

Drinking Water: Copper

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Too much copper in the human body can cause stomach and intestinal distress such as nausea, vomiting, diarrhea, and stomach cramps. This NebGuide discusses practices to manage copper in a domestic water supply such as one for a home or business.

Copper in Drinking Water

Copper rarely occurs naturally in the source water supply for drinking water systems. Most copper contamination takes place at some point in the water delivery system. This occurs as a result of micro-corrosion of the copper pipes or fittings, which are widely used in household plumbing.

The characteristics of water vary greatly depending on where the water comes from. Some water is naturally more corrosive. Factors causing corrosion include low (less than 8.0) pH, high temperature, low total dissolved solids (TDS) content and high amounts of dissolved oxygen or carbon dioxide. Generally, naturally soft water is more corrosive than hard water because it is more acidic and has low TDS. Increased copper levels in water softened with ion exchange water softeners have been observed.

Eventually, if the drinking water is not corrosive, mineral deposits (e.g., from hard water) deposit on the interior of new plumbing. These deposits form a mineral scale lining, such as calcium carbonate, inside pipes and fittings, which protects against copper contamination. It may take years for an effective mineral scale lining to form. Research has shown that protective mineral deposits, which some Nebraska utilities have, slowly improved copper protection over long periods. Softening hard water with an ion exchange unit can either prevent or dissolve the mineral scale, reducing or eliminating its protective effect. However, softening hard water can have

other benefits that outweigh the negative effects of increased copper concentrations.

Indications of Copper

Low concentrations of copper in drinking water may not noticeably alter the taste, color or smell of water. At low concentrations, copper in drinking water may cause no health symptoms. At high concentrations, it can cause a bitter metallic taste in water and result in blue-green stains on plumbing fixtures. At high concentrations, copper in drinking water may cause symptoms easily mistaken as flu or other illnesses. Thus, health symptoms may be the result of copper in drinking water but are not a reliable indication of it.

Potential Health Effects

Copper is an essential micronutrient and is required by the body in very small amounts. Excess copper in the human body can cause stomach and intestinal distress such as nausea, vomiting, diarrhea, and stomach cramps. The lowest level at which these adverse effects occur has not been well defined. People with Wilson's disease, a rare genetic disorder, are more sensitive to the effects of copper. For additional information on the potential health effects of copper in the human body, consult a physician.

Testing

Testing Public Water Supplies

Water supplied by Public Water Systems is regulated by the U.S. Environmental Protection Agency (EPA) and Nebraska Department of Health and Human Services (DHHS).

Public water systems identify homes with copper plumbing. Some of these homes are then monitored at the tap, with the

number of tap-sampling sites based on the number of people served by the public water supply. Additional monitoring for other water-quality parameters affecting corrosion is sometimes required to determine compliance with copper standards.

If consumers want to know the concentration of copper in their public water supply, they can contact the water utility to inquire about the water's copper concentration. The water supplier can provide information regarding the copper concentration in drinking water at the taps monitored. Under most circumstances, the copper concentration of drinking water at other homes and businesses served by the public water supply can be expected to be in a range close to that measured at monitored locations.

One notable exception can occur. New copper pipes and fittings can be found in new construction and in homes or buildings with remodeled, renovated or repaired water distribution systems. In these cases, sufficient time would not have passed for a protective mineral scale lining to deposit on new components in the system. Since mineral scale linings coat copper pipes and minimize copper dissolution in water, a higher copper concentration could be present in new pipes that have not yet formed a mineral lining. The formation of such a lining can take months to years.

Testing Private Water Supplies

Currently water quality in private wells is not regulated at the federal level or by Nebraska state government. Thus, the regular testing of a private water supply is not required under state or federal law. Although private water supplies are not subject to any regulations concerning copper contamination, users of private water supplies may want to have their water tested. If consumers want to know the concentration of copper in a private water supply, they will need to have the water tested at their own expense.

Tests to determine the presence of copper in drinking water should be done by a laboratory approved for copper testing. The Nebraska DHHS approves laboratories to conduct tests of drinking water supplies. An approved laboratory might not be approved to test for all potential drinking water contaminants. Rather, approval must be obtained for each specific contaminant. This approval means that recognized, standard tests and quality control procedures are used. See *Drinking Water: Approved Water Testing Laboratories in Nebraska* (G1614) for a list.

Laboratories not specifically approved to test for copper may use the same equipment and procedures as approved laboratories. Such laboratories may provide accurate analysis, but there is no independent information about the laboratory's ability to obtain reliable results.

Test kits and dip strips are available for do-it-yourself copper testing outside of a laboratory environment. These can be difficult to use due to the need for color matching, and may not provide accurate and reliable copper measurement.

To determine the concentration of copper in a private drinking water supply, water must be tested by laboratory analysis, and specific sampling procedures must be used. Individuals should carefully follow all directions provided by the laboratory and use provided containers when collecting water.

In general, when water is stagnant and in contact with copper pipes, it will continue to dissolve copper. For this reason, the highest copper concentration in drinking water will result

from water that has sat motionless in the plumbing system in contact with copper-containing components for an extended period of time (e.g., several hours or overnight). To evaluate the household's or building's highest copper concentration, collect a sample after water has sat motionless in the plumbing system for at least six hours. This is sometimes called a "first-draw" sample.

Interpreting Test Results

Public Water Supply Test Results

The quality of water supplied by public water systems is regulated by the EPA and Nebraska DHHS. This includes any water distribution system with 15 or more service connections or that regularly serves 25 or more people.

Public drinking water standards established by EPA fall into different categories, including Action Levels. An action level is the concentration of a contaminant in water which, if exceeded in a specified percentage of water samples tested, triggers actions that a water system must follow. Those required actions may include additional monitoring, treatment or other action.

EPA has established an enforceable copper concentration action level for public water supplies. This level is 1.3 milligrams per liter (mg/L), which also can be expressed as 1.3 parts per million (ppm). If the copper concentration exceeds 1.3 ppm in over 10 percent of the homes tested, the public water supplier must initiate the actions described in the "Options for Public Water Supplies" section of this publication.

Private Water Supply Test Results

Since EPA and Nebraska regulations do not apply to private drinking water wells, private well users may consider the EPA established action level of 1.3 ppm as a guideline in assessing the risk associated with their water supply. If copper concentrations are found to be above 1.3 ppm, private drinking water users might voluntarily consider EPA guidelines and try to reduce the copper concentration in the water, taking into account health risks, costs and benefits.

Options

Options For Public Water Supplies

A public water system that exceeds the EPA action level in more than 10 percent of sampled homes must initiate corrosion control treatment. This treatment usually consists of using a phosphate additive to inhibit corrosion.

Public water systems exceeding the EPA's action level are required to monitor other water parameters affecting corrosion. These parameters are used to identify optimal treatment, if needed.

Options For Private Water Supplies

Depending on the water chemistry, a mineral scale lining may coat copper pipes over time, minimizing the copper concentration in drinking water. However, it can take months to years for a protective lining to form on new copper pipes and fittings.

The copper concentration in drinking water may be reduced by flushing the water system before using the water for drinking or cooking. A second water sample,

called a “purged-line-sample,” must be analyzed for copper concentration to determine the effectiveness of this option. Individuals should collect a water sample after the tap has run for at least two minutes and the water has become noticeably colder. This sample will most likely indicate the copper concentration in source water that has not been in contact with the plumbing system for an extended period of time.

Flushing the water distribution system before using the water for drinking or cooking is a viable option if the copper concentration in the “purged-line-sample” is at or below an acceptable level. Flushing the system involves disposing of or beneficially using the water that has sat motionless in the plumbing system in contact with copper-containing components for an extended period of time. Anytime the water has not been used for several hours, the water must be run until it becomes as cold as it will get. This could take up to two minutes or longer depending on the system. Each faucet must be flushed individually before using the water for drinking or cooking. Water run from the tap during the flushing can be beneficially used for nonconsumption purposes such as watering plants, washing dishes or clothing, or cleaning.

If flushing the water system does not reduce copper levels to an acceptable level or is not an option of choice, consumers have several other options. Occasionally, corrosion can be increased by grounding electrical equipment (including telephones) to water pipes. Electric current traveling through the ground wire may accelerate corrosion. In this case, consumers should consult a qualified electrician.

If the main concern with copper is human health due to water consumption, the most economical approach will be to use either bottled water or a point-of-use (POU) device at locations where water is consumed. There are two POU treatment methods suitable for removing copper from drinking water, including reverse osmosis and distillation. Typically, these methods are used to treat water at only one faucet. Reverse osmosis units can remove approximately 85 percent of the copper from water; distillation can remove approximately 99 percent. A water softener can be used to pretreat water for either a reverse osmosis or distillation unit when water is excessively hard. For additional information on these treatment options, see *Drinking Water Treatment: Reverse Osmosis* (G1490); *Drinking Water Treatment: Distillation* (G1493); and, *Drinking Water Treatment: Water Softening (Ion Exchange)* (G1491).

If the main concern with copper is pin hole leaks or blue-colored water, a point-of-entry (POE) treatment device that treats all of the water that enters the house may need to be installed. The two most common POE treatment methods to stop corrosion are a neutralizing filter and polyphosphates. If the water is corrosive because of neutral or low pH, a neutralizing filter that slowly releases a chemical that raises the pH of the water can be used.

If dissolved gasses (oxygen or carbon dioxide) are a cause for the corrosion, polyphosphates are often used to

stop corrosion. Polyphosphates that are added to the water will provide a thin protective layer on the pipe surface that minimizes the copper release. Polyphosphates can be applied by using a cartridge that slowly releases polyphosphates and must be replaced on a routine basis or by using a pump that continuously injects a liquid polyphosphates solution into the water. In homes with water softeners, a small amount of unsoftened water will be bypassed around the softener because polyphosphates need a small amount of hardness to work.

For both neutralizing filters and polyphosphates, the filters or chemicals will need to be continuously added, which requires routine maintenance or the corrosion protection will be lost. It is highly recommended that one consult a water treatment professional when considering the implementation of a POE system.

Summary

Copper rarely occurs naturally in drinking water. It is more common for copper contamination to occur at some point in the water delivery system. Too much copper in the human body can cause stomach and intestinal distress such as nausea, vomiting, diarrhea, and stomach cramps. To determine the presence of copper in drinking water, a specific procedure to collect samples must be used and a certified laboratory must complete the testing. Public water supplies must comply with the EPA action level of 1.3 ppm copper.

Management of a private drinking water well for copper is a decision made by the well owner and/or water user. A water test is the only way to determine the copper concentration. If private drinking water exceeds the EPA copper standard of 1.3 ppm, steps can be taken voluntarily to reduce the risk. Options include managing the water supply used for drinking and cooking by flushing water with high copper concentrations from the water system, using water treatment equipment, or using an alternative water source. The option selected must be based on the specific situation.

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