Does your water smell like rotten eggs?

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If your water smells like rotten eggs, it may be contaminated with hydrogen sulfide (H_2S). Though H_2S contamination at the concentrations found in domestic drinking water supplies usually does not pose a health risk, it is still a nuisance and gives water a rotten egg smell and taste.

Sources of H_2S in Drinking Water

Sulfur-reducing bacteria (SRB) present in groundwater use sulfur as an energy source and chemically change sulfates to produce H_2S. These bacteria use the sulfur available from decaying plants, rocks, or soil. The SRB normally exist in oxygen-deficient environments, such as deep wells and plumbing systems. The SRB do not cause disease, but can impart a bad taste or odor.

Hydrogen sulfide gas may also be present naturally in groundwater. Though H_2S is normally found in wells, it can also enter surface water through springs and quickly escape into the atmosphere. Hydrogen sulfide is often present in wells drilled in shale or sandstone, near coal or peat deposits, or in oil fields.

Occasionally, a water heater can also become a source of foul H_2S odors. The magnesium rod used in heaters for corrosion control can chemically reduce sulfates to H_2S. Another source of H_2S is from sewage pollution.

Effects of Hydrogen Sulfide

In most cases, the rotten egg odor and taste is noticeable when the water is initially turned on or when hot water is turned on. Heat that forces this gas into the air makes the odor especially offensive in a shower.

Hydrogen sulfide can be corrosive to metals, such as iron, steel, copper, and brass. Hydrogen sulfide can cause yellow or black stains (metallic sulfides) on kitchen and bathroom fixtures. Hydrogen sulfide may discolor beverages prepared with contaminated water and affect the appearance and taste of cooked foods.

Hydrogen sulfide can affect water softeners, too, as they provide a favorable environment for SRB growth. High concentrations of dissolved H_2S can foul the resin bed of an ion exchange water softener. When an H_2S odor is observed in softened water, and no H_2S is detected in untreated water, it usually indicates the presence of SRB in the system.

What are the health effects?

Hydrogen sulfide can be toxic; however, the gas can be detected long before it reaches harmful concentrations. Hydrogen sulfide is flammable and poisonous. While such concentrations are not common, if gases are released in a confined area, they could cause nausea, illness, and in extreme cases, death.

Water with H_2S contamination alone may not cause disease. In some cases, however, sewage pollution may be the cause of H_2S odor, which can contain disease-producing contaminants. When sewage pollution is a suspected source of H_2S, immediately test the water for coliform bacteria.

How do I detect the presence of H_2S?

Hydrogen sulfide is one of a few water contaminants that human senses can detect even at low concentrations. Most people recognize the rotten egg odor.

Since H_2S is dissolved in water and can vaporize from it, samples must be analyzed at the source water site or stabilized before sending them to a laboratory. Several test kits available on the market cost approximately \$8 and only take a few minutes to use.

Unlike public water supplies that are regularly tested, domestic users and private water suppliers are responsible for testing water for contamination. If test results indicate bacterial contamination, shock chlorination (explained later) may be used to remove the bacteria.

Is H_2S regulated?

Hydrogen sulfide is not regulated because concentration levels high enough to be a drinking water health hazard make the water unpalatable. Most people can detect the odor of H_2S at levels as low as 0.5 parts per million (ppm). Concentrations less than 1 ppm give the water a musty odor. A 1-2 ppm hydrogen sulfide concentration gives water a rotten egg odor and makes the water very corrosive to plumbing. Generally, H_2S levels are less than 10 ppm but, occasionally, amounts up to 75 ppm have been found.

How can I treat contaminated water?

If H_2S is observed in a water supply, there are two basic options: a) obtain an alternate water supply, or b) use some type of treatment to remove the H_2S. It may be possible to repair an existing well. If that's not an option, try to obtain an alternate water supply either by drilling a new well in a different location or a deeper well into a different aquifer.

There are various methods for removing H_2S from water. The treatment method should be selected based on factors, such as the level of H_2S, the amount of water to be treated, the levels

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of iron and manganese, and bacterial contamination. Hydrogen sulfide may be reduced or removed by shock chlorination, water heater modification, activated carbon filtration, oxidizing filtration, or oxidizing chemical injection. Generally, the treatment for iron and manganese is the same as treatment for H_2S, which allows the removal of all three contaminants in one process.

Oxidation: Several methods can oxidize H_2S gas into sulfur and sulfates. Oxidation can be achieved by aeration, chlorination, ozone, and potassium permanganate. Using an oxidizing chemical can remove H_2S concentrations exceeding 6 ppm. There should be sufficient contact time (at least 20 minutes) between the chemical and water. Chlorine for example, quickly reacts with H_2S to form tasteless, odorless, yellow particles. A sand or aggregate filter can remove these yellow particles. Periodic filter backwashing is necessary to flush out the accumulated sulfur particles. The biggest drawback to an oxidation process is that all of the material that comes in contact with it is oxidized. For example, the process oxidizes iron to form corrosion and give water a rusty appearance. Hence, further treatment must be carried out to remove the rust.

Aeration: Oxygen in the air reacts with H_2S to form an odorless, dissolved sulfate. Some sulfur particles form after aeration. These sulfur particles should be filtered out.

Carbon Filtration: If H_2S is present in low levels, an activated carbon filter can be effective. The H_2S is adsorbed onto the surface of the carbon particles. The activated carbon filter must be replaced periodically to maintain performance. Frequency of replacement depends on daily water use and concentration of H_2S in the water. Moderate to high levels of H_2S in water will require very frequent filter replacement.

Manganese greensand filtration: It can be used when the water contains concentrations less than 5 ppm of H_2S. In this process, manganese oxide oxidizes the H_2S to sulfur, which is filtered. The bed should be regenerated once the manganese oxide is exhausted. The higher the H_2S concentration, the higher the production of sulfur, and the more frequently the bed should be regenerated.

Oxidizing filter: H_2S concentrations up to about 6 ppm can be removed using an oxidizing filter. This filter contains sand with a manganese dioxide coating that changes H_2S gas to tiny particles of sulfur that are trapped inside the filter. Periodic backflushing of the filter keeps it clean and maintains performance.

Ion exchange: The most common method of treating large quantities of water contaminated with H_2S is ion exchange. Ion-exchange resin adsorbs H_2S until the resin is exhausted with H_2S. Then the resin should be regenerated with a salt, such as sodium chloride, before further treatment can occur.

Water heater modification: If H_2S odor is associated primarily with the hot water system, modifying the hot water heater may reduce the odor. Replacing the water heater's magnesium corrosion control rod with one made of aluminum or other metal may improve the situation.

Shock chlorination: If sulfur-reducing bacteria are present, shock chlorinate the source water. Shock chlorination may reduce, but does not eliminate the H_2S-producing bacteria. Shock chlorination involves mixing a sufficient amount of a chlorine-based chemical with the well water to create a solution containing 200 ppm of chlorine throughout the entire system. The chlorinated water is drawn into all parts of the plumbing system and is left in the system for several hours and then flushed out. After the chlorination process is complete, the entire system must be emptied of chlorine and thoroughly flushed with fresh water. Proper precautions should be taken while handling chlorine, and the chlorine water used to flush the system should be properly disposed of.

Though most shock chlorination applications are successful, make certain there are no remaining bacteria before drinking the water. If the water supply continues to develop bacterial contamination problems even after being shock chlorinated, continuous chlorination should be carried out.

For additional information about shock chlorination, contact the National Drinking Water Clearinghouse at (800) 624-8301 or (304) 293-4191.

If you have any questions or comments for the NDWC's technical assistants, please call 800-624-8301. Or e-mail them at:

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References:

1) Drinking Water: Sulfates and hydrogen sulfide. http://ianrwww.unl.edu/pubs/water/g1275.htm
2) Hydrogen sulfide in drinking water. http://www.purewater4u.com/freeinfo/h2s.htm
3) McCain, W.F., R.L. Johnson, and B.H. O'Keefe. 1999. "Snuffing out H_2S in water and air," *Opflow*, Denver: American Water Works Association.
4) Wagnet, L. and A. Lemley. 1989. "Hydrogen sulfide in household water," Cornell Cooperative Extension, New York State College of Human Ecology
5) Bakies, E. February 1997. "Hydrogen sulfide, considered moving target by water improvement dealers," *Water Conditioning and Purification.*
6) Carrell, R. and L. Henke. May1997. "Treating your customer's rotten egg water," *Water Conditioning and Purification.*
7) McClure, A. 1999. "Hydrogen Sulfide removal with catalytic carbon," *Water Conditioning and Purification.*
8) Lyn, T.L. and J.S.Taylor 1992. "Assessing sulfur turbidity formation following chlorination of hydrogen sulfide in groundwater," Denver: American Water Works Association