Dissolved Gasses in Private Water Wells

Dissolved gases in well water are a common occurrence; the major gases found in wells are methane, carbon dioxide, nitrogen and hydrogen sulfide.

Hydrogen Sulfide

Hydrogen sulfide corrodes piping, creates odors in the house and turns water black. Homemakers will notice that it can change sterling silver to black almost instantly. H_2S can cause odor problems at a concentration level as low as 0.05 mg/L in well water.

Hydrogen sulfide often occurs naturally in well water, or it can be caused by the presence of sulfate-reducing bacteria in a well or water system. Since bacteria are the most common cause, treatment to control them should be tried first. Shock chlorination is the standard treatment for control of sulfate reducing and iron bacteria in a well. These bacteria also cause “biofouling” problems in water wells. Biofouling problems are related to the slimy bacterial deposits that build up in water wells. These slime deposits plug the intake areas of water wells, which reduces well capacity, as well as reducing water quality. Badly biofouled wells need to be professionally cleaned by a well driller. Simple shock chlorination by the well owner may not yield satisfactory results.

Hydrogen Sulfide in Water Heaters

Sometimes, hydrogen sulfide may only be present in the household hot water. This condition is caused by a biochemical reaction between sulfate in the water, sulfate-reducing bacteria and a magnesium rod in the hot water heater or organic matter in the water.

If the odor problem in the water heater is caused by heat-loving sulfate-reducing bacteria, disinfect the water heater with chlorine bleach or hydrogen peroxide.

Sometimes, the reaction with the magnesium rod is the cause of the odor problem. The purpose of the magnesium rod is to prevent corrosion of the water heater. Removing the magnesium rod will often prevent the odor problem but will void the warranty and lead to the possible earlier deterioration of the tank. If corrosion is a concern, the magnesium rod can be replaced with a zinc or aluminum rod to reduce the odor problem.

Water Treatment Options for Removing Hydrogen Sulfide

Water treatment systems that are effective commonly involve three basic steps:

- Changing the form of dissolved hydrogen sulfide in water into a solid using a chemical process
- Storing water in a tank or length of piping to allow sufficient time for the above change to happen
- Filtering the water to collect any particles formed by the process

Chlorination and Filtration

One method to remove hydrogen sulfide is to install a chlorine feeder and a filter. The hydrogen sulfide is oxidized by the chlorine, and any insoluble sulfide particles that form are removed by a filter.

Approximately 2 mg/L chlorine must be added to remove 1 mg/L of hydrogen sulfide. The most common system is to install a chlorine feeder and a full-size activated-carbon filter. The chlorine oxidizes the hydrogen sulfide and the activated-carbon filter removes the insoluble sulfide particles. This filter also removes any residual chlorine left after the oxidization of the hydrogen sulfide. This system is most appropriate in situations where there is only hydrogen sulfide is present and no significant amount of iron.

If the water also contains a significant amount of iron it is best to have a large sediment filter in front of the carbon filter. The iron should be filtered out before the water enters the carbon filter, which will extend the service life of the activated carbon.

It is important to have enough water flow capacity to backwash the filters. A typical 10-inch diameter filter will require at least 5 gallons per minute to properly backwash.

The chlorinator is wired to the pressure switch so that the chlorinator is activated when the water pump switches on. The retention tank is installed to ensure sufficient mixing and contact time to complete the oxidation process. The tank should be large enough to retain the water for at least 5 minutes at peak filter capacity (as a minimum, a 42-gallon retention tank is recommended). If iron is in the water, the retention time should be increased to about 20 minutes. A valve should be provided at the bottom of the retention tank to drain any sediment.

Chlorine test valves should be installed just after the pressure tank and just before the activated carbon filter. These valves are needed to help check the chlorine level in the treatment system and to make adjustments to the chlorine feeder.

Manganese Greensand Iron Filter

A properly maintained manganese greensand filter will effectively remove low levels of hydrogen sulfate, typically less than 2 mg/L. This type of filter oxidizes the hydrogen sulfate and filters out the resulting sulfide particles. It is very important that these filters have an adequate supply of water for backwash and are adequately regenerated with potassium permanganate.

Hydrogen sulfide requires three times the oxidizing power that iron does, so the greensand filter must be regenerated more often than it would for an equal amount of iron. Manganese stripping, from the manganese greensand, can also occur. This stripped manganese can cause black staining.

Aeration

Aeration is another option and is accomplished by spraying water into a ventilated storage tank. The hydrogen sulfide gas is separated from the water as it is sprayed and drawn off as a gas by a ventilation system. Aeration will remove most of the hydrogen sulfide, but chlorination may still be necessary. Some sulfide odors will remain if the water has a high pH. The lower the pH, the better this system will work. A second pressure system is required to pump the water from the storage tank into the distribution system.

Although not intended for the job, some aeration-type (chemical-free) iron filters have been used to successfully remove small amounts of hydrogen sulfate. There must be a much higher level of iron than hydrogen sulfate in the water for this approach to work successfully.

Alternative systems

Other oxidizing agents besides chlorine can be added to the water to oxidize hydrogen sulfate. These systems include hydrogen peroxide, potassium permanganate and ozone. Filtration of iron sulfate and iron oxide by-products will still be required after any of these agents have been added.

Methane and Carbon Dioxide

Common problems with methane and carbon dioxide are "spurting" taps and priming problems (gas locking) in pumps. The gas problem varies in severity - from occasional "spurting" from the hot water taps to a constant flow of gas from the well casing.

Methane, carbon dioxide and nitrogen are all odorless gases. **Exercise caution if the water contains methane. Methane will burn, can be explosive and must be vented to the outside**. Carbon dioxide and nitrogen should also be vented to the outside because these are asphyxiates and can cause death by suffocation. Carbon dioxide is heavier than air and can accumulate in low, enclosed spaces, such as wells or pump pits. Well pits are no longer legal in Ohio, but many old pits still exist.

The ability of water to hold gases varies with temperature and pressure. As water temperature increases, the amount of gas released increases. Gas "spurting" will often be worse from the hot water taps than the cold. Gas will escape from water more readily if left in an open tank than if it is contained in a pressure system or underground in an aquifer.

One method for detecting gases is to fill a glass with water from the tap. The water may appear milky-looking, with fine bubbles emanating from the bottom to the top. If the water clears from the bottom to the top as these bubbles rise, dissolved gases are present.

Air Volume Controls

A gas problem should not be confused with an improperly operating air volume control. Some older pressure systems are designed to add air to the pressure tank whenever the pump is operating. This type of system requires a deep well air volume control to release excess air from the pressure tank. If this control is not working, or is not installed, the pressure tank will become overcharged with air. This is a common cause of "spurting" taps.

Venting the Well Casing

If gas is present in the well, vent the casing to prevent gas from accumulating. If a pitless adaptor is used as the well connection, there is normally no ventilation problem because most pitless adaptors have ventilated caps. If the well connection is in a pit, pump house or house basement, the well casing must be vented to the outside. This venting can be done by installing a sanitary well seal with a vent pipe leading to the outside. To solve the problem in a pit, install a pitless adaptor, extend the casing above the ground surface, and backfill the pit where practical.

Pumping Problems

Severe gas problems may cause the gas locking (loss of prime) of submersible and jet pumps. Gas locking can sometimes be remedied by modifying the pump in consultation with representatives of pump companies, water well drillers or an agricultural water specialist.

When groundwater contains significant amounts of methane gas, it sometimes causes gas-locking problems in submersible water pumps. In a typical gas-lock situation, the pump will be operating normally, and then quit pumping for no apparent reason, but the pump keeps running. Gas bubbles collect in the impellers of the pump and prevent water from moving through the pump. If the pump is shut off for a while and then re-started, it will usually start pumping water again. In the past, solutions to this problem included:

1. Drilling holes in the submersible pump impellers to release the air bubbles
2. Moving the pump check valve from the top of the pump to 5 or 10 feet above the pump
3. Installing a shroud around the pump to divert gas bubbles past the pump intake

These solutions have had less than a 50 percent success rate. However, a fourth method has proven to work well in many situations. It involves diverting some of the water back down the water well, while the remaining water is pumped to the pressure tank.