ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Corrosivity of Water Supplies

What is meant by Corrosivity?
Corrosive water can be defined as a condition of water quality which will dissolve metals from metallic plumbing at an excessive rate. The factors that make water corrosive, which is sometimes called acidic or aggressive, include:

- A low **pH** value, typically below pH 7.
- A **lower alkalinity** value. In the remainder of this document, we use the term alkalinity when we specifically mean dissolved inorganic carbon (DIC) which consists of the alkalinity chemical factors of carbon dioxide, carbonate (CO_3), and bicarbonate (HCO_3). Alkalinity also includes hydroxide (OH).
- A higher specific conductivity, which is a measure of **total dissolved solids** (TDS).
- Higher temperature.

Unfortunately, most surface waters and many groundwaters in New Hampshire are highly corrosive. If you have copper plumbing and notice a bluish-green staining at drip points below leaky sinks and showers, your water is likely highly corrosive. Blue-green is the color of copper rust, and orange-brown is the color of iron rust. The abbreviation for copper is (Cu) and the abbreviation for lead is (Pb). Lead does not leave a discoloration stain. A water's corrosiveness can be made worse by the grounding of electrical devices on to the home's plumbing system.

Effects of Corrosive Water
Corrosive water can cause physical damage to plumbing systems, create taste problems and cause a health risk. These three concerns are discussed below.

1. **Damage to Plumbing** – If your water is leaching metals from the metallic plumbing of your home, you should expect that eventual plumbing repair or replacement will be necessary. While all plumbing will be somewhat effected over time by the water it carries, corrosive water will damage plumbing much more rapidly than water with low corrosivity. Pre-flushing the plumbing before taking water for consumption will not lessen this structural damage to the plumbing but will reduce the risk to health associated with ingesting elevated lead and copper.

2. **Aesthetic Considerations (taste and appearance) –** At higher levels of copper, water will have a metallic taste. There is little or no taste from lead, even when the dissolved lead concentration is high. The presence of elevated copper can also stain clothing and hair. Flushing the plumbing will reduce taste but will not lessen the structural damage that is occurring to the metal plumbing system.

3. **Health Risk –** Corrosive water, by itself, is not a health concern; orange juice, vinegar and carbonated soft drinks are all considerably more corrosive than typical New Hampshire well or surface water. What is of concern is that corrosive water can dissolve metals from the plumbing within a home. The consumption of excessive amounts of lead or copper from plumbing can present a health risk.

Plumbing containing significant concentrations of lead may be present in many older homes in New Hampshire. In addition, most of the copper pipe and fittings used in a home's plumbing prior to the mid to late 1980s has lead solder in sweated joints. When corrosive water is present in such piping, and especially when there is no water flow, lead and copper can accumulate to concentrations that present a health risk to users if stagnant water is regularly consumed. Visit the web page www.des.nh.gov/organization/commissioner/pip/factsheets/ard/index.htm and scroll to fact sheet ARD-EHP-9, "Copper: Health Information Summary," for more health related information.

Corrosive water can occur at both public and private wells. Public water systems are required to neutralize their water and DES tracks the result to insure effectiveness. Water from metal plumbing systems should be flushed after hours of nonuse.

This accumulation of metals increases as the water is sitting stagnant in the plumbing system. This can occur near the end of the periods between 11 p.m. to 6 a.m. associated with normal periods of sleep and during the day between 8 a.m. and 4 p.m., if all family members are at school or work. Using stagnant water for direct consumption, or for making a thermos of coffee or diluting frozen juice concentrates, can result in excessive lead or copper intake.

Using Flushing to Avoid Excessive Copper and Lead

Flushing is a process by which one runs the cold water to "waste" for a period of time to allow fresh water from the well to enter the plumbing system. The purpose of flushing is to flush fresh water from your well or the municipal water mains through the area where lead or copper plumbing has been used. There is generally little lead or copper in New Hampshire water wells.

There are two methods to determine how long you need to flush the cold water tap.

1. Use the following chart to determine the approximate volume of water to "waste" from a plumbing section to be assured that fresh water has arrived directly from the well or public water main.

Volume in Pipes
(Approx. Volume in 100 Linear Feet of Pipe)

Nominal/Inside Diameter in Inches	Gallons/100 feet	Feet / 1 gallon
0.50 - 0.662	1.5	67
0.75 - 0.824	2.7	37
1.00 - 1.049	4.5	22
1.25 - 1.38	7.7	13

2. Flush until after the water has turned cold (cold water indicates the arrival of fresh water from the well or public water main, approximately 1 minute. Surface water may not turn cooler during the summer. Allow further time for lead or copper service lines from the public water system to flush.

EPA Standard - Action Levels
EPA has established special health-based drinking water standards for lead and copper and given that category a special name. That category is called "action levels." The EPA's action level for lead in a public water system is 0.015 milligrams per liter (mg/L); the action level for copper is 1.3 mg/L. The term "action levels" has a special meaning which differs from the meaning of the term "maximum contaminant levels" (MCLs), which is used for all other health based drinking water contaminants.

The term "action level" means that at least 9 samples out of every 10, taken to evaluate corrosivity, must have lead and copper concentrations below the respective action levels noted above for samples collected in accordance with special sampling protocol, which includes collection during stagnant conditions. The action level would be exceeded by having lead and copper concentrations above the respective action levels in more than 10 percent of these stagnant samples. Where lead and copper concentrations exceed the action level, the utility is required to take certain actions which include study the corrosive nature of the water, take appropriate treatment action, and give public notice to system users of the failure to meet the action levels.

For a private well serving just one home, meeting the action levels for lead and copper would mean that individual copper and lead test results, taken under appropriate stagnant sampling conditions, should be 0.015 mg/L and 1.3 mg/L respectively. Please note, however, that action levels only legally apply to public water systems.

Is Your Water Corrosive?
The appropriate method for determining whether water is corrosive is to follow the EPA sampling protocol over a group of samples. For a private well not sufficiently large to be a Public Water System, an alternative is to infer the water's corrosiveness by examining the existing pH and alkalinity water quality data.

Determining Directly the Copper and Lead Concentrations in Stagnant Samples
In the EPA Safe Drinking Water Act, the corrosivity of water is determined by taking samples for lead and copper collected in accordance with the protocol shown below.

- Take a 1 liter volume sample.
- Take the sample under stagnant conditions (no flow for at least the previous 6 hours) at the faucet locations most used for drinking.
- Take each sample at homes with lead soldered plumbing built between 1982 and 1987.

The appropriate number of samples would be based on the number of people served by that public water system. For a private well, one sample is normally taken.

For public systems, if any more than 10 percent of these lead and copper samples are above either action level, the water is considered as too corrosive and certain actions are required. Often these actions result in the addition of chemicals to the water to neutralize the water's corrosivity.

Inferring a Water's Corrosiveness from pH and Alkalinity Data
The corrosive potential of water is largely, but not totally, determined by the water's pH and alkalinity concentrations. The pH is the most important single term. By reviewing your existing water quality data, an estimate can be made relative to the water's corrosivity by applying the following guidance.

1. Where the pH is below approximately 6, the water quality is normally highly corrosive and treatment is needed unless proven otherwise.
2. Where the pH is between approximately 6.0 through 6.9, water is somewhat corrosive and stagnant testing is probably appropriate.
3. Where the pH is between 7.0 through 7.6, the water is probably not too corrosive but stagnant testing is probably appropriate.
4. Where the pH is above 7.7, the water should not be corrosive to metal plumbing.

Within each range, higher alkalinity will result in less corrosive potential. For this discussion, higher alkalinity could be estimated as over 35 mg/L measured as calcium carbonate.

Plastic plumbing is common in new housing. Corrosive water will not injure plastic plumbing. Faucet and valves still have metal with some lead present. We suggest stagnant testing for lead to evaluate these fittings.

Testing for Corrosivity

Before taking a water sample for lead and copper laboratory testing, the plumbing needs to be evaluated. If the plumbing system has copper piping and fittings, it should be tested for lead and copper. If the system has galvanized iron pipe, testing should be processed for cadmium, lead, and zinc (excessive zinc does not create a health risk, but does cause taste conditions). Cadmium and lead are common impurities in the zinc used for galvanizing.

If the plumbing is PVC plastic for both the hot and cold water services, there is little to no exposure, other than sources of lead from faucets or well pumps. If there is more than one type of piping in the home, an evaluation should be made to determine what type of piping typically feeds the drinking water faucet and thus what metal contaminants should be tested for.

In addition to the home's plumbing, lead and other metals can also come from a well pump or the connecting piping to your home. Well pumps manufactured after January 1, 1996, generally have little lead.

The most logical test procedure is first to test for the "non-flushed" condition. If the first results are high for lead and copper, then retest under stagnant conditions to confirm the accuracy of the first results and confirm (with the flushed samples) that the source water is low in lead and copper.

Tests for copper, lead, and cadmium are $15 each at the DES Laboratory.

Ways to Reduce the Health Risk

Exposure to lead can be reduced by using the following actions.

- Do not use hot water for cooking or coffee. Draw cold water and heat it.
- Flush pipes before using water for drinking or cooking.
- Alternatively secure potable water from outside source (but make sure that source is safe and tested). Bottled water is well tested, has very low lead and copper, and is widely available.

Treatment Methods to Neutralize a Water's Corrosiveness

Treatment for reducing corrosivity in drinking water often involves increasing some combination of the water's pH or alkalinity. Widely used methods for doing this are discussed below.

Low Technology
For dug wells, where low cost is a significant part of the decision process, add a layer of calcite chips to the bottom of the existing dug well. Calcite is a form of limestone quarried under sanitary conditions. The calcite will dissolve slowly, neutralizing the water's corrosiveness. The thickness of calcite is determined by experimentation; typically begin with 3-5 inches of calcite. Advantages of this approach include no first capital cost, no moving parts, and little repair expectations. Disadvantages include adding some hardness and giving varying levels of treatment. This is not a good option if the bottom well tile is perforated. Be sure to disinfect the well after the addition of the calcite, and be certain that you do not damage or otherwise constrict water flow into the suction line of your pump. Replace lost (dissolved) calcite every three to six months. Calcite can be obtained from water conditioning stores.

For bedrock and point wells and where cost is not a significant factor, purchase a water treatment neutralizing tank and fill appropriately with calcite. This is the slightly more expensive option of adding calcite chips to your dug well. Replace lost calcite every three to six months. Advantages include no moving parts and little repair expectation. Disadvantages include adding some hardness and giving varying levels of treatment. Effectiveness is dependent on the water speed through the calcite bed.

Chemical Feed Equipment
A more high-tech approach consists of adding a dilute solution of soda ash (sodium carbonate) or baking soda (sodium bicarbonate). These chemicals would be first dissolved in water to make a solution. The selected solution is then fed into the discharge side of the well pump using a chemical feed pump. The pH and total alkalinity of the water are raised to make the water less corrosive. Advantages include the hardness of the water is not increased and the level of treatment level is more precisely tailored to the amount of solution being added to each gallon of pumped water. Disadvantages include the eventual need of repair for electro-mechanical devices. DES recommends that lye **not** be used for corrosion control because of the substantial dangers associated with this very strong chemical to children, pets, etc.

The choice of chemical feed equipment should be based on cost and the ability and willingness of the homeowner to maintain the system. For example, a soda ash solution system with a chemical feed pump requires routine inspection and filling of the chemical solution tanks approximately every few weeks. The calcite neutralizing tank requires little or no maintenance other than replacing the calcite chips that have dissolved away once every three to six months.

Operating a Corrosion Neutralizing System
Once installed, the corrosion neutralizing system needs to be adjusted to meet that well's particular level of corrosivity. The typical adjustment approach would proceed as follows.

Where blue-green staining has been present in the past, the neutralization process will take place in two steps. First, carry out a rough adjustment to reduce the majority of the water's corrosiveness using the appearance of blue-green staining as a guide to the amount of neutralizing chemical needed. Second, fine tune the amount of the chemical addition needed to optimize the neutralization. This fine tuning would substitute interpreting the laboratory test results of stagnant lead and copper samples for observations of the presence of blue-green staining.

To begin, first clean an area subject to blue-green staining. Rough adjust the chemical feed amount to that recommended by the company selling the device or, if no recommendation is made, select a relatively low amount of chemical at first. For the value chosen, allow a few weeks of operation and determine if the blue-green staining returns. If the staining reoccurs, significantly increase the amount of neutralizing chemicals, clean the stained water use fixtures and observe for a few more weeks. Using the reoccurrence of blue-green staining allows the rough setting of the chemical feed pump rate while avoiding the expense of numerous laboratory tests.

Once the blue-green stain abates, or if staining was never a factor, the second part of the effort is to "fine adjust" the amount of chemical added. This requires collection of treated water quality samples for laboratory testing for lead and copper after each small increase of the neutralizing chemical. The sample collection would require taking a 1 liter sample under stagnant conditions discussed on page 2. Continue to increase chemical feed until both the lead and copper water quality results are below their respective action levels discussed on page 3 or until there is no further improvement in lead and copper data, even though more neutralizing chemicals are added. Note the amount of improvement for each unit of addition of chemicals. If the lead and copper levels remain high, you are welcome to call us for further discussion.

Where Calcite Treatment is used in the Well

Start with 2 to 3 inches of calcite chips in a dug well or partially fill the treatment tank. Recognize that the calcite will dissolve away and thus the thickness of calcite will need to be periodically supplemented. The more frequently the missing calcite is replaced, the more uniform will be your corrosion control treatment.

For More Information

Please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov or visit our website at www.des.nh.gov/organization/divisions/water/dwgb/index.htm. All of the bureau's fact sheets are on-line at www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm.

Note: This fact sheet is accurate as of September 2009. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.