

Aggravating the problem. Many household activities can aggravate the problem: infrequent use of hot water, such as with vacation homes or being away for a weekend, or the use of iron plumbing, which is more likely to corrode than copper or PVC. A water softener reduces CaCO_3 levels, reducing protection from corrosion.

REMEDIES

Replace the magnesium anode.

Magnesium is commonly used for cathodic protection anodes because it provides much corrosion protection at the least cost. However, this level of protection is often not needed. Consult a reputable dealer of water heaters for a replacement anode that provides protection without supporting the sulfate-reduction reaction that causes the H_2S gas.

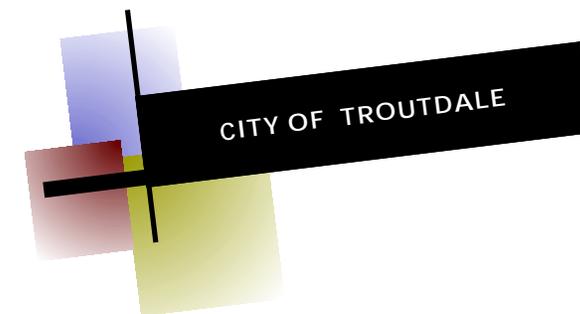


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PHEW! MY HOT WATER SMELLS LIKE ROTTEN EGGS

Taste and odor problems can affect hot or cold water, but hot water problems usually bring complaints of smells like rotten eggs.

The rotten egg odor is caused by hydrogen sulfide (H₂S) gas. The odor is repulsive, but the gas is not usually harmful at the low concentrations that occur in a household water system. This is not a problem of health but aesthetics. It is unpleasant to take a shower, wash clothes, or cook with water that smells like decay.

CHEMICAL CAUSES

Rotten-egg results from a chemical process that involves three primary components:

- sulfur (S)
- electrons, and
- bacteria.

Sulfur. Sulfur often appears in water as sulfate ions (SO₄⁼), which are quite stable. However, sulfate can convert to sulfides (S⁼) and hydrogen sulfide gas by the gain of eight electrons (negative charges). The gain of negative charges is called a reduction reaction.

Electrons. The sulfate-reduction reaction requires energy. Electrons are the energy source.

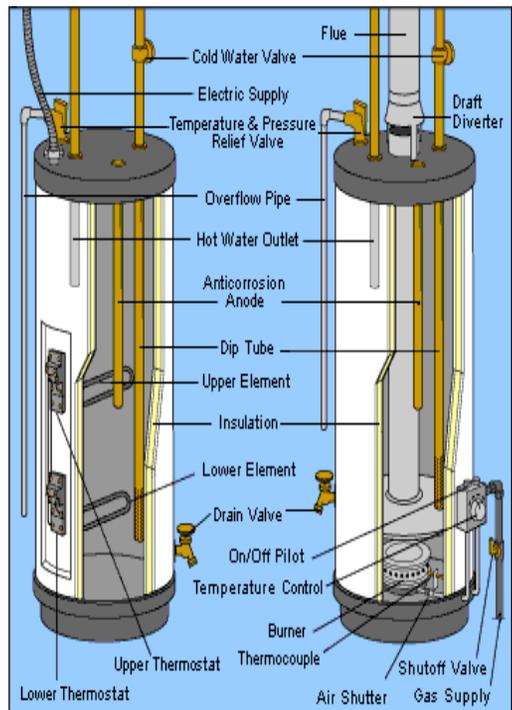
Excess electrons may occur in water as the result of the decay of organic matter or the corrosion of metals.

Sulfate may convert to the less stable sulfur form of sulfide in the presence of excess electrons, but this conversion is not entered into easily.

A catalyst is required to speed up the reaction if it is to take place at a rate sufficient to cause the nuisance odor.

Bacteria. The nonpathogenic, sulfate-reducing bacterium, *Desulfovibrio desulfuricans*, produces enzymes that have the power to accelerate the sulfate-reduction reaction.

However, the sulfate-reducing bacteria lack the ability to reduce the sulfates to sulfides without



the external energy source provided by the excess free electrons.

All three components of the reaction: the sulfates, the sulfate-reducing bacteria, and the excess electrons must be present for hydrogen sulfide to be produced. The rate of the H₂S gas production is determined by how active each component is.

Time. An influencing factor is the length of time that the water is in contact with the reaction. Even at a very low reaction rate, the H₂S may build in concentration to objectionable levels given enough time. If you can substantially reduce any one of the four factors, you can control the odor problem.

H₂S in Water Heaters

Water heater tanks can provide an ideal environment for the production of hydrogen sulfide gas. Modern steel water heaters are glass-lined to prevent corrosion. However, it is impossible to assure 100 percent coverage, especially since cracks may occur while the tank is in service.

Anode prevents corrosion. To protect steel exposed by small cracks in the glass coating, a long rod, or anode is used to provide cathodic protection. The rod is usually made of magnesium which corrodes more easily than steel. This corrosion frees many electrons that provide a protective film over the cracks in the glass. The steel will not corrode as long as the magnesium anode remains in the tank.

The number of electrons liberated by the corrosion of the magnesium anode may greatly exceed the amount required to protect the exposed steel of the water heater tank. The excess electrons provide the energy needed by the sulfate-reducing bacteria to produce H₂S gas.

Conditions are right. The sulfate-reducing bacteria thrive in the temperature range of most water heaters. In addition, the water heater tank provides for an extended contact time. Where there are many free electrons due to the corrosion of the anode, the hot water heater can be a major contributor to the rotten egg odor problems. If the odor is not detected at the cold water tap, the water heater is probably to blame for odor problems.