

Arsenic and Drinking Water

July, 2004

Your health could be effected by the level of arsenic in your drinking water. Recognizing the significant health effects, the EPA has lowered its drinking water standard for arsenic. High levels above the new standard have been found in groundwater at various locations throughout the United States. This fact sheet has been prepared by Adedge Technologies to provide you with information on arsenic and what you can do to determine if your well water has arsenic in it.

What is arsenic?

Arsenic is a naturally occurring, common element found in the earth's crust. Very low levels of arsenic are also present in plants and foods such as fish as well as in the air. Arsenic is typically found in combination with other elements - arsenic compounds - and has no distinctive taste or smell. Many of these compounds occur naturally but some are man-made.

Why the concern over arsenic if it occurs in nature?

At very low levels, there is relatively little concern. The body may even need very small amounts of arsenic. However, new evidence shows the amount of arsenic that can cause health problems is lower than previously thought. Most people consume small amounts of arsenic in the food they eat, but drinking water with even low to moderate levels of arsenic can provide more than is safe. And the most toxic form of arsenic, known as inorganic arsenic, is the form typically found in groundwater. Studies have shown that people drinking well water with elevated levels of arsenic have higher risks of some diseases.

Drinking well water with low to moderately elevated levels of arsenic over a long period of time may lead to chronic health effects. Chronic health effects, such as cancer, develop over a number of years and can be difficult to detect, especially in the early stages. Higher levels of arsenic can also lead to more immediate or acute health effects that usually have more noticeable symptoms.

The amount of arsenic in water is measured in micrograms of arsenic per liter of water or parts-per-billion, abbreviated as ppb, or as milligrams per liter or parts-per-million, abbreviated as ppm.

I've heard that arsenic can be present in different forms. Why is that important?

Yes, that's true. Naturally occurring arsenic in water is typically in one of two chemical forms: arsenic (III) or arsenic (V). Groundwater often contains one predominant form or some proportion of these two types of arsenic, depending on the water chemistry. Of importance is that:

- Arsenic (III) is more toxic than arsenic (V)
- Arsenic (III) is also much more difficult to remove with conventional treatment technology; and
- Laboratories only measure and report total arsenic and do not differentiate between the two species

Unfortunately, since most laboratory results will not tell the homeowner what type of arsenic is present, it is very important that the chosen treatment technology be able to adequately address both forms of arsenic. Certain technologies are ineffective for reducing arsenic (III). For instance, anion exchange, activated alumina adsorption, and reverse osmosis will reduce arsenic (V), but do not effectively reduce arsenic (III). Few technologies can remove both types of arsenic adequately in a single treatment step. A water treatment specialist should be consulted to ensure that a total solution is implemented.

Will arsenic in my water cause health problems?

If your water has arsenic, several factors working together will determine how likely it is for harmful health effects to occur. These factors are:

- **Dose** - How much arsenic you have been exposed to
- **Duration** - How long and how often you have been exposed
- **General Health, Nutrition, Age & Lifestyle** - Some people may be affected by lower levels of arsenic in water than others may. Young children, the elderly, people with certain long-term illnesses, people with poor nutrition, and smokers may be at greater risk than others.

What are the health effects from use of water with arsenic?

For water with arsenic levels less than 200 ppb, the major health concern is an increased chance of getting some types of cancer (such as skin, bladder, lung and possibly liver and kidney). How great is the chance of getting cancer? If 1000 people had long term use of household water with arsenic levels of 10 ppb, then several people might get cancer. For arsenic levels higher than 10 ppb the chance of getting cancer increases, while for lower arsenic water levels the chance decreases. How many years of water use also changes your chance of getting cancer.

As arsenic water levels become greater than 200 ppb and length of water use becomes longer than a year, the chance of having other health effects that you or your doctor can detect becomes more likely. These health effects include:

- Stomach and intestinal irritation apparent as pain, nausea, vomiting or diarrhea;
- Blood-related effects, such as decreased numbers of red and white blood cells which may result in fatigue, blood vessel damage resulting in bruising, and abnormal heart rhythm;
- Nervous system effects resulting in either a numbness or a "pins and needles" sensation in your hands and feet;
- Skin changes in coloring appearing as a fine freckled or "raindrop" pattern in the trunk and hands and feet, and unusual skin growth (possibly wart-like) on the palms and soles.
- The evidence from a few human studies suggests that arsenic exposure may increase the incidence of pre-clampsia in pregnant women, decrease birth weight of newborn infants and increase in the risk of malformations and stillbirths as well as that of spontaneous abortions. ^{1,2} Although recent laboratory studies suggest an increase in malformations and stillbirths in animals, ^{3,4} the effects of arsenic from drinking water in human reproduction have not been adequately studied. In order to assess the potential effects of arsenic in human reproduction, a properly designed epidemiological study in a large enough population is necessary. ⁵

Many of the health effects described above for arsenic are often seen with other common illnesses. This makes it difficult to know if these health effects are due to arsenic exposure. If you are concerned about health problems possibly due to arsenic in your water, you should discuss them with your doctor.

How do I determine if arsenic is in my water supply?

A number of analytical testing laboratories in the United States perform arsenic testing on drinking water samples. Most states maintain a list of certified laboratories, or you may check your local directory listings

for analytical laboratories. The laboratory can provide instructions on obtaining and submitting your water sample for analysis. According to most states, if you collect your own water sample, the cost of the test should be approximately \$25 - \$50.

What can I do if my water has high arsenic levels?

If the arsenic level in your water is greater than 10 ppb, it is recommended that you stop using your well water for drinking and preparing food. You should implement some form of treatment to decrease the amount of arsenic getting into your body. Drinking water and eating food prepared with water are believed to be the major ways water-borne arsenic gets into your body. Bathing/showering might result in some arsenic getting into your body or through inhalation of water or mist, but this is still being studied.

Arsenic is rather quickly removed from your body. Much of the arsenic in your body will likely be gone several days after stopping use of water for cooking and drinking. Some of the health effects described above either partly or completely go away after use of high arsenic water has ended, others may remain indefinitely.

Do not attempt to remove arsenic from water by boiling. Boiling water

Comparison of Treatment Technologies			
	Anion Exchange	Reverse Osmosis	Granular Ferric Oxide
Type of arsenic treated	As (V)	As (V)	As (V) and (III)
Pre-oxidation step required for Arsenic removal	Yes	Yes	No
Chemical Use	Yes, Salt	Membrane cleaning	None
Loss (waste) of water	5%	25-75%	< 1%
Frequency of Regeneration	Approx. every 2000-4,000 gallons	Not Applicable	Non regenerable; disposable media
Hazardous waste generation	Yes	Concentrated arsenic reject	None
Off-taste potential	Yes	No	No
Maintenance	High	High	Low
Arsenic "dumping" when capacity of media reached	Possible	N/A	No
Changes in water chemistry	Lowers pH	Removes TDS	Negligible
Relative cost	Moderate	High	Moderate

will only increase arsenic levels.

There are in-home treatment systems to remove arsenic from your water. Examples of treatment systems that have been used for individual homes are:

- **Adsorption-based** systems, such as granular ferric oxide (AD33), which adsorb the arsenic from the water.
- **Reverse Osmosis (RO)** systems that force water through a filter to remove some forms of arsenic.
- **Anion Exchange** systems that replace arsenic in water with a nontoxic chemical

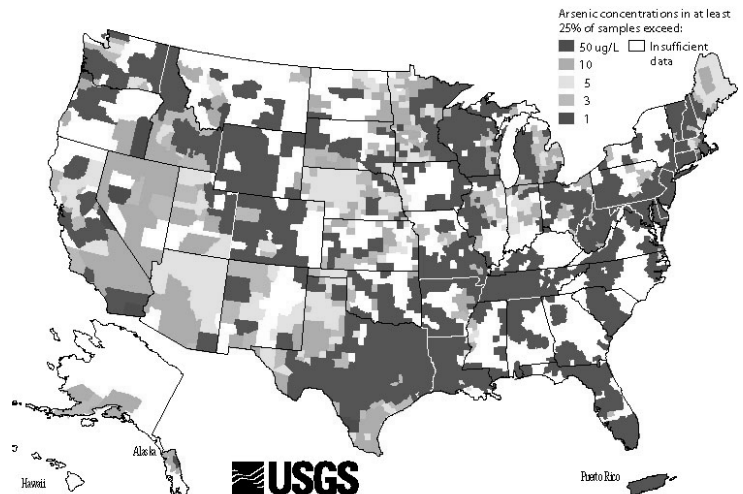
Which treatment system or combined systems are best for you will depend on several factors, such as 1) how high your arsenic levels are and therefore how much needs to be removed; 2) whether you want to treat all water coming into your house or just water at one or two faucets; and 3) the chemistry of your water - some treatment system do not remove certain forms of arsenic very well. Costs of systems can range from \$400 to more than \$7,000. Because choosing a system requires consideration of your specific water chemistry along with

your water needs, a qualified water treatment specialist with arsenic treatment experience should always be consulted.

Where can I find more information?

If you want more information on the issue of arsenic and health effects, there are a number of sources. We suggest that you read a variety of articles before making conclusions, rather than relying on only one source. The EPA's web site has information as well as links to other sources such as the National Academy of Sciences' report. A number of technical and trade magazines have had articles on arsenic over the past several years and you may want to search your library's database for references.

For general information on arsenic in drinking water, contact the Safe Drinking Water Hotline, at (800) 426-4791, or visit the EPA Safewater website at <http://www.epa.gov/safewater> or the arsenic website at <http://www.epa.gov/safewater/arsenic.html>. You can find additional information at www.adedgetechnologies.com. Various other organizations and manufacturers have information about arsenic on their websites. While much of this information is factual, there is also a great deal of incorrect or misinformation available - especially regarding treatment technologies. Because drinking water arsenic is a relatively new and growing concern, even some water treatment professionals and companies are not yet knowledgeable or experienced in arsenic treatment. Attempts to use some treatment technologies which work well for other water problems have been unsuccessful and result in unnecessary and costly mistakes. Look for water treatment professionals who are familiar with the full range of treatment technologies available and who are experienced in dealing with arsenic in the United States.



References:

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