How Well Do You Know Your Water?

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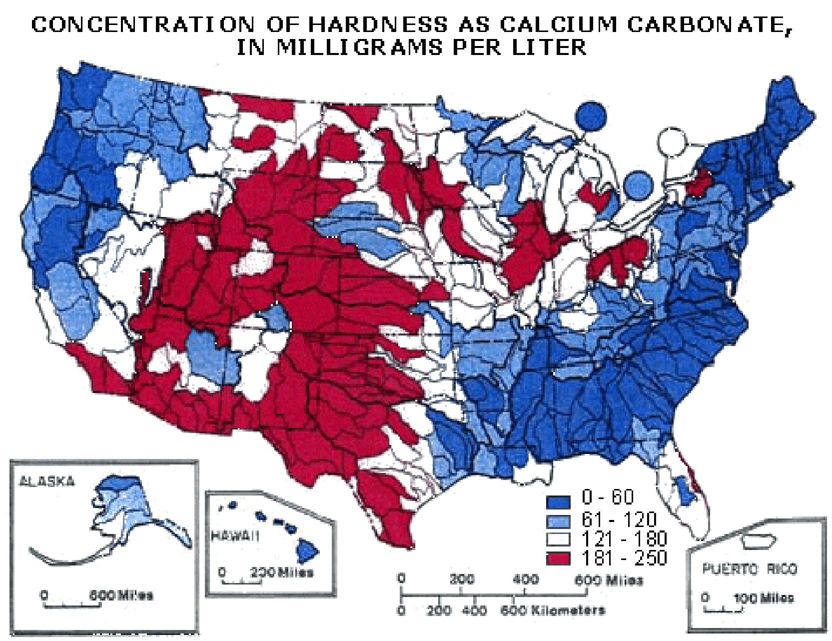
Water is often taken for granted. The earth possesses a bountiful supply of water. The quality of the water may vary. A number of factors influence the quality of the water available. Those factors may influence how well the water you have available will function. One factor is water hardness. Water hardness is caused by the presence of the dissolved minerals calcium and magnesium. When you have high levels of calcium and magnesium in your water, basic sanitation tasks become difficult -- more scrubbing power is required, and greater amounts of detergents are needed to clean.

Another characteristic that should be considered is the pH of your water. Not all water has a pH of 7. The pH is a key factor in sanitizer efficiency. Solutions of sanitizers have a definite pH or acidity which largely a function of the extender (buffer) material which is mixed with the active component.

One other factor included in this discussion is the iron content of your water. The iron content is of particular interest to egg processors.

Water Hardness

The amount of dissolved calcium and magnesium in water determines its "hardness." Water hardness varies throughout the United States. If you live in an area where the water is "soft," then you may never have even heard of water hardness. But, if you live in Florida, New Mexico, Arizona, Utah, Wyoming, Nebraska, South Dakota, Iowa, Wisconsin, or Indiana, where the water is relatively hard, you may notice that it is difficult to get a lather up when washing your hands. The map below will give you an idea of the water hardness in your area.



Mean hardness as calcium carbonate at USGS NASQAN stations during 1975 water year.

Water hardness is caused by dissolved minerals, primarily calcium and magnesium compounds (carbonates, chlorides, and sulfates). Permanent hardness is a term frequently used when referring to calcium and magnesium chlorides and sulfates in the water. These salts are rather stable and soluble under most conditions, thus causing minimal problems with cleaning. Temporary hardness is caused by the presence of calcium and magnesium bicarbonates, which are relatively soluble but unstable. The unstable condition of calcium and magnesium bicarbonates contributes to white deposits on equipment, head exchangers, and water utensils. The total of the permanent and temporary hardness is referred to as total hardness. Without effective treatment, hardness may result in excessive scale formation in water pipes and water heaters and require increased soap consumption. The U.S. Geological Water survey hardness classification is shown below.

Hardness	PPM	Gr/Gal[1]
Soft Water	0-60	0-35
Moderately Hard Water	60-120	3.5 to 7
Hard Water	120-180	7 to 10.5
Very Hard Water	Over 180	over 10.5

[1]17 ppm= 1 gr/gal.

Hard water may also shorten the life of plumbing and water heaters. When water containing calcium carbonate is heated, a hard scale is formed that can plug pipes and coat heating elements. Scale is also a poor heat conductor. With increased deposits on the unit, heat is not transmitted to the water fast enough and overheating of the metal causes failure. Build-up of deposits will also reduce the efficiency of the heating unit, increasing the cost of fuel.

Most natural water supplies contain at least some hardness due to dissolved calcium and magnesium salts. Other minerals, such as iron, may contribute to the hardness of water, but in natural water, they are generally present in insignificant quantities. The total hardness of water may range from trace amounts to hundreds of milligrams per liter.

Iron

Iron can appear in several forms in a water supply, and knowing which form is present is essential to choosing the correct treatment. Fortunately, determining which form of iron is present in a water supply is not difficult.

- Water drawn from a faucet appears clear, but when allowed to stand develops black or rust-colored particles that settle to the bottom of a container. When this occurs it is likely that ferrous iron is present. This form reacts with air, chlorine, or other oxidants to form ferric iron.

- Ferric iron is the second type of iron found commonly in water, seen in water that appears rusty, or has a red or yellow color, when drawn from a faucet. Ferric iron is insoluble in water, and settles quickly when allowed to stand in a container.
- Appearance of a slimy brown or red film on plumbing fixtures (such as inside a toilet flush tank); or a gelatinous sludge in pipes, may indicate the presence of iron bacteria. These bacteria live in the water, and metabolize iron to live. In some cases, these bacteria even attack steel pipes to get the iron they need.

Choosing the best treatment for iron removal depends not only on the form of the iron present, but also on how much of the contaminant is present, the hardness of the water, temperature variations, and the water's pH level. Because of the complexity of the problem, a thorough water analysis and consulting with a water treatment professional is recommended.

Iron bacteria can build up in low-flow areas of an automated watering system such as the quick disconnect fittings of recoil hoses that are not regularly flushed. It will appear as a thick rust colored sludge or slime. If the iron bacteria build-up becomes thick enough, anaerobic conditions may develop at the wall of the fitting or pipe which can cause corrosion of stainless steel or growth of sulfate-reducing bacteria.

However, iron can be a problem in an egg processing plant. Washing eggs in water containing high iron may introduce iron quantities sufficient to affect both the rate extent of subsequent spoilage due to bacteria. The USDA suggests that water with an iron content in excess of 2 ppm not be used unless it is deironized. Contamination with iron may influence spoilage in another manner. The microorganisms, having penetrated the shell to the egg membranes, can grow more readily because of the presence of this essential trace nutrient. Concurrently with growth at the membranes, the bacteria may excrete metabolic products which are able to defuse into the white, making this a more favorable medium for growth of the microorganisms. Among these products may be the iron binding compounds excreted by microorganisms which would allow the bacteria to satisfy their iron requirements even in the presence of large excesses of conalbumin. Conalbumin has iron binding properties which are thought to be responsible for its antimicrobial abilities.

Solving the problem of iron bacteria is usually accomplished through some sort of disinfection process such as chlorination, and then removing excess chlorine by an activated carbon filter. Diagnosing an iron bacteria problem is important, however, as they can plug or corrode pipes, and damage water softening equipment.

pH

Sanitizers are greatly impacted by pH. Therefore, steps in your process that may introduce materials containing the pH extremes could impact sanitizer efficiency. For example, if you wash shell eggs with a highly alkaline material (pH 10-11) and then rinse them with chlorinated water, the chlorine is probably not very effective. The high pH residue will reduce the chlorine activity. Or if you treat broiler carcasses with (trisodium phosphate) TSP and then add chlorine to your chiller without reducing the pH of the chiller the chlorine will not be effective due the high pH in the chiller from the TSP residue.

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