

Revised 11/03

Iron and Iron Bacteria in Water

Edstrom Industries
www.edstrom.com
819 Bakke Ave.
Waterford, Wisconsin 53185

4230-MI4146

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Edstrom Industries, Inc.
819 Bakke Avenue
Waterford, WI 53185-5913
(262) 534-5181
(800) 558-5913
(262) 534-5184 – FAX

Iron is one of the most common elements found in nature, accounting for at least 5% of the earth's crust. Nearly all water supplies contain some measurable amount of iron. Iron can stain and contaminate anything it contacts. The stains are usually yellowish- to reddish-brown, but they may be gray to black in the presence of some organics. Iron may also cause undesirable odors and tastes in water.

Occasionally, iron- or rust-colored deposits may appear in automated watering systems. Iron may be in the incoming water supply or result from the corrosion of steel piping components. This document explains the different types of iron seen in drinking water systems, including iron bacteria, and describes methods for water treatment and iron prevention. If you have any questions or concerns about water quality, contact Edstrom Industries at 800-558-5913.

Forms of Iron in Water

Iron occurs in many forms in water supplies. The most common forms are described below.

Dissolved iron

Dissolved or ferrous iron is usually found only in groundwater supplies that have not been exposed to oxygen. Water containing ferrous iron is clear and colorless. Upon contact with the air, oxygen is absorbed and reacts with the dissolved iron to form insoluble ferric oxide, also known as iron oxide or "red rust".

Undissolved iron

Insoluble ferric oxide is visible as a solid precipitate in water. It can color the water yellow to reddish-brown. It is usually formed from the oxidation of dissolved iron by exposure to oxygen or to other oxidants such as chlorine or ozone. If rust-colored stains are observed inside the components of an automated watering system on a chlorinated water supply, the stains are probably ferric oxide.

Iron bacteria

There are several non-disease-producing bacteria that grow and multiply in water and use dissolved iron as part of their metabolism. They oxidize iron into its insoluble ferric state and deposit it in the slimy gelatinous material that surrounds their cells. These filamentous bacteria grow in stringy clumps and are found in most iron-bearing surface waters. They have been known to proliferate in waters containing iron as low as 0.1 mg/l. In order to function, these aerobic bacteria need at least 0.3 ppm of dissolved oxygen in the water.

Iron bacteria do not cause health problems in people, but they may have the following unpleasant and possibly expensive effects:

- Unpleasant odors and taste following the death of the bacteria
- Increased organic content in water favoring the multiplication of other bacteria
- Piping clogged with rusty sludge
- Corroded piping and plumbing equipment
- Increased chances of sulfur bacteria infestation

Iron bacteria can build up in low-flow areas of an automated watering system, such as the quick disconnect fittings of recoil hoses that are not regularly flushed. Iron bacteria will appear as a thick, rust-colored sludge or slime. If the iron bacteria build-up becomes thick enough, anaerobic conditions may develop at the wall of the fitting or pipe, which can cause corrosion of stainless steel or growth of sulfate-reducing bacteria.

Organic iron

Organic iron is iron combined with organic matter, sometimes called tannins or lignins, and can stain water to give it the appearance of weak tea or coffee. Organic iron is picked up as groundwater passes through decaying or decayed vegetation. Such water is usually found in shallow wells or surface waters. Iron may be wholly or partially combined with the organic matter.

Standards and Occurrence

The USEPA (US Environmental Protection Agency) did not include iron in the National Primary (health-related) Drinking Water Regulations, but they did set a Secondary Regulation limit of 0.3 mg/l based on aesthetic and taste considerations. The objection to iron in water is not due to health reasons but to its appearance and the staining of plumbing fixtures. Taste and odor problems may also be caused by iron bacteria.

Surface water supplies usually have concentrations below the standard level (0.05 to 0.20 mg/l), although higher levels may be present due to corrosion of pipes. Higher iron levels (1.0 to 10 mg/l) are most common in ground water supplies.

Prevention and Treatment

Chemical treatment

Dissolved iron can be removed by oxidizing the iron into the insoluble form and then filtering out the precipitated solids. Iron in water can be oxidized by aeration, by filtration using an oxidizing media, or by addition of a chemical oxidizing agent such as chlorine bleach, hydrogen peroxide, or ozone.

Chlorination followed by filtration is one treatment method that can be easily used in an automated watering system. Water can be chlorinated using equipment such as the Edstrom Industries Central Proportioner. A retention tank may be needed to allow enough time for complete oxidation before the precipitated iron is removed by filtration.

An additional benefit of continuous chlorination is that the water will be disinfected, which can prevent the build-up of iron bacteria.

Flushing

Periodic flushing of low-flow lines and eliminating dead-end lengths of piping will help reduce bacteria, including iron bacteria. Flushing room distribution piping and rack manifolds will also help prevent bacteria build-up.

Cleaning iron stains

Components of an automated watering system that have been stained by iron in water can be cleaned by soaking the parts in a solution of sodium meta-bisulfite (available in commercial products like "Iron Out" and "Rust Out") and water. Follow the recommended instructions for cleaning plumbing fixtures. This cleaning method can also be used on the outside surfaces of stainless steel quick disconnects and piping that has become rusted due to the chemical cleaners used to sanitize animal rooms. The bisulfite solution will react with the iron oxide so it dissolves.

Related Water Problems

Manganese

Manganese is rarely found in a water source alone, but it is generally found in conjunction with dissolved iron. Concentrations as low as 0.1 mg/l are considered troublesome. Deposits of manganese will collect in plumbing systems. Tap water containing manganese will contain a black sediment and blackish turbidity. Manganese bacteria will often be present and, like iron bacteria, cause clogging of piping and fittings.

Manganese reduction and removal is commonly accomplished by the same techniques applied to iron removal. Like iron, there is no health-related standard for manganese in drinking water. The USEPA set a recommended limit of 0.05 mg/l for aesthetic reasons (taste, discoloration, and staining of laundry and plumbing).

Hydrogen sulfide

Hydrogen sulfide (H₂S) is a gas that gives water a rotten egg taste and odor. Sulfur is a common element that occurs naturally in many ground water supplies, especially those that also contain iron. Besides its offensive odor, hydrogen sulfide is highly corrosive and can eat away at metal piping and plumbing connections.

Sulfate-reducing bacteria (SRBs) are another source of hydrogen sulfide in water. These bacteria live where there is little or no oxygen and convert sulfate and other sulfur compounds into hydrogen sulfide. SRBs are often found inside thick, iron bacteria incrustations.

Like dissolved iron and manganese, hydrogen sulfide in water supplies can also be treated for removal by chemical oxidizing agents like chlorine. Like iron bacteria, SRBs can be controlled by chlorination, periodic flushing, and eliminating any dead-end lengths of piping.

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