinking water tap. This allows people to receive the positive benefits of drinking hard water but avoid the negative effects of hard water on hot water heaters, washing machines, and household plumbing. Another option to avoid drinking the additional sodium from sodium softening is to install a reverse osmosis filter at the drinking water tap. Reverse osmosis can remove sodium and alleviate health concerns associated with high sodium intake.



Note about water softeners

In areas with clayey soils, the sodium discharged in the recharging process can increase the risk of septic drainfield failure. Softening with potassium is a possible alternative. Softening with sodium can also increase the corrosive nature of water by reducing concentrations of protective calcium and magnesium and increasing concentrations of highly conductive sodium. Discharge of salt during softener recharge may also disrupt the solids settling process within the septic tank. Consider routing recharge waste water away directly to the leach field.

Additional Resources:

Hard Water Calcium and Magnesium; Wilkes University Center for Environmental Quality
http://www.water-research.net/hardness.htm

Household Drinking Water Protection and Treatment; MSU Extension Service
http://waterquality.montana.edu/docs/homeowners.shtml (listed under "Drinking Water")

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