

# ARSENIC IN PRIVATE WATER WELLS

*Kitt Farrell-Poe*

Arsenic is a naturally-occurring element that has been recognized and used as poison for centuries and can be found in some Arizona drinking waters. Although homeowners with private wells are not required to test their well water, they are responsible for the quality of it.

## Potential health effects

Arsenic is a toxic heavy metal and is also classified by EPA as a human carcinogen (cancer-causing agent). Signs of arsenic poisoning include thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhea, numbness in the hands and feet, partial paralysis, and blindness. Most exposure to arsenic occurs through eating or drinking arsenic-contaminated food or water. Worldwide, human arsenic intake is most associated with food. Approximately 93 percent of the average person's intake of arsenic is associated with food, especially seafood. However, arsenic in food sources is overwhelmingly organic arsenic, which is less toxic than inorganic arsenic. Drinking water represents the route of most hazardous exposure, because arsenic in groundwater is predominantly in the inorganic form.

Chronic arsenic ingestion from elevated levels in drinking water may cause skin cancer and an increase risk for cancers of the bladder, lung, kidney, liver, colon, and prostate. It may also be associated with cardiovascular, pulmonary, and other diseases and disorders. Various high-risk groups such as people suffering from malnutrition, protein deficiency, and hepatitis B infection may be more sensitive to the effects of arsenic. Other factors such as genetics, age, metabolism, diet, and health status may also affect health risks due to arsenic exposure.

## Sources of arsenic in drinking water

Arsenic occurs naturally in the environment (primarily rock and soil). It is also used by some industries, especially the wood treatment industry. When water comes in contact with arsenic-bearing rock, it can dissolve the arsenic and carry it in the water stream, even below the land surface. Arsenic concentrations in water can vary tremendously—even between wells that are very close together. Because arsenic is usually found in soil and rock underground, surface water supplies (such as rivers and lakes) generally have much lower concentrations than groundwater sources. In the US, concentrations in groundwater are generally highest in the Western states, especially in areas with geothermal activity.

There are numerous forms of arsenic in the environment and water. The most common are As(III) (arsenite) and As(V) (arsenate) in anaerobic waters. As(III) exists in most natural water as arsenous acid ( $\text{As}(\text{OH})_3$ ). As(III) is more mobile in underground environments than As(V), which is negatively charged. This characteristic of arsenic compounds is important for understanding treatment options. Removal efficiencies for As(III) are poor compared to removal of As(V). Treatment takes advantage of the charge to extract As(V). For this reason, some techniques convert As(III) to As(V) before treatment, to take advantage of the effects of negative charge.

## Drinking water standard for arsenic

Although there are no standards for private well water, owners of private wells can use the public drinking water standards as guidelines to ensure drinking water quality. For many years, the maximum contaminant level (MCL) set by the EPA for arsenic in publically-supplied drinking water was 50

parts per billion (ppb, equivalent to 50 micrograms per liter). However, in the 1990s, the EPA and the National Academy of Science determined that this level was too high, based on studies of long-term exposure to high levels of arsenic in drinking water. In 2001, a new standard of 10 ppb was set. By January 23, 2006, all public water systems were required to meet the new standard.

## Testing for arsenic in private water wells

To determine if arsenic is present, arrange to have your drinking water tested at a state certified laboratory. Carefully follow laboratory instructions to avoid contamination and to obtain a representative sample. If testing indicates that arsenic is present and treatment is required, other water quality characteristics can effect arsenic treatment and should be tested for, including pH, hardness, iron, manganese, nitrate, nitrite, and sulfate. If any of these are present, pre-treatment may be required.

Public water systems are required to test for arsenic every three years. If you wish to have a private well tested, you may want to do so on the same schedule. Use a laboratory certified by the Arizona Department of Health Services, Bureau of State Laboratory Services [contact information: 3443 N. Central Avenue, Suite 810, Phoenix, AZ 85012-2208; (602) 255-3454; (602) 255-3463 FAX; <http://azdhs.gov/lab/index.htm>]. Refer to fact sheet *Laboratories Conducting Soil, Plant, Feed, or Water Testing* (AZ1111) for more information.

### Sampling for Arsenic

A sample is meant to represent the entire volume of water from which it is drawn. It is important to collect, store, and transport a sample properly to avoid changing the contents in a way that alters the outcome of analysis. Before collecting a sample, be sure to contact a laboratory that is certified to analyze drinking water samples and that has experience with carrying out the analysis. It is best to obtain a sample container and instructions for how to collect the sample from the laboratory prior to collecting and submitting a sample. The laboratory can offer guidance about the best place to collect the sample in your home and should give instructions about how much water is needed and how to store the sample until it can be delivered to the laboratory. Be sure to follow instructions carefully, because a sample that is collected, stored, or delivered incorrectly could lead to misinformation about the quality of your water supply.

## Home treatment for arsenic

Home water treatment units fall into two general classes: point-of-entry (POE) and point-of-use (POU). Point-of-entry treatment units generally treat all or much of the water that enters a building. One example of a POE device is a home water softener. Some homeowners prefer to soften all water

before using it inside the home. Point-of-use treatment devices treat much smaller volumes of water, and treat water that comes from a specific fixture in the home. An example is a filtration unit for a faucet in the kitchen.

Several types of home water treatment systems are available to remove or reduce the amount of arsenic in drinking water, including reverse osmosis, ion exchange, distillation, and activated alumina.

- **Distillation** boils the water, catches the resulting steam, and condenses the steam on a cold surface (a condenser). Nitrate and other minerals remain behind in the boiling tank.
- **Reverse osmosis** forces water under pressure through a membrane that filters out minerals and nitrate. One-half to two-thirds of the water remains behind the membrane as rejected water. Higher-yield systems use water pressures in excess of 150 psi.
- **Ion-exchange** takes another substance, such as chloride, and trades places with nitrate. An ion exchange unit is filled with special resin beads that are charged with chloride. As water passes over the beads, the resin takes up nitrate in exchange for chloride. As more water passes over the resin, the chloride is exchanged for nitrate. The resin is recharged by backwashing with a sodium chloride solution. The backwash solution, which is high in nitrate, must be properly disposed of.
- **Activated alumina** is a granulated form of aluminum oxide. It is very porous and has a tremendous surface area for the removal of contaminants. In the treatment process, the water containing arsenic passes through a cartridge or canister of activated alumina. The alumina absorbs the arsenic and treated water continues to the faucet. An activated alumina cartridge combined with an activated carbon filter produces good, broad-range water treatment.

Before choosing a treatment system, it is important to compare the amount of arsenic present in your water supply with the levels each system can effectively treat. If arsenic concentrations in well water are elevated, arsenic absorption through skin contact (bathing, dishwashing, etc.) may be a concern and whole house treatment may be recommended. Refer to the fact sheet *Matching Drinking Water Quality Problems to Treatment Methods* (AZ1486l) for more information.

## For Additional Information

*Arizona Well Owner's Guide to Water Supply* (AZ1485)

Arizona Cooperative Extension (ACE) bulletins contain a variety of information about water, water quality, safe drinking water, and private wells. They are available through your county Extension office or from CALSmart Distribution Center, located in Tucson, at 4101 N. Campbell Avenue; (877) 763-531; (520) 795-8508 FAX; or visit <http://cals.arizona.edu/pubs/>

## Source

Daniels, B. and M. Mesner. 2005. Arsenic. Utah State University Extension fact sheet, NR/WQ/2005-21.

Healthy drinking water for Rhode Islanders: arsenic in private drinking water wells. 2003. State of Rhode Island Department of Health and the University of Rhode Island Cooperative Extension, Department of Natural Resources Science.

Walker, M. and C. Montecinos. 2008. Arsenic in drinking water: issues associated with revising the standard. University of Nevada Cooperative Extension Fact Sheet, FS-01-08.



**THE UNIVERSITY OF ARIZONA**  
**COLLEGE OF AGRICULTURE AND LIFE SCIENCES**  
**TUCSON, ARIZONA 85721**

**KITT FARRELL-POE, PhD**  
*Water Quality Specialist*

**CONTACT:**  
**KITT FARRELL-POE**  
**kittfp@ag.arizona.edu**

This information has been reviewed by University faculty.  
[cals.arizona.edu/pubs/water/az1486k.pdf](https://cals.arizona.edu/pubs/water/az1486k.pdf)

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