PRIVATE DRINKING WATER IN CONNECTICUT

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Publication No. 9: Hydrogen Sulfide and Sulfate in Private Drinking Water Wells

The U.S. Environmental Protection Agency (EPA) does not regulate Private wells. 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 Publication # 23 *Private Drinking Water Standards* for more information.

Introduction

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. While there is no federal drinking water quality standard set for hydrogen sulfide in water, water supplies with 1.0 milligram per liter (parts per million) of hydrogen sulfide may be corrosive and tarnish copper and silverware. Sulfides 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 (or possible continuous) 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. The Secondary Maximum Contaminant Level (SMCL) for sulfate in drinking water is 250 milligrams per liter (parts per million) as established by the EPA. Note that the SMCL is a recommended maximum concentration as opposed to a required maximum concentration.

Potential Health Effects

Hydrogen sulfide gas is flammable and poisonous at high concentrations. Build up of hydrogen sulfide concentrations in a confined area has been known to cause adverse health effects in workers. However the nose is very sensitive to the foul odor of hydrogen sulfide and under normal environmental conditions, this early warning provides protection from even mild health effects such as irritation.

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

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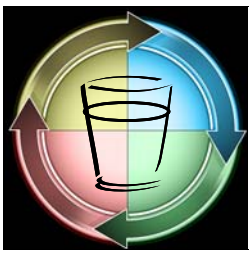
Elevated sulfate levels in water may have a laxative effect that can lead to dehydration, and is mostly a concern for infants. High sulfate levels can be a result of sulfur oxidizing bacteria present in the water supply. While a nuisance, sulfur-oxidizing bacteria do not present any known human health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

Indication of Hydrogen Sulfide and Sulfate in Drinking Water



- Hydrogen sulfide gas produces an offensive "rotten egg" odor or "sulfur water" 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 gives 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 and was not originally detected in the pre-treated water, it indicates the presence of sulfate-reducing bacteria in the treatment system.
- Sulfates can cause a scale buildup in water pipes similar to other minerals. It may be associated with a bitter taste in the water. While not as common, another bacteria, known as sulfur-oxidizing bacteria, feeds on sulfides, which converts it to sulfates. This can result in a dark slime that can clog plumbing and 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. Some water heaters contain a magnesium rod in the tank to prevent corrosion, the rod can chemically reduce naturally occurring sulfates to hydrogen sulfide. If this is happening, you may want to replace the magnesium rod (the sacrificial anode) with one made of aluminum or zinc. Check with a licensed plumber or heating system professional.

Testing for Hydrogen Sulfide and Sulfate in Private Drinking Water Wells

Since hydrogen sulfide is detectable by taste and smell, to determine its presence does not normally require a laboratory test. However, it is necessary to determine the amount of hydrogen sulfide in the water in order to determine which treatment method will be most effective.

To determine the level, arrange to test your drinking water at a state certified laboratory. Follow the laboratory's instructions carefully to avoid contamination and to obtain a representative sample. The water sample must be chemically stabilized immediately after collection, since hydrogen sulfide is a gas that can easily escape from the sample. Be sure to obtain the proper sample bottle, chemical preservative and instructions from the laboratory. If sewage pollution is the suspected source of contamination, collect a separate sample to test for bacteria. You may also want to test a sample for detergents. Most state certified laboratories have a standard test for detecting sulfate levels in water. Refer to Publication # 24 *Residential Well 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 recommended. Other options include buying bottled water, especially if water is used for food preparation, or installing a new well. A new well may need to be installed either deeper or shallower than the existing well or relocated to a different area on the 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, but it is not a permanent solution as the bacteria can reoccur. For more information on chlorination, see Publication #4 *Bacteria in Drinking Water Wells.*

If the rotten egg odor is only present in hot water, it may indicate a reaction with the magnesium rod in your water heater. Replacing the magnesium rod with an aluminum or zinc rod may solve the problem. If water temperatures are maintained >150^{0}F use only aluminum rods. To be sure, check with your licensed plumber or heating professional.

The type of treatment you choose will depend on the amount of hydrogen sulfide/sulfate present in your drinking water. Determine the concentration before purchasing a water treatment device.

Granulated Activated Carbon

If you have trace amounts (up to 0.3 milligrams per liter), installing an activated carbon filter will reduce the unpleasant taste, but it has limited capacity for odor absorption. Refer to Publication #*1 Activated Carbon Treatment of Drinking Water.*

Aeration

For levels less than 2.0 milligrams per liter, aeration treatment will work. Oxygen reacts with hydrogen sulfide to form an odorless, dissolved form of sulfate. Yellow sulfur particles may form after the water is aerated. Another drawback of this method is that it results in a strong hydrogen sulfide odor near the aerator that can be unpleasant if located in living areas. Aeration alone may not reduce hydrogen sulfide to unnoticeable levels, however the addition of a granular activated carbon filter following the aeration system may remove the remaining trace amounts. See Publication #1 *Activated Carbon Treatment of Drinking Water* and Publication #2 *Aeration Treating of Drinking Water Systems* for more information.

Iron Removal Filter

For levels between one and 10 milligrams per liter, an iron-removal filter containing manganese greensand may be used. Manganese dioxide oxidizes hydrogen sulfide particles that are then filtered out. The filters must be recharged, either continuously or batch, with a potassium permanganate solution 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 Publication #18 *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. The chlorine treatment can be combined with a granulated activated carbon filter to remove the chlorine taste in the water. Yellow sulfur particles may cause 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 Publication #1 *Activated Carbon Treatment of Drinking Water* and Publication #14 *Microfiltration Treatment of Drinking Water Systems* 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 concentration 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 of these treatment options see Publications:

#7 Distillation Treatment of Drinking Water Systems
#10 Ion Exchange Treatment of Drinking Water Systems
#21 Reverse Osmosis Treatment of Drinking Water Systems

For more information please click on the following links:
EPA Office of Groundwater and Drinking Water
http://www.epa.gov/ogwdw/
EPA New England
http://www.epa.gov/region01/

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