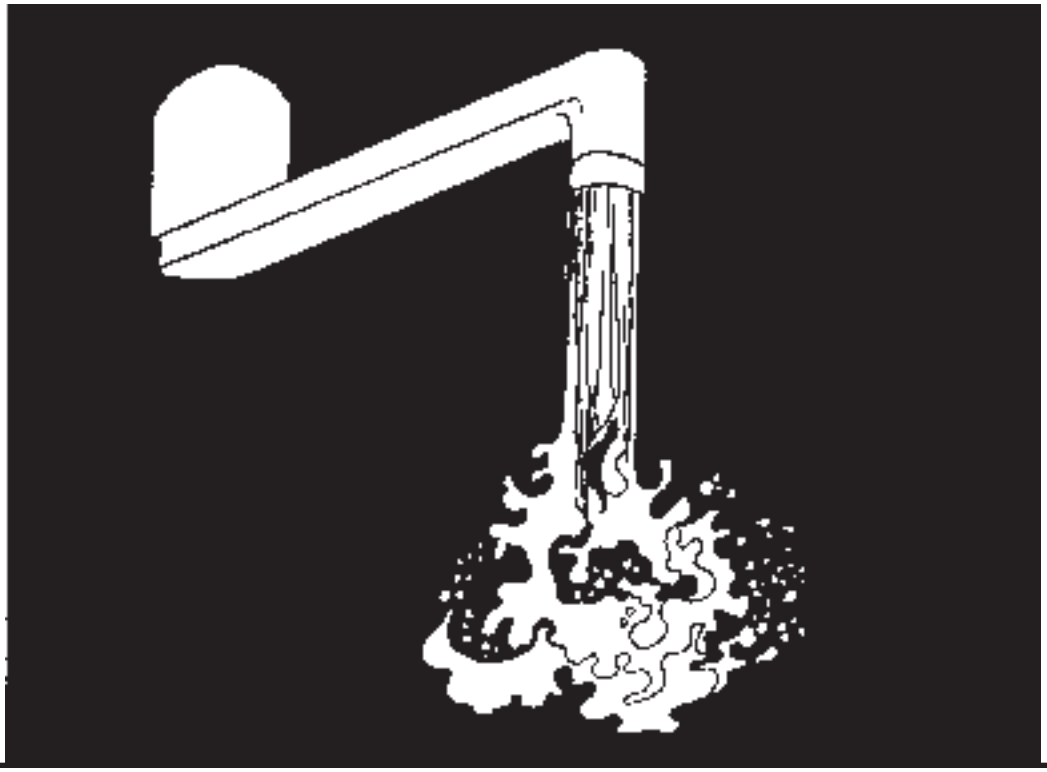
IRON

in Drinking Water



Bureau of Drinking Water & Groundwater • Wisconsin Department of Natural Resources • PUB-DG-035 2001

Iron in Drinking Water

Introduction

Iron is one of the earth's most plentiful resources, making up at least five percent of the earth's crust. When rainfall seeps through the soil, the iron in the earth's surface dissolves, causing it to go into almost every natural water supply, including well water. Although iron is present in our water, it is seldom found at concentrations greater than 10 milligrams per liter (mg/l) or parts per million (ppm).

Health and Water Quality

Iron is not considered hazardous to health. In fact, iron is essential for good health because it transports oxygen in your blood. In the United States, most tap water probably supplies less than 5 percent of the dietary requirement for iron.

Under Department of Natural Resources (DNR) rules, iron is considered a secondary or "aesthetic" contaminant. The present recommended limit for iron in water, 0.3 mg/l (ppm), is based on taste and appearance rather than on any detrimental health effect. Private water supplies are not subject to the rules, but the guidelines can be used to evaluate water quality.

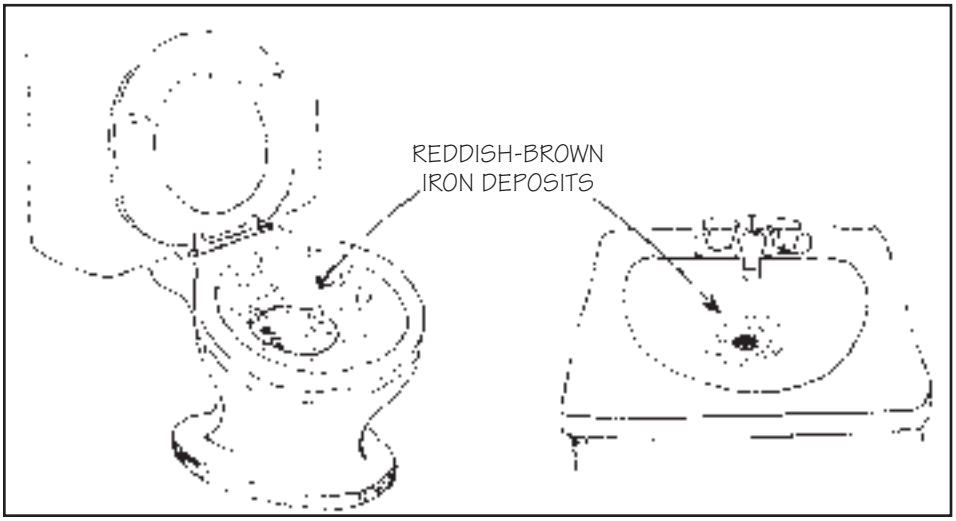
For instance, when the level of iron in water exceeds the 0.3 mg/l limit, we experience red, brown, or yellow staining of laundry, glassware, dishes, and household fixtures such as bathtubs and sinks. The water may also have a metallic taste and an offensive odor. Water system piping and fixtures can also become restricted or clogged.

Types of Iron

Iron is generally divided into two main categories: 1) **soluble** and 2) **insoluble**. Soluble iron, or "clear water" iron, is the most common form and the one that creates the most complaints by water users . This type of iron is identified after you've poured a glass of cold clear water. If allowed to stand for a few minutes, reddish brown particles will appear in the glass and eventually settle to the bottom.

When insoluble iron, or "red water"iron is poured into a glass, it appears rusty or has a red or yellow color. Although not very common in Wisconsin's water wells, insoluble iron can create serious taste and appearance problems for the water user.

Because iron combines with different naturally occurring acids, it may also exist as an organic complex. A combination of acid and iron, or **organic iron,** can be found in shallow wells and surface water. Although this kind of iron can be colorless, it is usually yellow or brown.



Finally, when iron exists along with certain kinds of bacteria, problems can become even worse. The bacteria consume iron to survive and leave a reddish brown or yellow slime that can clog plumbing and cause an offensive odor. You may notice this slime or sludge in your toilet tank when you remove the lid. For more information on iron bacteria, contact your DNR Regional Office and ask for the DNR publication, "Iron Bacteria Problems in Wells."

Once you determine whether you have "clear water," "red water," "organic" or "bacterial" iron in your water, you can take steps to correct the problem. Keep in mind that no one treatment method will work for every type of iron problem.

Test Your Water

Before you attempt to remove anything that appears to be iron-related, it is important to have your water tested. A complete water test to determine the extent of your iron problem and possible treatment solutions should include tests for iron concentration, iron bacteria, pH, alkalinity, and hardness.

If you receive your water from a public water system and experience red water problems, it is important to contact a utility official to determine whether the red water is from the public system or your home's plumbing or piping.

Well Construction/ Reconstruction

High iron levels may be avoided in some cases by changing the screen or casing depth interval of the well as long as the minimum casing depth requirements are still met. Talking to your neighbors about their well depths and iron levels will give you some idea of what well depth would pump the lowest amount of iron. It is also helpful to talk to a well driller or

pump installer about local conditions and the cost of drilling a new well in your area. The cost of well work should be compared to the long term (perhaps twenty years) cost of treating the water for any iron related problems.

Treatment

Table 1 lists treatment considerations for the various forms of iron. For additional information on water treatment systems, contact your County Extension Office or Extension Publications, Rm. 245, 30 N. Murray Street, Madison, WI 53715 and ask for publication G3558-5, "Choosing a Water Treatment Device."

When choosing a water treatment method or device, make sure you have answers to the following five questions:

1. What form of iron do I have in my water system?
2. Will the water treatment unit remove the total iron concentration (determined by the water test) in my water supply? (Total iron refers to both soluble and insoluble iron combined).
3. Will the treatment unit treat the water at the flow rate required for my water system?
4. Considering the results of my water test, will this method effectively remove iron? (For example, pH may need to be adjusted before beginning a particular treatment).
5. Would well construction or reconstruction be more cost effective than a long term iron removal treatment process?

Table 1: Treatment considerations for various forms of Iron.

Characteristic	Known As	Treatment Methods	Considerations
Drawn tap water is clear and colorless. When allowed to stand, reddish brown particles appear and settle to bottom.	Soluble Clear Water Fe+2 Ferrous Dissolved	Aeration/Filtration	May require lengthy contact time. Temperature dependent.
		Water softener	Hardness must be calculated. System must be airtight. All water must be treated.
		Chlorination/Filtration	Chlorine liquid or pellets. Frequent monitoring. Proper water pressure.
		Manganese greensand/ Filtration	Adequate pressure.
		Catalytic filtration "BIRM"	Dissolved oxygen, organic matter, chlorination, polyphosphate, temperature limitations.
		Ozonation	Used by some municipal systems. Expense.
		Sequestering	May not prevent staining. May need to remove sequestering agents and iron. Test for agents before choosing another treatment device.
Drawn tap water appears rusty or has a red or yellow color. When allowed to stand particles settle to bottom.	Insoluble Red Water Fe+3 Ferric Oxidized	Manganese greensand/ Filtration	Adequate pressure.
		Catalytic filtration "BIRM"	Dissolved oxygen, alkalinity, organic matter, chlorination, polyphosphate, temperature limitations.
		Chlorination/Filtration	Chlorine liquid or pellets. Frequent monitoring. Proper water pressure.
Water tank/toilet tank/plumbing have reddish brown or yellow gelatinous slime or sludge present. May have objectionable odor or oily sheen.	Bacterial Creno-thrix Leptothrix Gallionella	Shock chlorination and consider following with continuous chlorination. Bactericides.	Shock chlorination should include; cleaning the well thoroughly, cleaning pump and riser pipe, and complete chlorination and flushing of distribution system. Make sure bactericides can be used in drinking water. Bactericides need long contact time for adequate treatment.
High color content (yellow or brown) or colorless. Generally groundwater from shallow well or surface water.	Organic Hemme Tannin	Water softener	First step is to treat for organics. Hardness must be calculated. System must be airtight. Treat all water.
		Manganese greensand/ Filtration	First step it to treat for organics. Adequate pressure.
		Ozonation	Used by some municipal systems. Expense.

Aeration: Introducing oxygen to the water source to convert soluble iron to its insoluble form.

Filtration: Media used to entrap and screen out oxidized particles of iron. Usually requires backwashing to remove accumulated iron.

Water Softener: Removal of soluble iron by ion exchange.

Manganese Greensand: An ion exchange sand material which is capable of removing iron. Adsorbs dissolved iron and requires chemical regeneration.

Catalytic Filtration "BIRM": A granular filter medium that enhances the reaction between oxygen and iron and then filters the insoluble iron.

Ozonation: A specialized form of aeration using ozone to convert soluble iron.

Ion Exchange: Substituting an acceptable ion (such as sodium) for soluble iron.

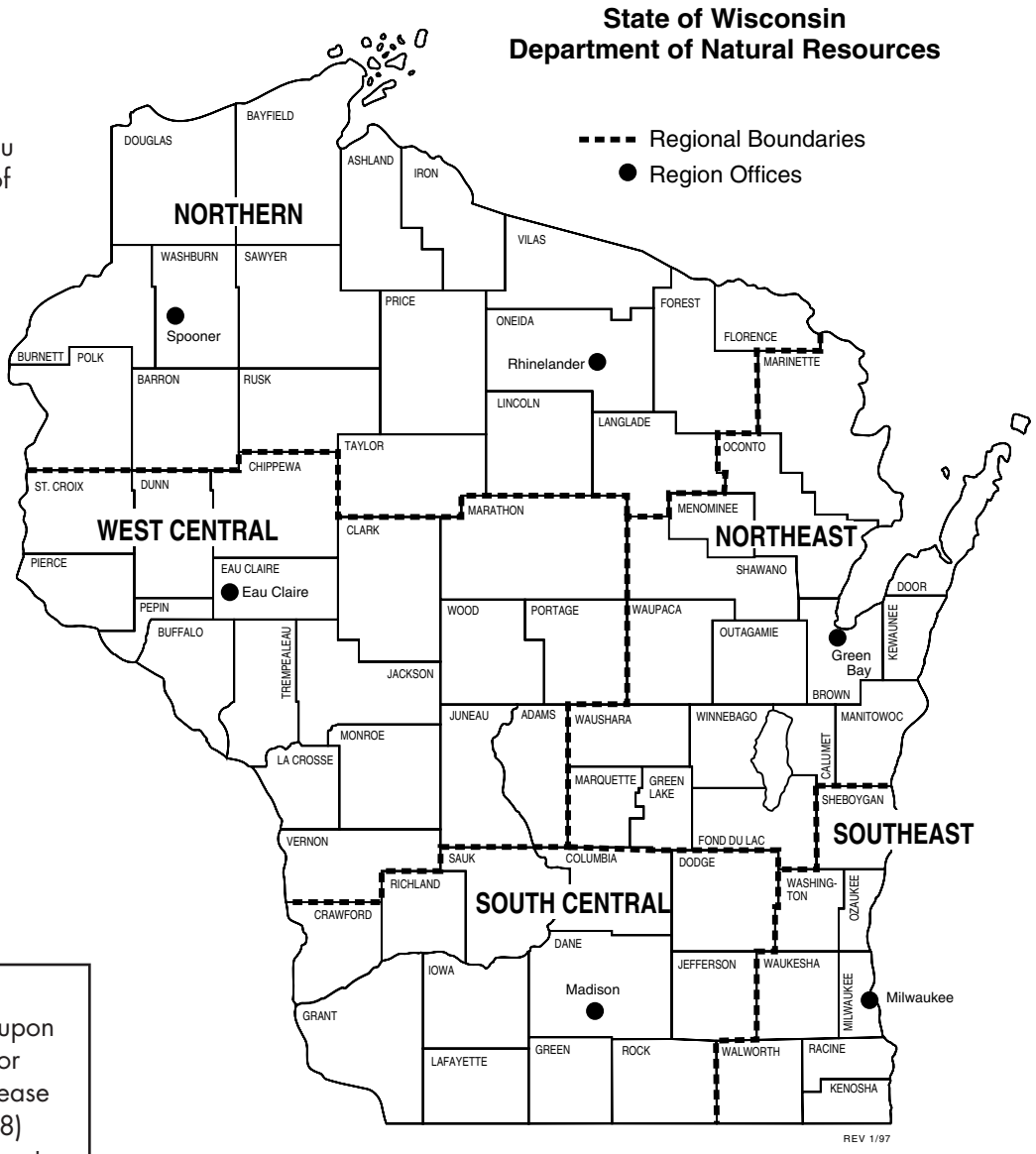
Sequestering: Adding chemical agents to water to keep metals like iron in solution to prevent characteristic red stains.

Chlorination: Chemical oxidizer used to convert soluble iron to an insoluble, filterable form.

Additional Information

Remember, the type of water you have will determine what type of treatment is possible. No one treatment technique works for every iron problem and well construction or reconstruction may be more cost effective. For additional information on iron in drinking water, contact a water treatment dealer, a water supply specialist at one of the DNR Regional offices listed on this page or in the:

DNR Bureau of Drinking Water and Groundwater
Box 7921
Madison, WI 53707-7921



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Northern Region
Department of Natural Resources
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(715) 635-2101

Department of Natural Resources
P.O. Box 818
Rhinelander, WI 54501
(715) 365-8900

West Central Region
Department of Natural Resources
P.O. Box 4001
Eau Claire, WI
54702-4001
(715) 839-3700

Northeast Region
Department of Natural Resources
1125 N. Military Avenue
P.O. Box 10448
Green Bay, WI 54307
(920) 492-5885

Southeast Region
Department of Natural Resources
2300 N. Dr. Martin Luther King Jr. Dr.
P.O. Box 12436
Milwaukee, WI 53212
(414) 263-8500

South Central Region
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711
(608) 275-3266

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