NebGuide

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Drinking Water: Arsenic

Bruce I. Dvorak, Extension Environmental Engineering Specialist
Sharon O. Skipton, Extension Water Quality Educator
Wayne Woldt, Extension Water and Environment Specialist
Andy Kahle, Drinking Water Program Specialist, Nebraska Department of Health and Human Services

University of Nebraska–Lincoln Extension and the Nebraska Department of Health and Human Services place a high priority on water quality and jointly sponsor this series of educational publications.

This publication discusses arsenic in public and private drinking water supplies.

Arsenic in Drinking Water

Arsenic is a naturally occurring element present in rocks and soil. Arsenic is the 20th most abundant element in the earth's crust and often forms compounds by combining with oxygen, chlorine, and sulfur. As water passes through and over soil and rock formations, it dissolves many compounds and minerals including arsenic. The result is that varying amounts of soluble arsenic are present in some water sources. Arsenic chemistry is complex because it has many forms.

Arsenic contamination in a drinking water source most often results from natural sources. However, contamination can be the result of human activities. Arsenic solutions were used to treat a variety of health disorders in the past. While the medical use of arsenic has declined, an arsenic solution received Food and Drug Administration approval for leukemia treatment in 2000. Arsenic has been used in mining and manufacturing and was a component of some pesticides used in the past. Chromated copper arsenate was used to pressure-treat wood for preservation and to prevent insect damage; this wood is commonly known as CCA-treated lumber.

Although arsenic use as described above has the potential to result in arsenic contamination of groundwater, primarily as a result of industrial activity, the arsenic in most Nebraska water supplies is naturally occurring and comes from the aquifer from which the water is pumped.

Indications of Arsenic in Water

Arsenic in drinking water cannot be detected by taste, sight, or smell. The only way to know the concentration of arsenic in water is through sampling and laboratory testing, which is described in greater detail in the Sampling and Testing section.

Potential Health Effects

Arsenic exposure can cause a variety of adverse health effects. The severity of the effect depends on how much arsenic is in the water, how much water is consumed, how long a person has been exposed to the water and a person's general health. Arsenic poisoning can be acute or chronic. Acute poisoning can occur when a high concentration (over 60 mg/L) of arsenic is ingested over a short period of time. This is more likely to occur in situations where arsenic has been concentrated by industrial processes or at unregulated waste disposal sites. Chronic poisoning can occur when moderate or small amounts of arsenic are ingested over long periods (usually five years or longer), such as where groundwater containing arsenic is consumed daily for extended periods. Some Nebraska groundwater supplies contain arsenic in high enough concentrations to present an increased risk of chronic poisoning.

Uncertainty exists in arsenic risk assessment, and more research must be done to determine the exact connections between level of arsenic, duration of exposure, and health effects. However, studies summarized in a report by the National Research Council point to a preponderance of evidence that long-term ingestion of arsenic can increase the risk of skin, bladder, lung, kidney, liver, and prostate cancer. Noncancer effects of ingesting arsenic may include cardiovascular, pulmonary, immunological, neurological effects and endocrine problems such as diabetes.

Symptoms of chronic arsenic poisoning usually are delayed, with years of exposure required to initiate the disease process. Factors such as genetics, age, metabolism, diet, and overall health also may impact health risks associated with arsenic exposure, because they potentially affect one's ability to remove arsenic from the body. Individuals with chronic Hepatitis B infection, protein deficiency or malnutrition may be more sensitive to the effects of arsenic. Children and older adults may be other groups at special risk.

This publication is not a substitute for professional medical advice. If you have any questions or concerns related to potential health effects from consuming water containing arsenic, consult your physician.

Sampling and Testing

Testing Public Water Supplies

Public water supplies classified as either community or nontransient noncommunity are required to test for arsenic concentration on a regular basis. If your water comes from a public water supply, contact the water utility to inquire about the arsenic level in your drinking water.

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. Consumers wanting to know the concentration of arsenic in a private water supply must have the water tested at their own expense. The Nebraska Depart-ment of Health and Human Services certifies laboratories to conduct tests for drinking water supplies. The three labs listed below are certified for testing private water supply samples for arsenic:

Nebraska Department of Health and Human Services
Public Health Laboratory
3701 South 14th
Lincoln, NE 68502
(402) 471-2122

Servi-Tech Laboratories, Inc.
1602 Parkwest Drive
Hastings, NE 68901
(402) 463-3522

Energy Laboratories
2393 Salt Creek Highway
P.O. Box 3258
Casper, WY 82602-3258
(888) 235-0515

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

Interpreting Test Results

Public Water Supply Test Results

The quality of water supplied by Public Water Systems is regulated by the U.S. Environmental Protection Agency (EPA) and the Nebraska Department of Health and Human Services. This includes any well with 15 or more service connections or that serves 25 or more people on a regular basis.

Public drinking water standards established by EPA fall into two categories — Secondary Standards and Primary Standards. Secondary Standards are based on aesthetic factors such as taste, odor, color, corrosivity, foaming, and staining properties of water that may affect the suitability of a water supply for drink-ing and other domestic uses. *Primary Standards* are based on health considerations and are designed to protect human health. The EPA has established an enforceable Primary Standard for arsenic in public drinking water supplies.

Three expert panel reports on the science, cost of compli-ance, and benefits analyses on arsenic in drinking water were released in October 2001. For further information on these reports, see the Expert Panel Reports section at the end of this publication. With this new information, EPA issued regulations revising the arsenic drinking water standard. EPA established an enforceable Maximum Contaminant Level (MCL) for ar-senic of 0.010 milligrams per liter (mg/L), which also can be expressed as 0.010 parts per million (ppm). This amount is equivalent to 10 micrograms per liter (ug/L), which also can be expressed as 10 parts per billion (ppb). This MCL became effective in January 2006 and applies to all commu-nity water systems (CWS) and nontransient noncommunity water systems (NTNCWS). A CWS is a public water system that serves at least 15 locations or 25 residents regularly year round (e.g., most cities and towns, apartments and mobile home parks with their own water supplies). An NTNCWS is a public water system that is not a CWS and serves at least 25 of the same people more than six months of the year (e.g., schools, churches, nursing homes or businesses with their own water supplies).

As many as 94 Nebraska public water systems have documented historic arsenic levels greater than 10 ppb in their source water. Communities are located throughout the state, with clusters in the Panhandle, southwest, and south central areas.

Private Water Supply Test Results

Since EPA and Nebraska regulations do not apply to private drinking water wells, users of private drinking water may consider the EPA established MCL of 10 ppb as a guide-line in assessing the risk associated with their water supply. Since many public drinking water wells in Nebraska are known to have arsenic levels above the MCL, it is likely that some private drinking water wells also have arsenic higher than the MCL. Arsenic concentration can vary greatly from well to well; this variability makes the prediction of arsenic concentrations in a specific well very difficult. However, arsenic should be suspected in private wells located near public wells with elevated arsenic, or in geographic regions and geologic formations in which public wells with elevated arsenic are present. In addition, arsenic can be present in any private well, and users may want to consider having the water tested for arsenic concentration. If arsenic concentrations are found to be above 10 ppb, private drinking water users might voluntarily consider EPA guidelines and try to reduce the arsenic concentration in the water, taking into account health risks, cost, and benefits.

Options

Options For Public Water Supplies

Of the 94 public water systems in Nebraska affected by the arsenic rule, some communities addressed this MCL by shutting down or replacing one or two wells. Other communities have used other approaches for lowering the arsenic concentration in the drinking water. These alternatives may range from finding new wells that yield water with a lower arsenic concentration, treating the water, or becoming part of a larger rural or community water district (which benefits from economies of scale in treating water or obtaining water from a high quality source). Management and disposal of the waste stream generated from treatment (arsenic removed) must also be taken into consideration.

Community-based water users wishing to reduce arsenic levels prior to a community achieving compliance can treat water as described in the Options For Private Water Supplies section.

Options For Private Water Supplies

It may be possible to obtain a satisfactory alternate water supply by drilling a new well in a different location or a deeper well in a different aquifer. However, drilling a new well does not guarantee a satisfactory water supply will be found. An-other alternative source of water is bottled water that can be purchased in stores or direct from bottling companies.

In addition, research is being conducted to find new technologies for arsenic removal from private drinking water supplies. The treatment system or combination of systems that will be best for a private well user depends on several factors including the level of arsenic in the water, desired level of arse-nic removal from the water, the quantity of water to be treated, and the chemistry of the water. Existing treatment systems that can be used for arsenic reduction include reverse osmosis, distillation, adsorption, and (anion) ion exchange. Reverse osmosis utilizes a pressure driven membrane. Pretreatment may be required for sediment and/or hardness. Distillation is achieved by heating water and collecting the steam as treated water. For more information on these treatment options see *Drinking Water Treatment: Reverse Osmosis* (G1490) and *Drinking Water Treatment: Distillation* (G1493). Adsorption utilizes porous granular media with adsorptive properties that adsorb arsenic from the water as it passes through the treat-ment system. Media shown to be effective in arsenic adsorp-tion include activated alumina, granular ferric hydroxide and titanium dioxide. Anion exchange is an adsorption treatment process. The process is similar to that of water softening, but contaminant-specific adsorption media is used. The chemistry of arsenic complicates arsenic removal. Individuals should work with a reliable, competent water treatment dealer to select the best treatment method for a given situation and to determine the best long-term plan to ensure that the treatment unit continues to be effective.

Summary

Arsenic is a naturally occurring element present in rocks and soil. As water passes through and over geologic forma-tions it can dissolve arsenic. The result is that arsenic can be present in some water sources. Ingesting drinking water containing arsenic can cause adverse health effects. Most no-tably, arsenic is a known carcinogen, and long-term ingestion may increase the risk of cancer. Public water supplies must comply with the EPA standard of 10 ppb. Management of a private drinking water well for arsenic is a decision made by the well owner and/or water user. Research is being con-ducted to identify effective, economical methods for arsenic removal and residual disposal. The treatment system or combination of systems that will be best for a given situation depends on several factors. Each individual private well owner/user needs to determine their willingness to accept risk, and work with professionals to manage the risk.

Expert Panel Reports

National Drinking Water Advisory Council Report, "Report of the Arsenic Cost Working Group to the National Drinking Water Advisory Council," August 14, 2001. U.S. EPA Web site: *http://www.epa.gov/safewater/*.

The Science Advisory Board Report, "Arsenic Rule Benefits Analysis: An SAB Review," 2001. U.S. EPA Web site: *http://www.epa.gov/sab/ec01008.pdf*.

National Academy of Sciences National Research Council Report, "Arsenic in Drinking Water: 2001 Update," 2001. National Academy Press Web site: *http://www.nap.edu/catalog/10194.htm*.

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