Oregon Health Authority

Drinking Water Program Fact Sheet: Recommendations for Arsenic Removal from Private Drinking Water Wells in Oregon

Introduction

Arsenic is a naturally occurring element found in soils and groundwater. Arsenic concentrations vary in accordance with geographic location. When arsenic levels are found to be too high at a specific location, it may be necessary to treat drinking water to remove it.

Arsenic usually exists in two different forms, or valences, in a natural setting depending on the amount of oxygen available in groundwater. In more shallow aquifers with higher levels of oxygen, arsenic will usually exist as arsenate, As (V). In deeper, anaerobic ground waters, arsenic usually occurs as arsenite, As (III). In the pH range of 4 to 10,the predominant As (III) compound is neutral in charge, while As (V) species are negatively charged. Removal efficiencies for As (III) are usually less than those of As (V) because of As (V)'s negative charge. In many cases, pretreatment of As (III) to oxidize it to As (V) may be necessary to efficiently remove arsenic from drinking water.

It should be noted that a recent USGS study in Oregon's Willamette Basin found a predominance of As (III) species, even in shallow wells. *This information is limited, however, and anyone interested in pursuing arsenic removal should always first have their water tested by an Oregon Health Authority Drinking Water Program-certified laboratory and should consult a water treatment specialist.* Water treatment specialists can be found in the yellow pages.

What options are available for removing arsenic from my drinking water?

Reverse Osmosis Systems

The most cost-effective method for removing arsenic from a private water supply appears to be reverse osmosis, commonly called RO. RO can be thought of as filtration at a molecular level. It works by forcing water through a special, selective membrane. The membrane has microscopic pores that are specially sized to allow water molecules through, while trapping larger inorganic molecules like lead, iron, chromium and arsenic. Studies have shown that RO can be up to 95% effective for removal of As (V).

Most RO systems installed in homes are called point-of-use (POU) systems. Typically, they are designed to produce only a small amount of water daily, 2 to 3 gallons per days, and are usually located near the kitchen sink. The system consists of a pre-filter that removes sand and grit, the membrane where RO actually occurs, and an activated carbon polishing filter to aid in taste and odor control. Treated water is stored in a small tank and is accessed through a faucet located next to the regular kitchen faucet.

Pros and Cons of RO

Advantages:

1) RO is very effective at removing inorganic constituents like arsenic, iron,

lead, chromium and manganese. As stated above, when operated under ideal conditions, RO can remove over 95% of As (V).

2) RO requires very little maintenance and no addition of chemicals.

Disadvantages:

1) Smaller RO point-of-use systems produce only a few gallons of treated water per day. The supply of drinkable water is limited and normally available only in the kitchen area of the home.

2) If you have As (III) in your drinking water, you'll need to pre-oxidize it to As (V), which will increase the complexity and cost of your system.

3) RO-treated water may taste bland because the inorganic materials removed in the treatment process also impart taste to drinking water.

4) If you have significant amounts of iron or manganese in your water, you'll probably need additional pretreatment equipment to remove those prior to RO treatment.

5) Larger RO systems called point-of-entry systems can treat water for the entire house. However, these are much more expensive. More importantly, RO point-of-entry systems can cause corrosion control problems in house plumbing, which can elevate the levels of lead and copper found in your drinking water.

Anionic Exchange Systems

Anionic exchange systems use a physical/chemical process to exchange ions between a resin bed and water passing through. These systems soften water, remove iron and manganese, and lower nitrate and arsenic levels. Specific contaminant removal is determined by the composition of the resin bed used. Anionic exchange systems are typically point-of-entry systems, meaning that they treat all water coming into the home.

These systems work by passing water through the resin bed, which is charged with chloride ions from dissolved salt. Arsenic molecules in the water replace these chloride ions by knocking them off and taking their place. This process continues until all of the sites on the resin are full. The resin is then backwashed with water that is super-saturated with dissolved salt. The chlorine ions in this backwash water strip the embedded arsenic molecules out of the resin and into the backwash wastewater. New chlorine ions replace the arsenic molecules, fully recharging the resin bed so that the process can be performed again.

Pros and Cons of Anionic Exchange

Advantages:

1) Anionic exchange requires little maintenance; additional salt is added every few weeks.

2) Systems are typically installed to treat an entire house.

Disadvantages:

1) Other constituents in water can compete with arsenic for the resin sites reducing the systems effectiveness. EPA recommends the influent water have less than 500 mg/L of total dissolved solids (TDS) and less than 25 mg/L of sulfate.

2) Treated water can have a very low (acidic) pH and high levels of chloride,

which can cause corrosion control problems and high levels of lead and copper in the treated water.

3) If the system fails, all of the arsenic captured on the resin at that time can be released at once causing a large concentration of arsenic in the treated water.

Iron Oxide Filter Systems

Iron oxide filters are a relatively new and promising method for lowering arsenic levels in private drinking water systems. Like activated carbon, these granular filters have large amounts of surface area and an affinity for arsenic to adhere to its surface. Although these filters are fairly new to the home treatment market, the principals behind them have been used by public water suppliers for many years.

Iron oxide media can be housed in small inline filter cartridges (point-of-use) or in larger tanks like the ones used for ion exchange systems (point-of-entry). These filters can be used to enhance the performance of reverse osmosis systems that are not effectively removing As (III). The media can be disposed of as non-hazardous waste.

Pros and Cons of Iron Oxide Filters

Advantages

1) They are effective for both As (III) and As (V) removal.

2) They can be used as point-of-use or point of- entry systems.

3) They remove other inorganic constituents.

4) They are simple to use and install.

5) They are disposable as non-hazardous waste.

Disadvantages

1) The media must be replaced on regular basis.

2) The presence of iron, manganese, sulfate, silica or organic carbon can reduce effectiveness.

Arsenic Treatment Checklist:

1) Have I had my water tested at a state certified laboratory?

2) Have I done a retest to confirm the results?
3) Have I also tested for iron and manganese?

4) Have I contacted a water treatment professional to aid in the analysis and selection of an adequate solution?

5) Have I checked references for the water treatment professional that I've selected?

6) Are there other problems with my drinking water that should also be addressed?

Where can I find additional information?

For more information regarding the health effects of arsenic, contact one of the OHA toxicologists at (971) 673-0911.

A list of Oregon certified drinking water laboratories can be received by calling the Drinking Water Program at (971) 673-0405, or by utilizing the web address listed below.

Information on the Web:

Oregon certified drinking water laboratories list:
http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Documents/AllLabsDWMatrix.pdf

EPA's private wells page:
http://water.epa.gov/drink/info/well/

The State of Maine has an excellent web page devoted to private wells, with a large section devoted to arsenic removal. Much of this fact sheet was derived from their site. State of Maine information:
http://www.maine.gov/dhhs/eng/water/Templates/PrivateWells/privatewells.htm