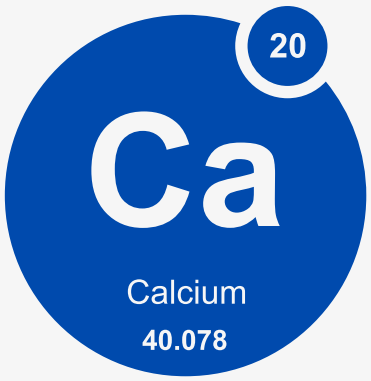
CALCIUM HARDNESS

Community Science Institute
Partnering with Communities to Protect Water

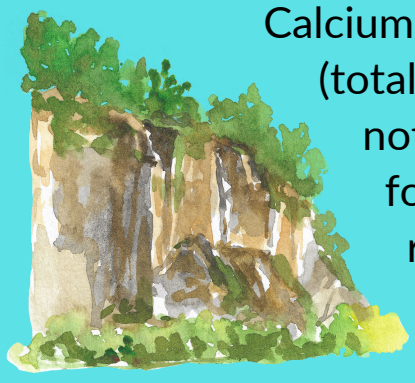
WHAT IS CALCIUM HARDNESS?

Calcium hardness refers to the concentration of dissolved calcium in water. *Hard water* has a *high* concentration of dissolved calcium, while *soft water* has a *lower* concentration. **Total** hardness calculates the concentration of numerous minerals, while **calcium** hardness focuses only on calcium. The two measures are usually comparable, as more hardness comes from dissolved calcium than from other minerals.



WHY DO WE MEASURE CALCIUM HARDNESS?

Calcium hardness and total hardness are highly related water quality indicators. Most hardness comes from dissolved calcium, meaning testing calcium hardness gives us a lot of information about general water hardness. Like the other dissolved minerals associated with water hardness, dissolved calcium is important for fish skeletal development and may offer other benefits to fish.



Calcium hardness only gives us a piece of the picture of overall (total) hardness. However, in potable water, total hardness is not a certifiable test. Many people test their drinking water for calcium hardness because they need a certified test result. Results from a certified test can be used for regulatory purposes, while results from a non-certified test cannot.

Water hardness can be higher due to surrounding geological features, such as the prevalence of limestone in the environment. Hardness can be an issue in home water systems; many people install water softeners. Hard water in a home can mean more soap is needed to form a lather or calcium deposits are left on dishes. Pipes and appliances can form buildup from hard water. However, consuming hard water does *not* negatively impact human health.

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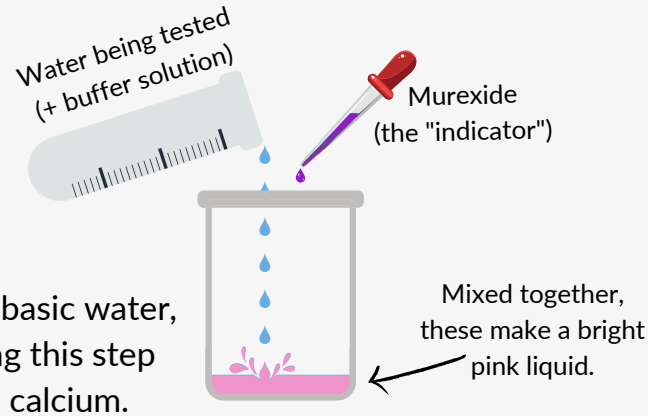
HOW DO WE MEASURE CALCIUM HARDNESS?

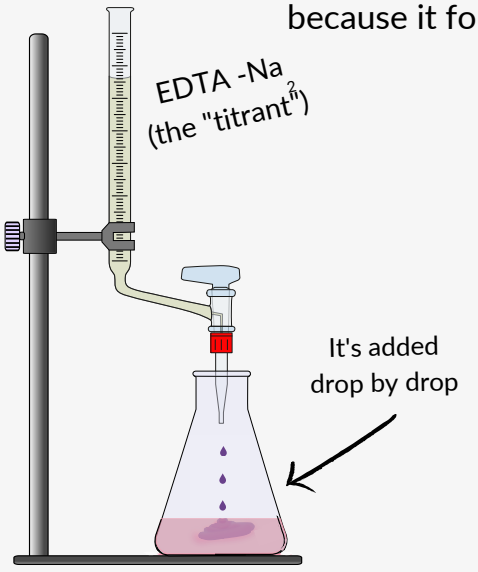
Calcium hardness is measured using a laboratory test that employs a buffer, an indicator, and a titrant, as illustrated below.

First, a solution called a “buffer,” made of sodium hydroxide, is added to the water sample. The buffer raises the pH of the sample to around 10 (making it more basic). Raising the pH is important to the color change that occurs later in the test. At a high pH, the “indicator,” which is added next, will naturally be purple when calcium is not present.

Next, a substance called “murexide” is added to the water being tested for total hardness. Murexide is called an "indicator" because it will cause a visible change to our mixture when the test is complete.



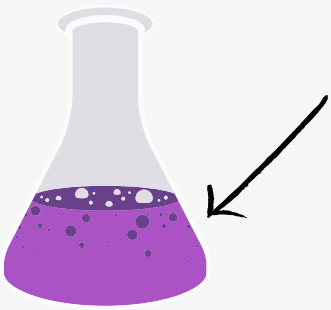
Though murexide is purple in more basic water, it turns the liquid bright pink during this step because it forms a complex with calcium.



Then, a compound called EDTA disodium salt (EDTA -Na_2) is added to the mixture drop by drop.

EDTA forms a *more stable complex* with the calcium in the water sample than the indicator (murexide) did. As the calcium bonds with the EDTA instead of the murexide, the liquid changes color. Remember, murexide is purple at a high pH when it is *not* in a complex with calcium.

Eventually, all of the calcium in the water has bonded to the EDTA being added.



Once this happens, the remaining indicator in the water mixture (murexide) makes the liquid turn purple instead of pink!

From there, CSI chemists calculate the **concentration of calcium carbonate ($CaCO_3$)** equivalent in the water based on how much titrant (EDTA) was needed to bind to all of the calcium to turn the mixture purple.