# Healthy Drinking Waters

*for*

## MASSACHUSETTS

Safe and healthy lives in safe and healthy communities

# Hydrogen Sulfide and Sulfate in Private Drinking Water Wells

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Private well owners are responsible for the quality of their drinking water. The U.S. Environmental Protection Agency (EPA) does not regulate private wells. Homeowners with private wells are generally not required to test their drinking water, although local Boards of Health or mortgage lenders may require well water testing. While there is also no state requirement to have your well water tested, the Massachusetts Department of Environmental Protection (MassDEP) recommends that all homeowners with private wells do so, and use a state certified testing laboratory. Homeowners can use the public drinking water standards as guidelines to ensure drinking water quality.

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.

NEW ENGLAND Regional Water Program

UMassAmherst Outreach UMass Extension

EPA United States Environmental Protection Agency New England

## 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.

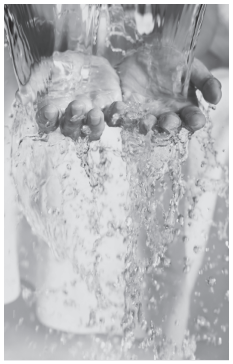
## Potential Health Effects

***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 wastewater 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 wastewater 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.



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## 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.

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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 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 can cause a scale buildup in water pipes as do other minerals, and 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, sandstone, or near coal 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 hydrogen sulfide 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 wastewater 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.

## Reducing Sulfide/Sulfate in Your Drinking Water

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,

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refer to the fact sheet: *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.

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### Granulated Activated Carbon

If you have up to 0.3 milligrams per liter of hydrogen sulfide in the water, installing an activated carbon filter will reduce the unpleasant taste. However, this method has a limited capacity for odor absorption.

### 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, if the aerator is located near living areas, is that the aeration process produces a strong hydrogen sulfide odor near the aerator. 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.

### 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.

### 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 concentrations of 6 milligrams per liter or more of hydrogen sulfide. 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 in 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.

### 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.

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 logbook 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 the fact sheet: *Questions to Ask When Purchasing Water Treatment Equipment*.

# Resources

### UMass Extension

This fact sheet is one in a series on drinking water wells, testing, protection, common contaminants, and home water treatment methods available on-line at the University of Massachusetts website: http://www.umass.edu/nrec/watershed_water_quality/watershed_online_docs.html and Cape Cod Cooperative Extension: 508-375-6699 http://www.capecodextension.org

### MA Department of Environmental Protection, Division of Environmental Analysis

Offers assistance, information on testing and state certified laboratories: 617-292-5770 For a listing of MassDEP certified private laboratories in Massachusetts: http://www.mass.gov/dep/service/compliance/wespub02.htm

### U.S. Environmental Protection Agency, New England Office

Information and education on where drinking water comes from; drinking water testing and national laws; and how to prevent contamination: 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

### MA Department of Conservation and Recreation, Division of Water Supply Protection

Maintains listing of registered well drillers, information on well location and construction: 617-626-1409 http://www.mass.gov/dcr/waterSupply/welldril/index.htm

### NSF International

The NSF International has tested and certified treatment systems since 1965. For information on water treatment systems: 800-NSF-MARK (800-673-6275) http://www.nsf.org/consumer/

### 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: http://www.wqa.org

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