

Healthy Drinking Waters for Rhode Islanders

SAFE AND HEALTHY LIVES IN SAFE AND HEALTHY COMMUNITIES

Hydrogen Sulfide and Sulfate in Private Drinking Water Wells

PRIVATE WELLS CURRENTLY ARE NOT REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA). Private well owners are responsible for the quality of their drinking water. Homeowners with private wells are generally not required to test their drinking water. However, they can use the public drinking water standards as guidelines to ensure drinking water quality. Refer to the factsheet *Drinking Water Standards* for more information.



There is no drinking water quality standard set for hydrogen sulfide in water. There is, however, a Secondary Maximum Contaminant Level (SMCL) set for odor in drinking water, which would capture the presence of hydrogen sulfide. The SMCL for sulfate in drinking water is 250 milligrams per liter (parts per million) as established by the EPA.

Summary



Hydrogen sulfide is a gas that is produced naturally by decomposing organic material and sulfur-reducing bacteria. Hydrogen sulfide gives water a nuisance "rotten egg" smell and taste. Water supplies with 1.0 milligram per liter

(parts per million) of hydrogen sulfide may be corrosive and tarnish copper and silverware. It can also produce yellow or black stains on kitchen and bathroom fixtures and can affect the appearance and taste of some foods and beverages. Treatment options for hydrogen sulfide include aeration, granular activated carbon filtration, and shock chlorination to kill the sulfur producing bacteria.

Sulfates are part of naturally occurring minerals contained within soil and rock formations. As water percolates down through the soil, these minerals can dissolve releasing sulfates into groundwater. Treatment options for sulfates include reverse osmosis, distillation, and ion exchange.

Potential Health Effects

Hydrogen sulfide gas is flammable and poisonous at high

concentrations. Usually it is not a health risk at concentrations present in household water. Build up of hydrogen sulfide concentrations in confined areas has been known to cause adverse health effects.

Water with dissolved hydrogen sulfide gas alone does not cause disease. In rare cases, however, hydrogen sulfide odor may be from sewage pollution, which can contain disease-causing contaminants. Therefore, arrange to test the water for bacterial contamination if sewage is the likely source of hydrogen sulfide. In addition, you may want to conduct a detergent test if sewage contamination is suspected.

Elevated **sulfate** levels in water may have a laxative effect that can lead to dehydration and is mostly a concern for infants. While a nuisance, sulfur-oxidizing bacteria do not present any known human health risk.

Indication of Hydrogen Sulfide and Sulfate in Drinking Water

- Hydrogen sulfide gas produces an offensive "rotten egg" or "sulfur water" odor and taste in the water.

- Most people can detect **hydrogen sulfide** in water at concentrations as low as 0.5 milligrams per liter.
- Concentrations less than 1 milligram per liter give water a “musty” or “swampy” odor.
- A concentration of 1 – 2 milligrams per liter gives water the “rotten egg” smell and makes it very corrosive to household plumbing.

- ◆ The odor may be noticeable only when the water is initially turned on or when hot water is running. Heat forces the hydrogen sulfide gas into the air, which may cause the odor to be particularly offensive in the shower.
- ◆ Hydrogen sulfide is corrosive to metals such as iron, steel, copper, and brass. It can tarnish silverware and discolor copper and brass utensils. It can also cause yellow or black stains on kitchen and bathroom fixtures.
- ◆ Coffee, tea, and other beverages made with hydrogen sulfide contaminated water may be discolored and the appearance and taste of cooked foods can be affected.
- ◆ High concentrations of dissolved hydrogen sulfide can foul the resin bed of an ion exchange water softener. When hydrogen sulfide odor occurs in treated water, yet was not originally detected in the pre-treated water, this usually indicates the presence of a sulfate-reducing bacteria in the treatment system. Ion exchange units provide a convenient environment for these bacteria to grow. A “salt-loving” bacteria, which uses sulfates (naturally occurring from dissolved minerals in soil and rock) as an energy source, produces a black slime inside ion exchange units. Regular treatment system maintenance can help prevent this from occurring.
- ◆ Sulfates, which can cause a scale buildup in water pipes similar to other minerals, may also be associated with a bitter taste in the water. While not as common, another form of bacteria that feeds on sulfides (sulfur-oxidizing bacteria) converts sulfides to sulfates which results in a dark slime that can clog plumbing and/or stain clothing.



Sources of Hydrogen Sulfide and Sulfate in Drinking Water

Hydrogen sulfide gas occurs naturally in groundwater and can result from a number of sources.

- ◆ Decomposing underground deposits of organic matter such as decaying plant material can produce hydrogen sulfide.
- ◆ Wells drilled in shale or sandstone or near coal or oil fields or peat deposits may also be sources of hydrogen sulfide.
- ◆ Sulfur-reducing bacteria feed on the naturally occurring sulfates in water, producing hydrogen sulfide gas as a by-product.
- ◆ Water heaters may also be a potential source of hydrogen sulfide gas. If a magnesium rod is in the tank to prevent water heater corrosion, the rod can chemically reduce naturally occurring sulfates to hydrogen sulfide.

Testing for Hydrogen Sulfide and Sulfate in Private Drinking Water Wells

Since hydrogen sulfide is detectable by taste and smell, a laboratory test is not needed to detect its presence, however, a test is necessary to determine the amount of hydrogen sulfide in water. To determine the level, arrange to test your drinking water at a state certified laboratory. Carefully follow laboratory instructions to avoid contamination and to obtain a representative sample. The amount present in water determines which treatment method will be most effective. Because it is a gas dissolved in water that can easily escape or be lost from the sample, a water sample must be chemically stabilized immediately after collection in order for the laboratory to accurately measure its concentration. Be sure to contact the laboratory for the proper sample bottle, chemical preservative and instructions. If sewage pollution is the suspected source of contamination, collect a separate sample to test for bacteria. In addition, you may also want to conduct a test for detergents.

Most state certified laboratories have a standard test for detecting sulfate levels in water. Follow laboratory instructions carefully to avoid contamination and to obtain a good sample. Refer to factsheet *Home Water Testing* for more information.

Corrective Action

The recommended treatment varies with the amount and form in which hydrogen sulfide and/or sulfate are detected in the water, and whether you need whole house treatment, (point-of-entry), or point-of-use treatment for drinking and cooking. At elevated levels, whole house treatment is usually recommended. Other options include buying bottled water - especially if the main problem occurs with food and beverage preparation - or installing a new well. Depending on the source of the problem, a new well

may need to be installed that is either deeper or more shallow than the existing well, or be located within a different area on your property to avoid the sulfur source. If the hydrogen sulfide is a result of sulfur bacteria in the pipes, chlorinating your well can kill the bacteria. However, this is not a permanent solution and the bacteria can re-occur. For more information on shock chlorination procedures, refer to the factsheet *Bacteria in Drinking Water Wells*.

If the rotten egg odor is only present in hot water this can indicate a reaction with the magnesium rod in your water heater. Replacing the magnesium rod with an aluminum rod should solve this problem.

The type of treatment you choose will depend upon the amount of hydrogen sulfide/sulfate present in your drinking water. It is important to determine the concentration before purchasing a water treatment device.

Granulated Activated Carbon

If you have trace amounts of hydrogen sulfide in the water, (up to about 0.3 milligrams per liter) installing an activated carbon filter will reduce the unpleasant taste. However, this method has a limited capacity for odor absorption. Refer to the factsheet *Activated Carbon Treatment of Drinking Water* for more information.

Aeration

For levels less than 2.0 milligrams per liter, aeration treatment will work. In this case, oxygen will react with hydrogen sulfide to form an odorless, dissolved form of sulfate. Yellow sulfur particles may also form after the water is aerated. Another drawback of this method is that the aeration process produces a strong hydrogen sulfide odor near the aerator, which may be unpleasant if located near any living areas. This process by itself may not reduce hydrogen sulfide to unnoticeable levels. The addition of a granular activated carbon filter following the aeration system may remove the remaining trace amounts. Refer to the factsheets *Activated Carbon Treatment of Drinking Water* and *Aeration Treatment of Drinking Water Supplies* for more information.

Iron Removal Filter

An iron-removal filter containing manganese greensand may be used for levels of hydrogen sulfide between 1 and 10 milligrams per liter. Manganese dioxide oxidizes hydrogen sulfide and the oxidized particles are then filtered out. The filters must be recharged with a solution of potassium permanganate when the manganese greensand is depleted. Water with a pH below 6.7 may need to be neutralized before this treatment method is effective. Refer to the factsheet *pH – Acidity of Drinking Water* for more information.

Oxidizing Chemicals

Injection of an oxidizing chemical such as chlorine or potassium permanganate, followed by a filter to remove taste or sediment is the most common method for high concentrations of hydrogen sulfide (levels of 6 milligrams per liter or more). Sufficient storage must be provided to maintain 20 minutes of contact time between the water and the chlorine. This process may produce objectionable taste in the water. The chlorine treatment can be combined with a granular activated carbon filter to remove the chlorine taste to the water. Yellow sulfur particles may also be produced, which can form a yellow film on clothing and fixtures. A sand or aggregate filter can remove the yellow particles. Backwashing the filter is necessary every few days or weeks to flush out the accumulated particles. Refer to the factsheets *Activated Carbon Treatment of Drinking Water* and *Microfiltration Treatment of Drinking Water Supplies* for more information.

Naturally Occurring Sulfates

When the problem is naturally occurring sulfate, small concentrations may be treated using point-of-use distillation and reverse osmosis. Large concentrations may be treated using a whole-house ion exchange treatment. This process is also used to soften hard water and reduce iron and manganese in drinking water. This treatment may be problematic with the presence of sulfate reducing bacteria.

For more information on these treatment options, see factsheets entitled:

- 💧 *Distillation Treatment of Drinking Water Supplies*
- 💧 *Reverse Osmosis Treatment of Drinking Water Supplies*
- 💧 *Ion Exchange Treatment of Drinking Water Supplies*

When choosing a treatment system, consider both the initial cost and the operating costs. Operating costs include the energy needed to operate the system, additional water that may be needed for flushing the system, consumable supplies and filters, repairs, and general maintenance.

Regardless of the quality of the equipment purchased, it will not operate well unless maintained in accordance with the manufacturer's recommendations. Keep a log book to record equipment maintenance and repairs. Equipment maintenance may include periodic cleaning and replacement of some components. Also consider any special installation requirements that may add to the equipment cost. For more information, refer to factsheet *Questions to Ask When Purchasing Water Treatment Equipment*.

Protection of Private Drinking Water Supplies

You can protect your private well by paying careful attention to what you do in and around your home as well as your neighbor's activities near your well. Regular testing and adopting practices to prevent contamination can help ensure that your well supplies you and your family with good quality drinking water. For more information on well protection see the factsheet entitled *Drinking Water Wells*.

For More Information:

This factsheet is one in a series on drinking water wells, testing, protection, common contaminants, and home water treatment methods. Contact the URI Home*A*Syst Program for more information.

University of Rhode Island Cooperative Extension Home*A*Syst Program

Offers assistance, information, and workshops on private well water protection. 401-874-5398 www.uri.edu/ce/wq

RI Department of Health, Office of Drinking Water Quality

Offers assistance, information on testing and state certified laboratories.

401- 222-6867 <http://www.health.ri.gov/environment/dwq/Home.htm>

For a listing of HEALTH's certified private laboratories in Rhode Island <http://www.health.ri.gov/labs/instate.htm>

US EPA New England website: <http://www.epa.gov/ne/eco/drinkwater/>

US Environmental Protection Agency. For a complete list of primary and secondary drinking water standards: <http://www.epa.gov/safewater>

RI Department of Environmental Management, Office of Water Resources

Maintains listing of registered well drillers, information on well location and construction.

401-222-4700 <http://www.state.ri.us/dem/programs/benviron/water/permits/privwell/index.htm>

NSF International

For information on water treatment systems, NSF International has tested and certified treatment systems since 1965.

800-NSF-MARK <http://www.nsf.org/water.html>

Water Quality Association

The Water Quality Association is a not-for-profit international trade association representing the household, commercial, industrial, and small community water treatment industry. For information on water quality contaminants and treatment systems. www.wqa.org

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