



Hydrogen Sulfide in Hot Water Heaters

Periodically I receive calls from water system operators that their systems have customers who complained of foul-smelling, bad tasting water in their homes. The customers' assumption is that the problem is caused by the public water supply system. However, many times I have found that the problem in the water is hydrogen sulfide that is being created in the customers' water heater tank.

H₂S, taste and odor, and bacteria

Hydrogen sulfide (H₂S) has the smell of rotten eggs and is one of the few water contaminants a person can detect in small amounts by taste and smell. Odors can be detected as low as 0.5 parts per million (ppm). At 1.0 ppm and greater, the water will have an odor of rotten eggs and a musty or metallic taste. Research suggests 10 ppm and above is not common and is very rare. Most people will find any smell or taste of hydrogen sulfide offensive and will find something else to drink other than that water.

Sulfate-reducing bacteria known as *Desulfovibrio* is the cause of the hydrogen sulfide in the water. These bacteria cover many species that grow in the presence of oxygen but prefer no oxygen. These bacteria are non-pathogenic and can naturally occur in groundwater and surface water. *Desulfovibrio* bacteria thrive on sulfate

in the water. The sulfate is from geological formations and from decaying plants. Sulfate naturally occurs in rocks and soil.

The activity of this bacteria is most common to potable water from wells, plumbing systems associated with hot

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water heaters, boilers, and dead-end mains or anywhere the water oxygen levels are low in the water supply and especially if the water has a high sulfate level. I have also encountered this problem with many shallow, alluvial wells. Some of the well maintenance cleaning treatments that I have helped water systems conduct were to get rid of or control *Desulfovibrio* bacteria.

The complaints about odorous water usually originate from one or two households. The locations are often not close to each other on the public water supply distribution system. The taste and odor issues are usually from the

hot water side of the household plumbing and not the cold water side. Some hydrogen sulfide can sometimes be detected in the cold side especially when heated on the stove or in a microwave.

Household water heaters

There are locations where the high levels of sulfate in the water provide the conditions where *Desulfovibrio* bacteria can create hydrogen sulfide on the household hot water side and possibly on the cold water side too. It is more evident on the hot water side in the water heater tank because of the bacteria grow better in warmer water temperatures. The ideal temperatures for growth are 77° F to 104° F. The bacteria die off at the temperature of 140° F.

I've recommended that many homeowners change the anode in their water heater. And, depending on the degree of the problem, it may also be advisable to disinfect the water heater using 3% hydrogen peroxide, as it is safe versus adding an extremely high chlorine solution to the hot water heater. Also, raising the temperature of the water heater setting higher than the 140° F for several hours should kill the bacteria. Regardless, the hot water heater should be drained and flushed if such treatment is conducted.

Graphic: The graphic above shows biofilm of sulfate-reducing, anaerobic bacteria *Desulfovibrio desulfuricans* grown on a hematite surface. The photo is a color-enhanced digital micrograph of a black and white scanning electron microscope (SEM) image. Graphic used courtesy of Pacific Northwest National Laboratory.

Water system operations

I have encountered another anomaly in regards to *Desulfovibrio* bacteria. It is that over chlorination can cause additional customer complaints. Sometimes operators might believe that increasing the chlorination from e.g., 0.5 mg/L free residual to say 3.0 mg/L the day before bacteriological samples needed to be collected will mix the higher residuals into the existing water.

I know that one operator did this routinely with the hope of having less possibility of failed bacteriological monitoring. In several cases, the high dosage was allowed to continue. Soon, the operator was dealing with complaints of strong chlorine odor in the water. In one instance, a 4.0 mg/L free residual was recorded in the distribution system. I advised to reduce the dosage and so it was turned back to 1.5 mg/L free residual at the wells.

A few days later the system started to receive complaints of bad tasting water and very dirty water at some households. Such problems had never before been experienced. All the complaints were from households that had hot water heaters more than two years old. As stated earlier, *Desulfovibrio* bacteria can live in the water heater tanks. In this case of the homeowners, the high dosage of chlorine likely broke down the bacteria in the hot water heaters creating the sudden complaints of foul smelling, turbid water.

The problem was minimized after the water with lower chlorine residuals was supplied to the homes and the bad water had been flushed out. Maintaining good free chlorine residual at all times prohibits or lessens the chances of bacteria growing in hot water tanks.

Private, rural household systems

In recently visiting with a plumber, he mentioned he has encountered the same problem on private or rural households. He stated that it could be corrected temporarily by shutting off the hot water heater and then draining

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or flushing it with a dose of sodium hypochlorite. However, the problem frequently returns. I suggested that the private well and or cistern should have the same chlorination treatment because that is where the bacteria likely originate and the reason the problem returns.

Attend this conference session

I want to remind readers that a presentation on the topic of water wells and maintenance of water will be given at the 2015 KRWA conference. It is a five-hour session on Tuesday, March 24. The title of the workshop is

“Geology, Aquifers, and Water Wells – Ensuring a Good Water Supply”. Presenters are Ned Marks of Terrane Resources, Mike Schnieders, Water Systems Engineering and Brad Vincent, Ground Water Associates. That session will discuss bacteria growth in water wells. This is the same bacteria that can be present in water heater tanks. When in wells, this bacteria with iron reducing bacteria can reduce water production of wells and can cause increased chlorine demand, and also create bad-tasting water. I encourage systems with water wells to attend that session and as many of the other sessions as possible.

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