



# Arsenic Treatment and Removal for Private Water System Wells

The USEPA and Ohio Department of Health recommend that owners of private water wells with elevated arsenic use an alternate source of water for drinking and cooking, or install a water-treatment system that removes arsenic. Private water wells provide water to homes and small businesses (less than 25 people, less than 15 service connections). Because arsenic occurs naturally in geologic formation, there is no guarantee that installing a new well will decrease the arsenic concentration of the water.

**The term “elevated arsenic” refers to arsenic concentrations greater than the health standard of 10 ug/L.**

Treating water to remove arsenic is not simple. Common household water-treatment methods, such as water softeners, activated carbon filters, and sediment filters are not effective for removing arsenic from water. Arsenic cannot be removed from water by boiling.

There are several methods for removing arsenic from water, and the effectiveness of each method depends on the chemistry of the water being treated. Groundwater chemistry varies across the U.S., and therefore, the effectiveness of arsenic treatment methods can also vary.

Ohio groundwater with elevated arsenic is relatively difficult to treat because it contains a large proportion of As(3). There are two forms (or “species”) of arsenic—As(3) and As(5):

As(3) is also referred to as As(III), trivalent arsenic, or arsenite.

As(5) is also referred to as As(V), pentavalent arsenic, or arsenate.

Some treatment methods only remove As(5). Other methods can remove both types of arsenic, but are less effective at removing As(3). If arsenic concentrations are elevated, and a large percentage of the arsenic is As(3), an additional pretreatment may be needed to convert As(3) to As(5).

Methods for removing arsenic from water include adsorptive media, reverse osmosis, distillation, and anion exchange. These methods can be used in two different types of treatment systems (see table below).

Method of removing arsenic	Treatment Options	
	Type of system	
	Single tap Point-of-Use (POU)	Whole house Point-of-Entry (POE)
Adsorptive media	x	x
Reverse osmosis	x	x
Distillation	x	
Anion exchange		x

Point-Of-Use (POU) systems treat water from a single tap, and Point-Of-Entry (POE) systems treat all of the water that enters a home. Single-tap systems are often used in kitchens to treat only the water used for drinking and cooking – usually a few gallons per day. Whole-house systems typically treat 250 gallons or more per day. Each treatment option has advantages and disadvantages. Characteristics of 6 treatment options are summarized in the table below.

SINGLE TAP Point-of-use (POU) systems					
Method	Type of arsenic removed	Advantages	Disadvantages	Estimated costs*	
				Initial	Maintenance
<a href="#"><u>POU Adsorptive Media</u></a>	Can remove As(3) and As(5), but, capacity to remove As(3) is lower.  Pretreatment is usually needed.	Produces very little wastewater. Spent media is non-hazardous and disposable.  Simple to install and operate.	The media can be expensive, especially without using additional pretreatment .	\$300 – \$700	\$300 - \$500 every 6 months - 1 year
<a href="#"><u>POU Reverse Osmosis</u></a>	Removes about 95% As(5) and 50-60% As(3).  Pretreatment is usually needed.	Requires little maintenance.	For each gallon of treated water, creates about 7-9 gallons of “reject” water.	\$300 – \$1,500	\$100 - \$200 every 1-2 years
<a href="#"><u>POU Distillation</u></a>	Removes both As(5) and As(3).  Pretreatment is not required.	Simple to install and operate.	Slow process; uses a lot of electricity.	\$300 - \$1,200	-
WHOLE HOUSE Point-of-entry (POE) systems					
Method	Type of arsenic removed	Advantages	Disadvantages	Estimated costs*	
				Initial	Maintenance
<a href="#"><u>POE Adsorptive Media</u></a>	Can remove As(3) and As(5), but capacity to remove As(3) is lower  Pretreatment is usually needed.	Produces very little wastewater. Spent media is non-hazardous and disposable.  Simple to install and operate.	The media can be expensive, especially without using additional pretreatment .	\$2,400 - \$4,500	\$700 - \$900 per year
<a href="#"><u>POE Reverse Osmosis</u></a>	Removes about 95% As(5) and 50-60% As(3).  Pretreatment is usually needed.	Requires little maintenance.	For each gallon of treated water, creates about 0.5 - 1 gallon of “reject” water.	\$5,000 – \$12,000	\$250 - \$500 every 1-2 years
<a href="#"><u>POE Anion Exchange</u></a>	Removes only As(5).  Pretreatment is required to remove As(3).	Operation is similar to a water softener.	Without careful maintenance, an abrupt increase in arsenic in treated water could occur.  Produces waste water with elevated arsenic.	\$1,800 - \$2,500	\$700 – \$900 every 8-10 years

Two forms of pretreatment may be needed to increase the efficiency of arsenic treatment systems.

### Pretreatment to remove iron

In Ohio, groundwater with elevated arsenic has elevated concentrations of iron, which can “foul” water-treatment systems by clogging up the pore spaces with small iron particles. If a home water softener is already in place, iron (or manganese) fouling should not be an issue for new arsenic removal systems. Oxidation/filtration is another pretreatment method that can remove iron.

### Preoxidation to convert As(3) to As(5)

As(3) is harder to remove from water than As(5). Anion exchange systems remove only As(5), so a pre-oxidation step is required to convert As(3) to As(5). Adsorptive media and reverse osmosis remove both forms of arsenic, but the efficiency for removing As(3) is lower than for As(5), and a pre-oxidation step will improve the efficiency and lower operating costs, especially for whole-house systems. Manganese dioxide filters and chlorination are two methods that can be used to oxidize As(3) to As(5).

Pretreatment to remove iron		
Method	Advantages	Disadvantages
Water softener (cation exchange)	Removes dissolved iron and manganese. Readily available; already used by many homeowners. Simple to operate because of automation.	Not recommended for removing precipitated (particulate) iron or manganese. Uses salt for regeneration; produces brine that requires disposal.
Oxidation/filtration	Removes dissolved and particulate iron and manganese. Removes some arsenic along with the iron.	Some systems require use of chlorine, a hazardous chemical. Produces waste water that requires disposal.
Pretreatment to convert As(III) to As(V)		
Method	Advantages	Disadvantages
Manganese dioxide filter	Simple to operate because of automation. Requires no chemical use.	Some vendors may not have expertise with the system. Media may be expensive.
Chlorination	Provides disinfection. Long history of effective use in public-water systems.	Chlorine is a hazardous chemical. Requires careful operation and maintenance. Chlorine may react with organic matter to form undesirable by-products. May cause a taste issue. Causes dissolved iron and manganese to precipitate, so filtration may be required.

Many of these technologies work on the principle of selectively removing or absorbing arsenic from the water onto the treatment media. The treatment media, over time, will become saturated with arsenic and other inorganic constituents, and then start releasing arsenic at high levels back into the water supply. This is called breakthrough. ***It is very important that the treatment system installed is evaluated to determine the frequency at which the treatment media must be replaced or regenerated to ensure that breakthrough of arsenic does not occur.*** The treatment media must be replaced or regenerated at the schedule recommended by the water treatment installer to ensure effective removal of arsenic.

## Installation of Arsenic Removal and Treatment Systems

The purchase and installation of treatment equipment to remove arsenic from your private water well is not only a big financial investment in your water system, but is also the primary line of defense to remove or lower the arsenic in your water supply. The lowest price unit may not always be the best choice. Be an informed consumer. Be sure to choose a registered and bonded private water systems contractor to ensure your point of entry (POE), whole house treatment system meets all state requirements, is tested for safety and effectiveness, and provides consumer protection. State rules require that all treatment systems and components in contact with drinking water meet the NSF International standards for safety for contact with drinking water, and the treatment units meet the contaminant reduction claims as presented by the manufacturer.

If you find that you have elevated arsenic in your well, the local health district will not condemn your well or force you to install arsenic treatment system, although the installation of treatment is highly recommended. The decision to install and the selection of treatment equipment to remove or reduce arsenic levels in your drinking water supply is your choice. You may wish to consult your physician or health care provider about potential impact to you and your family's health based on the level of arsenic exposure through drinking and cooking water sources.

There are a few steps to follow when installing an arsenic treatment system:

1. Contact your local health district to obtain an alteration permit to install a POE, whole house arsenic removal system. Obtaining a permit helps ensure that the treatment system used is approved and is installed correctly and safely. A trained sanitarian from the local health district will inspect and test your system to make sure it meets all standards and is working to remove or lower the level of arsenic in your drinking water. The installation of point of use (POU) systems such as RO does not currently require that private water system alteration permit be obtained. Some local plumbing departments may require a plumbing permit for the installation of POU devices.
2. Contact a registered private water systems contractor who specializes in the installation of arsenic removal equipment. Any company who installs POE, whole house treatment equipment in Ohio for the removal of arsenic must be registered and bonded by the Ohio Department of Health. Registration and bonding provides protection to you as a consumer. A list of Ohio registered private water systems contractors can be found at: <http://www.odh.ohio.gov/odhprograms/eh/water/PrivateWaterSystems/List-of-PWSCContractors.aspx>. Registration and bonding with the Ohio Department of Health as a private water systems contractor is currently not required for the installation of a POU device such as a RO or distillation device.
3. ODH recommends that you obtain at least two quotes from registered private water system contractors. The quotes should completely describe all installation, company testing and maintenance costs. A service contract may be necessary for some systems so it is important to compare all costs for installation and long-term maintenance.
4. After the arsenic removal system is installed, contact the local health district for an inspection and the collection of a water sample. A sanitarian from the local health district will schedule a time to perform the inspection and collect the sample. The local health district will send you the water sample results.
5. Remember to perform all maintenance on your system that is required by the manufacturer. Many treatment units will require that media be replaced or flushed and proper maintenance is critical to ensure that your treatment unit continues to effectively remove the arsenic from the water.

### **Where can I get more information?**

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