



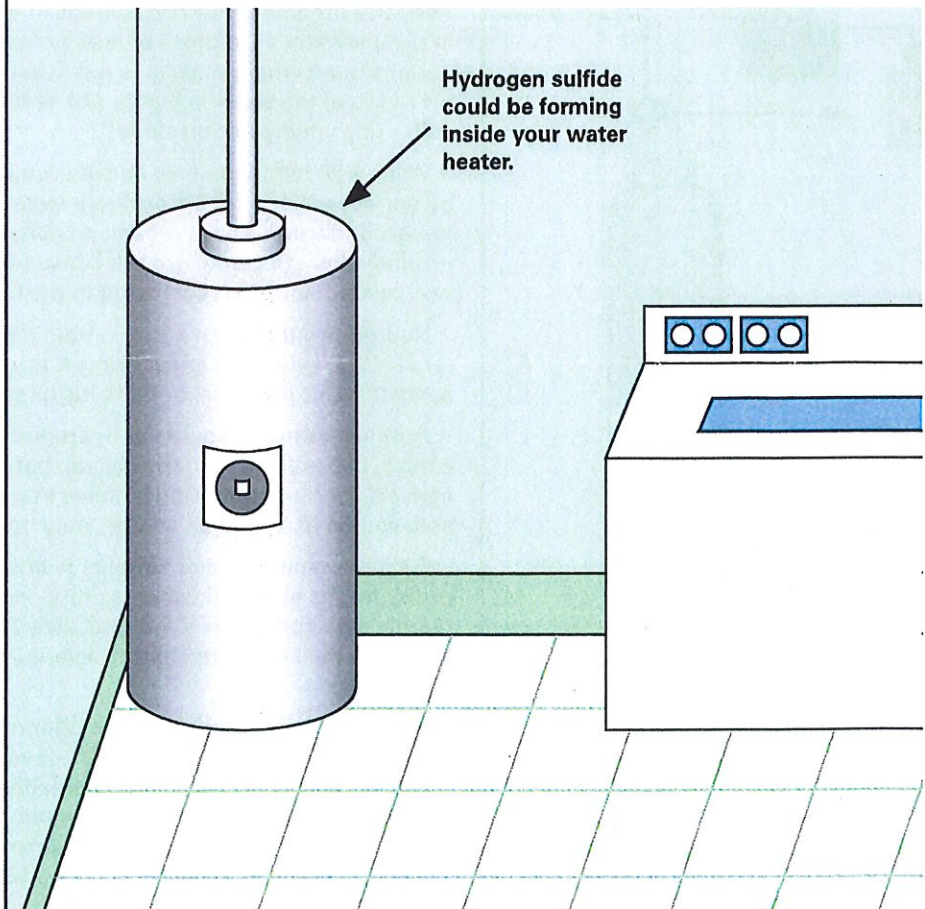
YOUR HOUSEHOLD WATER QUALITY: HYDROGEN SULFIDE AND SULFATE

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WHAT ARE HYDROGEN SULFIDE AND SULFATE?

- **Hydrogen sulfide, or hydrosulfuric acid (H_2S)**, is a gas that may occur in your household water. Common names include **stink gas** and **sewer gas**. Hydrogen sulfide is insoluble in water, but underground, this gas remains trapped within the water. When the water is pumped to the surface, the hydrogen sulfide gas escapes and is therefore easy to smell. Most people can smell hydrogen sulfide in water with a concentration of as little as **0.5 parts per million (ppm)**. Waters with concentrations from **0.5 to 1 ppm** smell "musty" or "swampy." Concentrations **greater than 1 ppm** smell like "rotten eggs" and are corrosive to 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.
- **Sulfate (SO_4)** in groundwater is dissolved from naturally occurring minerals contained in soils, aquifer rocks and sediments. It does not produce gas and is odorless.



ARE THERE ANY HEALTH RISKS FROM HYDROGEN SULFIDE AND SULFATE IN MY DRINKING WATER?

Drinking water with high levels of hydrogen sulfide can cause nausea and stomach pain. However, it is highly unlikely that a person could consume a harmful dose of hydrogen sulfide from drinking water because water becomes unpalatable due to its unpleasant taste and odor long before hydrogen sulfide reaches a harmful level. In well water, it is usually just a nuisance.

High levels of sulfate (above 250 ppm) may have a laxative effect, cause dehydration and be especially detrimental to the health of infants and young animals. Sulfate levels in excess of 250 parts per million require treatment of drinking water before use.

DOES THE EPA REGULATE HYDROGEN SULFIDE AND SULFATE IN DRINKING WATER?

Hydrogen sulfide is neither a primary contaminant nor a secondary contaminant in the Environmental Protection Agency's current drinking water standards. **Sulfate** is a secondary (nuisance) contaminant with a secondary MCL (Maximum Contaminant Level) of 250 ppm. Visit <http://water.epa.gov> for further details about drinking water standards.

WHY IS HYDROGEN SULFIDE IN MY WATER?

Hydrogen sulfide gas can occur naturally in groundwater in two ways:

- It may be produced by sulfur-reducing bacteria during the decomposition of organic matter in low-oxygen environments.
- It may be produced by chemical reduction of dissolved sulfate by sulfate-reducing bacteria in low-oxygen environments.

Both sulfur- and sulfate-reducing bacteria are harmless to human health. They use organic sulfur compounds in decaying plant materials and sulfate in groundwater as sources of energy for their growth. Both processes occur underground where oxygen is not available and water pH is less than 6.0. If the pH range of the water is higher (7.0-12.0), the water may contain other forms of sulfur (e.g., sulfide or bisulfide).

Wells with inadequate wellhead protection are susceptible to contamination by surface water after a storm/rain event that may carry organic materials into the groundwater. These organic materials serve as food for the bacteria in the groundwater. Bacterial growth consumes oxygen that eventually makes the well anaerobic, which can result in the formation of hydrogen sulfide.

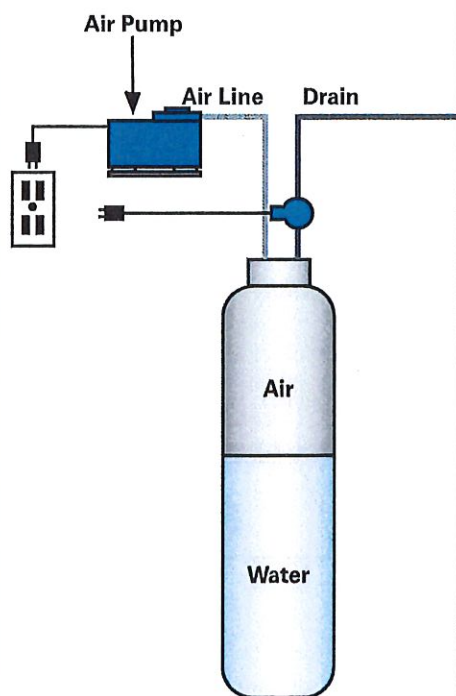
Hydrogen sulfide can occur in both deep and shallow wells and also can enter surface water through springs. It is often present in wells drilled in shale or sandstone, or near coal or oil fields or peat deposits.

Another common source of hydrogen sulfide is the magnesium corrosion control rod present in many electric hot water heaters, which can chemically convert naturally occurring sulfates in water to hydrogen sulfide. If this is the sole source of hydrogen sulfide, only hot water will have this odor.

An ion exchange water softener is another possible contributor to the odor problem. The softened water is more corrosive, increasing the rate at which the magnesium rod is dissolved. This dissolved magnesium provides an energy source to the sulfate-reducing bacteria, which may increase hydrogen sulfide production.

In rare cases, hydrogen sulfide odor may be from sewage pollution, particularly in poorly constructed or shallow wells located near leaky sewer lines or septic drainfields. Sewage contamination can also introduce coliform bacteria and other potentially hazardous contaminants, like nitrates, into your water supply. If sewage contamination is suspected, test your water for coliform bacteria and nitrate. In addition, you may want to conduct a test for the presence of detergent.

Example of an Aeration System



WHY SHOULD I BE CONCERNED ABOUT HYDROGEN SULFIDE AND SULFATE IN HOUSEHOLD WATER?

Hydrogen Sulfide

Hydrogen sulfide can be a nuisance in several ways besides unpleasant odor and taste problems.

- Hydrogen sulfide is extremely corrosive to iron, steel, copper and brass. It will quickly corrode even stainless steel. Wells constructed with steel casing and houses plumbed with copper pipes will have a shortened life.
- Hydrogen sulfide can also:
 - ✓ create a coal-black tarnish on silverware
 - ✓ discolor copper and brass utensils
 - ✓ cause yellow or black stains on laundry and bathroom fixtures
 - ✓ discolor beverages made with water containing it
 - ✓ alter the appearance and taste of cooked foods

High concentrations of hydrogen sulfide can adversely affect an ion exchange water softener. Occasionally, a water treatment system may impart the hydrogen sulfide smell to water when there was no smell detected beforehand. 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. These bacteria produce a black slime inside ion exchange units. Regular treatment system maintenance can help prevent this from becoming a problem.

Sulfate

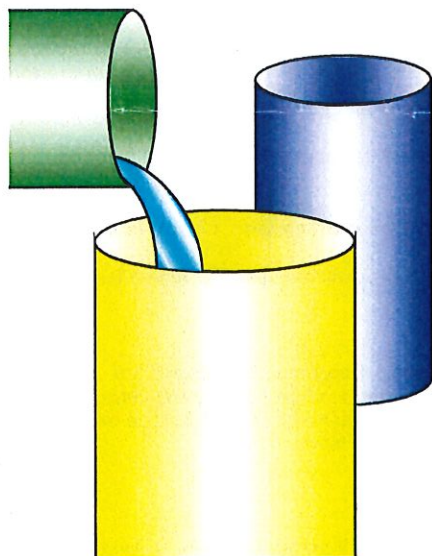
- Sulfate can add a bitter taste to water and have a laxative effect.
- Sulfate minerals can cause scale buildup in water pipes.
- Sulfate can make cleaning clothes difficult. Using chlorine bleach in sulfur water may reduce the cleaning power of detergents.
- Sulfur-oxidizing bacteria produce effects similar to those of iron bacteria. They convert sulfide into sulfate, producing a dark slime that can clog plumbing and/or stain clothing. Blackening of water or dark slime coating the inside of toilet tanks may indicate the presence of sulfur-oxidizing bacteria; however, sulfur-oxidizing bacteria are less common than sulfate-reducing bacteria.

CAN I HAVE MY WATER TESTED BY A LABORATORY FOR HYDROGEN SULFIDE AND SULFATE?

It is very difficult to test for hydrogen sulfide in a laboratory because the hydrogen sulfide escapes very quickly from water and may be gone by the time the water reaches the laboratory. The rotten egg smell of hydrogen sulfide is unmistakable, but test kits are available for on-site hydrogen sulfide measurement.

A laboratory test may be required to verify the level of hydrogen sulfide in your water in order to select an appropriate treatment method, but water samples collected to test for hydrogen sulfide must be stabilized immediately. Most laboratories will provide special sample bottles that contain a chemical for this purpose. However, the stabilizing chemical often interferes with other tests and a separate sample will be required if additional tests are requested. When collecting any water sample, carefully follow the laboratory's instructions for proper sample collection. In general, the delivery of a refrigerated sample is required within 48 hours of collection.

The presence of sulfate is easily determined in laboratory water tests. If you send your water to a laboratory for a test package that includes multiple tests, make sure that the test package you select includes sulfate.



For a list of state certified water testing laboratories, contact the Georgia Environmental Protection Division, Watershed Protection Branch, Drinking Water Program, **Compliance and Enforcement Unit** by phone at 404-656-5660 or visit their website at www.gaepd.org.

WHAT CAN BE DONE TO REMOVE HYDROGEN SULFIDE OR SULFATE FROM WELL WATER?

You can address hydrogen sulfide and sulfate problems in well water through the following ways:

- If the hydrogen sulfide gas is being produced by an active colony of sulfur-reducing bacteria, this must be determined and eliminated by shock chlorination.
- If you detect the smell of hydrogen sulfide only from the hot water faucet, your water heater may be causing the problem. In this case, the problem can be eliminated or minimized by replacing the magnesium rod with one made of aluminum or zinc, preferably by a licensed plumber. If water temperature is maintained above 150°F, use only an aluminum rod.
- You can install an appropriate treatment system.

Detailed guidance on the above three suggested actions is provided in University of Georgia Cooperative Extension Circular 858-15, "Your Household Water Quality: Removal of Hydrogen Sulfide and Sulfate," available at your local Extension office and online at <http://www.caes.uga.edu/publications>.

Sources:

Hydrogen Sulfide and Sulfate in Private Drinking Water Wells. Rhode Island Department of Health and University of Rhode Island Cooperative Extension.

Hydrogen Sulfide and Sulfate in Private Drinking Water Wells. The State of Connecticut Department of Public Health.

Hydrogen Sulfide in Drinking Water. New Hampshire Department of Environmental Services.

Hydrogen Sulfide in Drinking Water - Causes and Treatment Alternatives. Texas AgriLife Extension Service, The Texas A&M University System.

Hydrogen Sulfide in Household Drinking Water. Cornell Cooperative Extension, Cornell University.

Sulfate and Hydrogen Sulfide in Household Water. Virginia Cooperative Extension, Virginia Tech and Virginia State University.

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