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# G98-1360 Drinking Water: Copper

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**Nebraska Cooperative Extension G98-1360-A**


# Drinking Water: Copper

**Too much copper in the human body can cause stomach and intestinal distress such as nausea, vomiting, diarrhea and stomach cramps. This NebGuide discusses how to determine if copper is in a domestic water supply and options that can be taken to reduce the copper in water.**

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## Copper in Drinking Water

Copper rarely occurs naturally in water. Most copper contamination in drinking water happens in the water delivery system, as a result of corrosion of the copper pipes or fittings. Copper piping and fittings are widely used in household plumbing.

Because the physical and chemical characteristics of water vary, the corrosive properties of water vary as well. Factors causing corrosion include acidity (low 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. Observations have shown increased copper levels in water softened with ion exchange water softeners.

If the water is not corrosive, hard water minerals are slowly deposited on the interior of plumbing. These hard water deposits form a calcium carbonate lining inside pipes and fittings which protects against copper contamination, however, it may take up to five years for an effective calcium carbonate lining to form and softening hard water with an ion exchange unit can either prevent or dissolve the calcium carbonate scale, reducing or eliminating its protective effect.

## Indications of Copper

At very high levels, copper can cause a bitter metallic taste in water and result in blue-green stains on plumbing fixtures. At low levels, copper in drinking water may cause no health symptoms. At high levels, copper in drinking water may cause symptoms easily mistaken as flu or other illnesses. Thus health symptoms are not a reliable indication of copper in drinking water.

## Potential Health Effects

Although 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 your physician.

## Testing

To determine if copper is present in drinking water, specific sampling procedures must be used. Analysis should be done by a laboratory certified to test for copper. Carefully follow all directions and use containers provided by the laboratory when collecting water samples for testing.

To evaluate the household's highest level of copper exposure, collect a sample after water has been motionless in the plumbing system for at least six hours. When collecting the sample, collect the first water from the faucet. **Do not allow any water to run before collecting the sample.** This is called a first-draw or first-flush sample. Since the corrosive process is continuous, water drawn after an extended period of nonuse will contain the highest copper levels.

After the tap has run for at least five minutes, collect a second sample. This is called a purged-line or flushed sample. This provides a sample that has not been in contact with the plumbing system for an extended period of time.

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.

Water supplied by Public Water Systems is regulated under the Federal Safe Drinking Water Act by the U.S. Environmental Protection Agency (EPA) and the Nebraska Department of Health and Human Services Regulation and Licensure. The current enforceable copper concentration action level for public water supplies is 1.3 milligrams per liter (mg/L), equivalent to 1.3 parts per million (ppm). **The copper action level is discussed below in the "Interpreting Test Results" section.**

The Safe Drinking Water Act requires public water systems to complete a distribution system materials evaluation and/or review other information to target homes at high risk of copper contamination. Water samples are taken at the tap in at-risk homes, with the number of tap-sampling sites based on the population served.

A public water system exceeding the EPA action level in more than 10 percent of sampled homes must notify customers via newspapers, radio, television or other means. These systems must be monitored every six months. Systems serving more than 500 people continuing to exceed the action level must initiate corrosion control treatment. Systems serving less than 500 people continuing to exceed the

action level must either initiate corrosion control treatment, install a point-of-use or point-of-entry treatment system in each home or provide bottled water for every home.

Those small- and medium-sized water systems (serving less than 50,000 persons) exceeding the EPA's copper action level, as well as all large systems (serving more than 50,000), are required to monitor other water parameters affecting corrosion. These parameters are used to identify optimal treatment, if needed.

## Interpreting Test Results

Both the magnitude of the copper concentration and the comparison between the first-draw and flushed samples must be considered when interpreting test results. If results show higher levels of copper in the first-draw sample than the flushed sample, the copper is most likely coming from components of the household plumbing, such as copper pipes or fittings. On the other hand, if test results show nearly equal amounts of copper in both the first-draw and flushed samples, the copper is probably coming from a source outside the house.

EPA's Maximum Contaminant Level Goals (MCLG) are desirable, non-enforceable, health-based goals established to assure a safe water supply. Water containing any chemical in an amount equal to or below its MCLG is not expected to cause any health problems, even over a lifetime of ingestion. The current MCLG for copper in drinking water is 1.3 mg/L.

EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to control copper should it occur in their customers' drinking water. Thus EPA set the 1.3 mg/L as an enforceable action level for copper. When the copper concentration exceeds 1.3 mg/L, the water supplier must initiate the actions described above. The 1.3 mg/L concentration can also be used as an action level for private water supplies.

## Options

The following options apply to individual households and do not address actions a public water supply system may need to take.

If water tests indicate copper is present in drinking water, the first course of action is to try to identify the source. If possible and cost-effective, eliminate the source. If the source is the water system piping, this is generally not practical.

If the source of copper is the in-home plumbing system, flushing the water system before using the water for drinking or cooking is a practical option. Flushing the system means anytime the water from a particular faucet has not been used for several hours (approximately six or more), it should be run until it becomes as cold as it will get. Flush each faucet individually before using the water for drinking or cooking. Water run from the tap during the flushing can be used for non-consumption purposes such as watering plants, washing dishes or clothing or cleaning. Avoid cooking with or consuming water from hot water taps as hot water dissolves copper more readily than cold.

If flushing the water system does not reduce copper levels to an acceptable level or is not an alternative of choice, consider an alternative drinking water source such as bottled water or water treatment. If the water is corrosive because of low pH (acidic), a neutralizing filter can be used to raise the pH of the water. This will reduce or eliminate corrosion problems.

One practice which may increase corrosion is the grounding electrical equipment (including telephones) to water pipes. Electric current traveling through the ground wire may accelerate corrosion. In this case, consult a qualified electrician.

Reverse osmosis and distillation treatment can be used to remove copper from drinking water. Typically, copper removal by reverse osmosis or distillation is used to treat water at one faucet.

## Summary

Coper rarely occurs naturally in drinking water, but can occur as a result of corrosion in the water 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, as well as its possible source, a specific procedure to collect samples must be used and a certified laboratory must complete the testing. If test results indicate the presence and source of copper, appropriate steps should be taken. Options include removing the copper source, managing the water used for drinking and cooking by flushing water with high copper concentrations from the system, using water treatment equipment or using an alternative water source. Options selected must be based on the specific situation.

## Related Publications

- EC94-135, *Understanding Pesticides and Water Quality in Nebraska*
- EC98-765, *Improving Drinking Well Condition*
- EC98-766, *Drinking Water Well Condition*
- EC90-2502, *Perspectives on Nitrates*
- G89-946, *Water Treatment Equipment: Water Softeners*
- G90-976, *Water Treatment Equipment: A Buyer's Guide*
- G90-989, *Drinking Water: Bacteria*
- G92-1079, *Home Water Treatment Equipment: An Overview*
- G95-1255, *Shock Chlorination of Domestic Water Supplies*
- G96-1274, *Drinking Water: Hard Water*
- G96-1275, *Drinking Water: Sulfates and Hydrogen Sulfide*
- G96-1279, *Drinking Water: Nitrate-Nitrogen*
- G96-1280, *Drinking Water: Iron and Manganese*
- G96-1282, *Drinking Water: Man-made Chemicals*
- G97-1333, *Drinking Water: Lead*
- G98-1369, *Drinking Water: Nitrate and Methemoglobinemia*

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