



## Understanding Arsenic Treatment for Your Private Well

Office of Water Quality

(317) 234-7430 • (800) 451-6027

[www.idem.IN.gov](http://www.idem.IN.gov)

100 N. Senate Ave., Indianapolis, IN 46204

### Introduction:

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants across the United States, including many parts of Indiana. One path of arsenic exposure is through your drinking water (ingestion). Chronic arsenic exposure can cause serious health effects. *The information included here is intended to help you know your testing and treatment options and effectively discuss treatment with a water treatment professional.* For more information on health effects related to arsenic, see the IDEM Arsenic Fact Sheet at [www.idem.IN.gov/4522.htm#owq](http://www.idem.IN.gov/4522.htm#owq).

### What should I do after I get my results?

- Contact a water treatment professional to determine a treatment solution based on your water results. Different treatment options they may suggest are described in the tables below (check the professional's references and certifications).
- Obtain at least two quotes before selecting a treatment system. The quote should describe all installation, water testing, and ongoing 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.
- After a treatment system is installed, do regular (quarterly or annual) sampling of both the untreated and treated water to check that the system is treating/removing contaminants of concern.
- Perform all maintenance required by the manufacturer. Without proper maintenance you put yourself and your family's health at risk because the treatment system may not be effectively removing arsenic.

### What other information should I know?

Factors that Impact Treatment:

Before you determine what treatment option to use it is important to consider the water chemistry and all contaminants of concern for your water in addition to the advantages and disadvantages of each treatment option.

- **Type of Arsenic:** There are two types of arsenic: arsenic 3 and arsenic 5. Arsenic 3 is more toxic, harder to treat, and more likely present in a well as it ages. Because of this, IDEM recommends always using a pretreatment oxidation method (explained in Pretreatment section and Tables below) to effectively remove all types of arsenic.
- **Groundwater Chemistry:** Performing additional water tests in addition to arsenic can help you understand if there are other contaminants or factors present that may decrease the effectiveness of certain treatment systems. It is important to test, and do continued testing because groundwater chemistry is specific to your well and can change over time.
  - The presence of competing ions (iron, manganese, etc.), chloride, pH, total organic carbon, and total dissolved solids in the water are all factors that can impact the effectiveness of treatment.
  - If you decide to treat multiple contaminants in your water, check with the National Sanitation Foundation (NSF) to see if the water treatment product is certified to treat all of the contaminants of concern.

## **Types of Treatment Systems:**

There are two common types of water treatment systems that can be installed to make your water safer to drink. Table 1 below outlines home treatment options available for arsenic.

- **Point-Of-Use (POU)** systems treat water from a single tap. Single-tap systems are installed at a dedicated faucet, often in the kitchen, to treat only the water used for drinking and cooking – usually a few gallons per day. When POU treatment is used, all water for ingestion including, but not limited to, cooking, drinking, and ice-making, should be obtained from this tap.
- **Point-Of-Entry (POE)** systems treat all of the water that enters a home. Whole-house systems typically treat 250 gallons or more per day. Whole-house treatment for arsenic is not generally necessary because arsenic is not readily absorbed through the skin. However, POE systems may be the desired option if other contaminants of concern are present.

## **Pre and Post Treatment:**

Pre or post treatment may be needed to effectively protect your health, increase effectiveness of treatment, and reduce your maintenance costs.

- **Pretreatment** is a step in the treatment process before your main treatment system. For arsenic, pretreatment usually involves oxidation (the moving of electrons) to convert arsenic 3 to arsenic 5 – the form that is easier to treat. Several treatment systems only remove arsenic 5 or only a small portion of arsenic 3. As a result, IDEM recommends using pretreatment for your water to ensure all arsenic is being removed. Other influences on pretreatment are described in Table 1. Common pretreatment options are described in Table 2.
- **Post treatment** is a step in the treatment process after the main treatment system. Post treatment is recommended if your treated water interacts negatively with lead or copper plumbing. Be sure to work with a water treatment professional to test your treated water for all contaminants of concern.

## **Other Options to Consider:**

In some cases there may be an alternative to installing a treatment system to provide water for drinking and cooking.

- Connecting to a municipal water supply line.
- Bottled water or a water cooler service\*.
- Drilling a new well\*\*.

*\*Check the water quality test results of the service you use.*

*\*\*Drilling a new well may not produce water that is free of arsenic, as arsenic can occur naturally and be a part of the geology of the area.*

## **Additional Information:**

- For more information on arsenic levels in Indiana's groundwater visit the Indiana Department of Environmental Management's Statewide Groundwater Monitoring Network website at [www.idem.IN.gov/cleanwater/2453.htm](http://www.idem.IN.gov/cleanwater/2453.htm).
- For general information on arsenic, look at the Indiana Department of Environmental Management's Arsenic Fact Sheet, available at [www.idem.IN.gov/4522.htm#owg](http://www.idem.IN.gov/4522.htm#owg).
- For an interactive website that covers a range of arsenic-related information, visit Dartmouth Toxic Metals Superfund Research Program's Arsenic and You: Information on Arsenic in Food, Water & Other Sources at [www.dartmouth.edu/~arsenicandyou/](http://www.dartmouth.edu/~arsenicandyou/).
- For information about arsenic and its health impacts, visit the Agency for Toxic Substances & Disease Registry's Toxic Substances Portal: Arsenic at [www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=3](http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=3).
- For more information on types of treatment systems, visit the U.S. Environmental Protection Agency Arsenic Virtual Trade Show at <https://cfpub.epa.gov/safewater/arsenic/arsenictradeshow/arsenic.cfm?action=point-of-use>.
- For information on treatment systems certifications, visit the National Sanitation Foundation Drinking Water Filters, Testing, and Treatment website at [www.nsf.org/consumer-resources/water-quality/water-filters-testing-treatment](http://www.nsf.org/consumer-resources/water-quality/water-filters-testing-treatment).

**Table 1: Treatment Systems to Remove Arsenic**

<i>Method of Removing Arsenic</i>	<i>Adsorptive Media POU &amp; POE</i>	<i>Reverse Osmosis POU &amp; POE</i>	<i>Distillation POU</i>	<i>Ion Exchange POE</i>
<i>How does it work?</i>	Adsorptive media works when particles of arsenic “stick” to the media because they are negatively charged, and the media is positively charged. Opposite charges attract causing the arsenic to become stuck to the media and removed from the water.	Reverse osmosis filtration works by pushing water through a membrane with microscopic pores that allow certain sized materials through. Arsenic is too big for the pores, becomes caught, and is removed from the water. Filtered water is stored in a tank under the sink.	Distillation works by heating up water until it boils, collecting the steam, and then converting that steam back into water. Arsenic and other contaminants stay in the boiler where water was heated, and clean water is collected in a tank under the sink.	Ion exchange works similarly to a water softener. Water is passed through a bed of resin that is charged with ions that remove the negative ion Arsenic 5. Arsenic 3 isn't removed because it doesn't have a charge.
<i>Do I need Pre-Treatment to convert Arsenic 3 to Arsenic 5?</i>	Yes	Yes	No	Yes
<i>When would I need additional Pre-Treatment?</i>	<ul style="list-style-type: none"> <li>It depends on the type of adsorptive media selected, and the presence of competing compounds. Both influence the effectiveness of the media to remove the arsenic.</li> <li>When the water pH is greater than 7.5 because treatment becomes less effective</li> </ul>	<ul style="list-style-type: none"> <li>If there is a significant amount of iron or manganese in your water</li> </ul>	<ul style="list-style-type: none"> <li>Not typically needed</li> </ul>	<ul style="list-style-type: none"> <li>If there is more than 500 mg/L of total dissolved solids (including iron and manganese) and more than 25 mg/L of sulfate in the untreated water. Under these conditions the resin can become less effective as the dissolved solids compete with arsenic.</li> </ul>
<i>Do I need Post-Treatment?</i>	If the water becomes corrosive and comes into contact with lead or copper plumbing then your water might need to undergo post treatment. If water is not post treated, lead and copper could be released from the plumbing and may cause lead and copper to be released into drinking water. Work with a water treatment professional to ensure all contaminants of concern are removed from your finished drinking water.			
<i>How do I dispose of the waste?</i>	Contact your local health department, or the manufacturer of your treatment system for information on how to properly dispose of solid waste and wastewater from your treatment system.			

**Table 1 Continued: Treatment Systems to Remove Arsenic**

<i>Method of Removing Arsenic</i>	<i>Adsorptive Media POU &amp; POE</i>	<i>Reverse Osmosis POU &amp; POE</i>	<i>Distillation POU</i>	<i>Ion Exchange POE</i>
<i>Pros and Cons</i>	<ul style="list-style-type: none"> <li>• Adsorptive media can be expensive</li> <li>• Costs can increase without pre-treatment</li> <li>• Able to specifically target and filter arsenic</li> <li>• Small amount of wastewater is produced</li> </ul>	<ul style="list-style-type: none"> <li>• Large amount of wastewater: for each gallon of treated water there is about 4-20 gallons of wastewater. More water is wasted as the filter clogs</li> <li>• Produces a small amount of treated water a day; the capacity depends on the system</li> <li>• Treated water may taste bland because most minerals have been removed</li> </ul>	<ul style="list-style-type: none"> <li>• Uses a lot of electricity</li> <li>• Slow process that produces only a few gallons of treated water a day, the capacity depends on the system</li> <li>• Treated water can taste bland because most minerals have been removed</li> </ul>	<ul style="list-style-type: none"> <li>• If not maintained properly, sulfate ions in untreated water can compete with arsenic for space on the resin. Large amounts of arsenic can be displaced from the resin by the sulfate and re-contaminate your drinking water</li> <li>• Can process high concentrations of arsenic regardless of the pH of the untreated water</li> <li>• Operated similar to a water softener; salt is added every few weeks</li> </ul>
<i>What are the estimated initial costs?*</i>	POU: \$150 – \$700 POE: \$1,400 – \$4,500	POU: \$150 – \$1,500 POE: \$5,000 – \$12,000	\$300 – \$1,200	\$1,500 – \$2,500
<i>What are the estimated maintenance costs?*</i>	POU: \$300 – \$500 Every 6 months to 1 year POE: \$500 – \$900 Every year	POU: \$100 – \$200 Every 1 – 2 years POE: \$45 – \$500 Every 1 – 2 years	Systems typically last about 10 years  Electricity to run the system	\$100 – \$900 Every 8 – 10 years  Electricity to run the system
<i>How do you maintain this system?</i>	<ul style="list-style-type: none"> <li>• Replace adsorptive media</li> <li>• Manufacturer's maintenance requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Replace filters and cartridges</li> <li>• Clean or replace membrane when it becomes clogged or dirty</li> <li>• Manufacturer's maintenance requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Clean boiling chamber and heating coils</li> <li>• Manufacturer's maintenance requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Add salt based on sulfate concentration rather than arsenic level</li> <li>• Replace resin bed</li> <li>• Manufacturer's maintenance requirements</li> </ul>

\*Costs and maintenance schedules are general estimates and may vary depending on your personal water system needs. Estimates may also not include cost of installation

**Table 2: Pre-Treatment Options for Converting Arsenic 3 to Arsenic 5**

Method	Iron Removal	Removing Iron and Converting Arsenic 3 to Arsenic 5 by Oxidation		Converting Arsenic 3 to Arsenic 5 by Oxidation
	Water Softener (Cation Exchange)	Iron Oxidation Filter	Manganese Dioxide Filter	Chlorination
How does it work?	<p>Water softeners can be used as a pre-treatment step to remove excess iron from the water. Water softeners reduce the “hardness” of water by decreasing the amount of minerals such as calcium, magnesium, and iron. This process is done by replacing or exchanging the unwanted minerals with another substance, usually sodium. In order for certain arsenic treatments to be effective iron levels need to be low so iron does not plug or block filters. Water softeners will <b>not</b> remove arsenic by themselves.</p>	<p>Iron Oxidation and Manganese Dioxide filtration removes iron from the system similarly to water softeners. In the process the system also may remove both Arsenic 5 and Arsenic 3 with varying levels of effectiveness through the process of oxidation.</p>		<p>Chlorination treatment works through oxidation. Specifically, it oxidizes or converts Arsenic 3 to Arsenic 5, making the arsenic easier to remove with other treatment.</p>
Pros and Cons	<ul style="list-style-type: none"> <li>• Removes iron and manganese only in their dissolved state (in the solution)</li> <li>• Removing iron can increase the effectiveness of other treatments by reducing filter blockages</li> <li>• Systems are readily available for use</li> </ul>	<ul style="list-style-type: none"> <li>• Removing iron can increase the effectiveness of other treatments by reducing filter blockages</li> <li>• Effectiveness depends on the pH, chloride concentration, total organic carbon, and the iron to arsenic ratio</li> <li>• Iron oxide filters can be effective at removing Arsenic 5</li> <li>• Wastewater must be disposed of properly. Contact your local water treatment provider for information on disposal</li> <li>• Filter media needs to be replaced on a regular basis and can be expensive</li> </ul>		<ul style="list-style-type: none"> <li>• Chlorine is hazardous and this system requires careful operation and maintenance</li> <li>• Undesirable disinfection by-products can form from chlorine interactions</li> <li>• May cause dissolved iron and manganese which can cause taste issues</li> <li>• Disinfects the system to reduce bacteria</li> <li>• Effective at pH range of 6.3 to 8.3</li> </ul>