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### G97-1333 Drinking Water: Lead

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## Drinking Water: Lead

Too much lead in the human body can cause serious damage to the brain, kidneys, nervous system and red blood cells. This NebGuide discusses practices to address lead in a domestic water supply.

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### Lead in Drinking Water

Small quantities of lead can be a serious health concern, especially for children. Sources of lead in the environment include lead-based paint; lead contaminated soil, air and dust; lead contaminated food; imported food in lead-soldered cans; non-FDA regulated ceramics with lead glazes; leaded crystal and lead contaminated drinking water.

Lead rarely occurs naturally in water. Most lead contamination takes place at some point in the water delivery system. This occurs as a result of corrosion, the reaction between the water and lead in parts of the water delivery system. Materials in the water delivery system which may contain lead include service connections, pipes, solder and brass fixtures.

Water's characteristics vary: some water is naturally more corrosive than others. Several factors cause water to be corrosive including 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. Softening naturally hard water with an ion exchange water softening unit does not appreciably change the corrosivity of the water, resulting in little, if any, effect on the water's ability to dissolve lead.

Lead in drinking water from plumbing or fixtures is most often a problem in either very old or very new houses.

Through the early 1900's it was common in some areas of the country to use lead pipes for interior plumbing. Lead piping was also used for the service connections used to join residences to public water supplies. Lead piping is most likely to be found in homes built before 1930. Copper piping replaced lead piping, but lead-based solder was used to join copper piping. It is likely lead-based solder was used in any home built before 1988.

Today, brass materials are used in nearly 100 percent of all residential, commercial, and municipal water distribution systems. Many household faucets, plumbing fittings, check valves and well pumps are manufactured with brass parts. While brass contains some lead to make casting easier and the machining process more efficient, the lead content of brass plumbing components is now restricted to 8 percent. Even at this low level, however, lead can be leached from new brass faucets and fittings. Eventually, if the water is not corrosive, hard water minerals deposit on the interior of plumbing. These deposits form a calcium carbonate lining inside pipes and fittings which protects against lead contamination. It may take up to five years for an effective calcium carbonate lining to form. Softening naturally hard water with an ion exchange water softening unit can either prevent or dissolve the calcium carbonate scale, eliminating its possible protective effect.

Some private wells may have submersible pumps containing brass or bronze capable of leaching lead. Some well screens also may contain lead or were installed with a "lead packing collar". Potential lead contamination also exists if the well is a driven, sandpoint well and has been "shot" to clear the screen. Lead shot was sometimes poured into a well to keep out sand. In other wells, lead wool was used. None of these practices are recommended and driven, sandpoint wells are not allowable under Nebraska well construction regulations.

Older water coolers with lead-lined tanks are another possible source of lead in drinking water. The Lead Contamination Control Act of 1988 required the repair or recall of lead-lined tanks and prohibited manufacturing and sale of such coolers. As with any repair or recall notice, it is possible that less than 100 percent compliance was achieved and coolers with lead-lined tanks could remain in use.

### **Indications of Lead**

Lead does not noticeably alter the taste, color or smell of water. The effects of low levels of lead toxicity in humans may not be obvious. There may be no symptoms present or symptoms may be mistaken as flu or other illnesses.

### **Potential Health Effects**

As far as we know, lead has no benefits to humans or animals. Lead is a cumulative poison, meaning it accumulates in the body until it reaches toxic levels. It can be absorbed through the digestive tract, the lungs and the skin and is carried by the blood throughout the body. The severity of the effects of lead poisoning varies depending on the concentration of lead in the body. This concentration can be determined with a blood test.

Although lead has long been recognized as poisonous at high dosages, recent studies have shown it is damaging at lower levels than previously believed. As a result, lead exposure levels considered acceptable have been lowered. While some effects of lead poisoning may diminish if exposure is reduced, others are irreversible.

Excess lead in the human body can cause serious damage to the brain, kidneys, nervous system and red blood cells. Young children, infants and fetuses are particularly vulnerable to lead poisoning. An amount of lead which would have little effect on an adult can greatly effect a child. Also, growing children more rapidly absorb any lead consumed. A child's mental and physical development can be irreversibly stunted by lead.

Lead in drinking water is not the predominant source of lead poisoning, but it can increase total lead exposure, particularly the exposure of infants who drink baby formulas and juices which are mixed with water. On average, about 10 to 20 percent of a child's total lead exposure might come from drinking water. Infants who are fed formula could get 40 to 60 percent of their lead intake from water.

The Centers for Disease Control and Prevention recommend all children be tested for lead with a blood test. Parents or guardians should consult with their physician.

## **Testing**

To determine if lead is present in drinking water and to determine the possible source of the contamination, water must be tested using specific sampling procedures. Tests to determine the presence of lead in drinking water should be done by a laboratory certified specifically for lead testing. Carefully follow all directions provided by the laboratory and use provided containers when collecting water samples. Home test kits available on the market may not provide accurate results.

To evaluate the household's highest level of lead exposure, collect a sample after water has sat motionless in the plumbing system for six or more 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. Because lead will continually dissolve into the water, the lead concentration will increase with time. This is why water drawn after any extended period of nonuse will contain the highest lead levels.

Collect a second sample after the tap has run for at least five minutes. This is called a purged-line or flushed sample, which will indicate the lead concentration in water that has not been in contact with the plumbing system for an extended period of time. If the first-draw sample contains a higher amount of lead than the purged-line sample, the water is leaching lead from the plumbing system. If both samples contain nearly equal amounts of lead, the water is being contaminated by a source other than the household plumbing system.

Although private water supplies are not subject to any regulations concerning lead contamination, users of private water supplies may want to test their water supply. This is especially true if a problem is suspected or if children use the water.

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

Public water systems must complete a distribution system materials evaluation and/or review other information to target homes at high risk of lead contamination. At-risk homes are then monitored at the tap, with the number of tap-sampling sites based on the population served.

Additional monitoring for other water-quality parameters affecting corrosion is required to both optimize any required treatment and determine compliance with lead standards.

All large systems (serving more than 50,000 persons), as well as small and medium-size water systems (serving less than 50,000 persons) exceeding the EPA's lead action level, are required to complete additional monitoring. The lead action level is discussed below in the "Interpreting Test Results" section.

A public water system exceeding the EPA action level in more than 10 percent of sampled homes is required to take action to reduce lead levels. The system must initiate corrosion control treatment, source water treatment and public education. If a system continues to exceed the lead action level following these three steps, lead service lines must be replaced over a 15 year period.

## **Interpreting Test Results**

Interpreting water test results for lead involves considering both the magnitude of the lead concentration in the samples and comparing the first-draw and flushed samples. As discussed earlier, if results show higher levels of lead in the first-draw sample than the flushed sample, the lead is likely coming from components of the household plumbing (lead piping, lead-based solder or brass fixtures and fittings). On the other hand, if test results show nearly equal amounts of lead in both the first-draw and flushed samples, the lead 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 completely 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 drinking this water. The MCLG for lead in drinking water is zero.

EPA has established an enforceable lead concentration action level for public water supplies. The lead action level is 15 micrograms per liter (mg/l) = parts per billion (ppb) which is equivalent to 0.015 milligrams per liter (mg/l) = parts per million (ppm). When the lead concentration exceeds 15 ppb, the water supplier must initiate the actions described in the previous section. The 15 ppb concentration should also be used as an action level for private water supplies.

## Options

If water tests indicate lead is present in drinking water and testing determines the source is household plumbing, first try to identify and eliminate the lead source. If it is neither possible nor cost-effective to eliminate the lead source, flushing the water system before using the water for drinking or cooking may be an option. Flushing the system means anytime the water in a particular faucet has not been used for several hours, water should be run until it becomes as cold as it will get. This could take as little as two minutes or longer than five minutes depending on your system. 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 clothes or cleaning. Flushing may be ineffective in high-rise buildings with large-diameter supply pipes joined with lead-based solder.

Avoid cooking with or consuming water from hot-water taps. Hot water dissolves lead more readily than cold water. Especially avoid using water from a hot water tap for making baby formula.

If water tests indicate the presence of lead, and the source was determined to be beyond the household plumbing, again the first course of action is to identify and eliminate the source if possible. If served by a public water system, contact the water supplier and ask what steps can be taken to deal with the lead contamination. If the source of water is a private well, check both the well and the pump for potential lead sources. A licensed water well contractor may be able to help you determine if any of the well components are a source of lead.

In addition to identifying potential lead sources, consider the corrosivity factor. One practice which may increase corrosion is the grounding of electrical equipment (including telephones) to water pipes. Electric current traveling through the ground wire accelerates the corrosion of lead in the pipes. In this case, a qualified electrician should be consulted.

If at all possible and if cost-effective, eliminate the source of lead in drinking water. If that is not possible, consider water treatment or an alternative drinking water source (such as bottled water).

There are several treatment methods suitable for removing lead from drinking water, including reverse osmosis, distillation and carbon filters specially designed to remove lead. Typically these methods are used to treat water at only one faucet.

Reverse osmosis units can remove approximately 85 percent of the lead from water. Distillation can remove approximately 99 percent. A water softener can be used with either a reverse osmosis or distillation unit when water is excessively hard. Low flow rates are required when using lead selective carbon filters. Typically they have flow controllers which limit the system to 0.25 to 0.5 gallons per minute.

## Summary

Lead rarely occurs naturally in drinking water. It is more common for lead contamination to occur at some point in the water delivery system. Too much lead in the human body can cause serious damage to the brain, kidneys, nervous system and red blood cells. Young children, infants and fetuses are especially vulnerable to lead poisoning. To determine the presence of lead in drinking water and its possible source, a specific procedure must be used to collect samples and a certified laboratory used for testing. If test results indicate the presence of lead and the source is identified, appropriate steps should be taken. Options include removing the lead source and managing the water supply use for drinking and cooking by flushing water with high lead concentrations from the water 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*
- G98-1360, *Drinking Water: Copper*
- G98-1369, *Drinking Water: Nitrate and Methemoglobinemia*

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