Healthy Drinking Waters

for

MASSACHUSETTS

Safe and healthy lives in safe and healthy communities

Iron and Manganese in Private Drinking Water Wells

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Private well owners are responsible for the quality of their drinking water. The U.S. Environmental Protection Agency (EPA) does not regulate private wells. Homeowners with private wells are generally not required to test their drinking water, although local Boards of Health or mortgage lenders may require well water testing. While there is also no state requirement to have your well water tested, the Massachusetts Department of Environmental Protection (MassDEP) recommends that all homeowners with private wells do so, and use a state certified testing laboratory. Homeowners can use the public drinking water standards as guidelines to ensure drinking water quality.

The Secondary Maximum Contaminant Level (SMCL) for iron is 0.3 milligrams per liter (parts per million) and for manganese is 0.05 milligrams per liter (parts per million) as established by the EPA.

Summary

Iron and manganese are naturally occurring elements commonly found in Massachusetts groundwater and wells. While not considered a health hazard, their presence often results in staining of laundry and plumbing components, as well as offensive tastes and appearances. Treatment methods for these elements depend on the form in which they occur in the untreated water. Therefore, accurate water testing is important before considering your options and selecting treatment equipment. A summary of treatment options is shown in *Table I*.

Indications of Iron and Manganese

Forms of Iron and Manganese in Drinking Water

Iron and manganese come in three different forms, which cause the appearance of the water to range from clear to discolored.

- In deep wells, where oxygen content is low, the iron/manganese-bearing water is clear and colorless because the iron and manganese are dissolved. Water from the tap may appear clear, but once it is exposed to air, iron and manganese are oxidized and change from colorless, dissolved forms to colored, solid forms.
- When oxygen in the air mixes with dis-

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solved iron particles in water, the iron changes to white, then yellow and finally to red-brown solid particles that can settle out of the water. If the water coming from your tap appears "rusty" colored, then this process has already begun to take place by the time the water reaches your faucet.

- Iron that does not form large enough particles to settle out remains suspended (colloidal iron) leaving the water with a red or yellow tint. Manganese is usually dissolved in water, although some shallow wells contain colloidal manganese (black tint). These colloidal sediments tend to form when iron and manganese combine with organic matter (tannins) in the water and produce the staining properties of water containing high concentrations of iron and manganese. These iron or manganese particles may be plentiful enough to clog water pipes.

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Effects of Iron and Manganese in Drinking Water

- Iron and manganese can affect the flavor and color of food and water. They may react with tannins in coffee and tea to produce a black sludge, which affects both taste and appearance. Manganese is objectionable in water when present in smaller concentrations than iron.
- Iron will cause reddish-brown staining of laundry, porcelain, dishes, utensils and even glassware. Manganese acts in a similar way but causes a brownish-black stain. Soaps and detergents do not remove these stains, and use of chlorine bleach and alkaline builders (such as sodium and carbonate) may intensify the stains.
- Iron and manganese deposits can build up in pipelines, pressure tanks, water heaters and ion exchange units. This reduces the available quantity and pressure of the water supply. Iron and manganese accumulations become an economic problem when water supply or treatment equipment needs replacing. There are also associated increases in energy costs from pumping water through constricted pipes or heating water with heating rods coated with iron or manganese mineral deposits.
- A problem that frequently results from iron or manganese in water is *iron or manganese bacteria*. These bacteria are not health-threatening and can occur naturally in soil, shallow groundwater, and surface water. The bacteria feed on iron and manganese in water. These bacteria form red-brown (iron) or black-brown (manganese) slime in toilet tanks and can clog pipes. These bacteria can give the water a musty or swampy smell.

Sources of Iron and Manganese in Drinking Water

Iron and manganese are naturally occurring elements in the earth. Iron and manganese are non-hazardous elements that can be a nuisance in a water supply. Iron and manganese are chemically similar, causing similar problems. Iron occurs more frequently, while manganese is typically found in iron-bearing water. As water percolates through soil and rock, it can dissolve minerals containing iron and manganese and hold them in solution. Occasionally, corrosion and deterioration of old iron pipes may also be a source of iron in water.

Testing for Iron and Manganese in Private Drinking Water Wells

To determine if iron and manganese are present, arrange to test your drinking water at a state certified laboratory. Follow laboratory instructions carefully to avoid contamination and to obtain a good sample. Home test kits may not provide accurate results. The amount of iron and manganese in water is important to help you determine the type of treatment system you need to remedy the problem.

Reducing Iron and Manganese in Your Water Supply

Several methods are available for removing iron and manganese from water. The most appropriate method depends on many factors, including the concentration and form of the iron and/or manganese in the water, the presence of iron or manganese bacteria, and the volume of water you need to treat. Generally speaking, there are five basic methods for treating water containing these contaminants. They are: (1) *phosphate compounds*; (2) *ion exchange*; (3) *oxidizing filters*; (4) *aeration (pressure type) followed by filtration*; and (5) *chemical oxidation followed by filtration.*

Most treatment techniques are effective in water within a narrow pH range near 7.0. The phosphate compound treatment is effective within a pH range of 5.0 to 8.0. Therefore, it may also be necessary to treat well water for pH in order to effectively treat for iron and manganese.

Table 1 summarizes the treatment options of iron and manganese in drinking water.

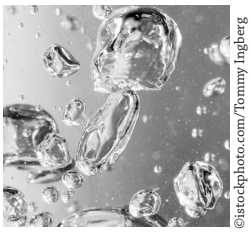
Treatment for plumbing corrosion

Corroded iron pipes and equipment may cause reddish-brown particles in the water that, when drawn from the tap, will settle out as the water stands. This can indicate oxidized iron or, in some cases, it may only be iron corrosion particles. Raising the water's pH and using a sediment filter is the simplest solution to this problem.

Treatment for iron and manganese bacteria

The most common approach to control iron and manganese bacteria is shock chlorination. Shock chlorination procedures are described in the *Bacteria in Drinking Water* fact sheet. It is almost impossible to kill all the iron and manganese bacteria in your system. They will grow back eventually so be prepared to repeat the treatment from time to time. Chlorination rapidly changes dissolved iron into oxidized (colored) iron that will precipitate into a solid form.

If bacteria regrowth is rapid, repeated shock chlorination becomes time consuming. Continuous application of low levels of chlorine may be less work and more effective. An automatic liquid chlorine injector pump or a dispenser that drops chlorine pellets into the well is a common choice. The iron precipitate will dissipate over time. A filter may be needed to remove oxidized iron if continuous chlorination is used to control iron bacteria.



When choosing a treatment method, consider both the initial cost and the operating costs. Operating costs include the energy needed to operate the system, additional water that may be needed for flushing the system, consumable supplies and filters, repairs, and general maintenance.

Regardless of the quality of the equipment purchased, it will not operate well unless maintained in accordance with the manufacturer's recommendations. Keep a logbook to record equipment maintenance and repairs. Equipment maintenance may include periodic cleaning and replacement of some components. Also consider any special installation requirements that may add to the equipment cost. For more information, refer to fact sheet: *Questions to Ask When Purchasing Water Treatment Equipment*.

Table I. Treatment of Iron and Manganese in Drinking Water

Indication	Cause	Treatment
Water is clear when drawn but red-brown or black particles appear as water stands; red-brown or black stains on fixtures or laundry	Dissolved iron or manganese	Phosphate compounds (*< 3 mg/L* iron*) Ion Exchange (*<5 mg/L combined concentrations of iron and manganese*) Oxidizing filter (*manganese greensand or zeolite*) (*<15 mg/L combined concentrations of iron and manganese*) Aeration (pressure) (*<25mg/L combined concentrations of iron and manganese*) Chemical oxidation with potassium permanganate or chlorine; followed with filtration (*>10 mg/L combined concentrations of iron and manganese*)
Water contains red-brown particles when drawn; particles settle out as water stands	Iron particles from corrosion of iron pipes and equipment	Raise pH with neutralizing filter
Water contains red-brown or black particles when drawn; particles settle out as water stands	Oxidized iron/manganese due to exposure of water to air prior to tap	Particle filter (if quantity of oxidized material is high, use larger filter than inline; e.g., sand filter)
Red-brown or black slime appears in toilet tanks or from clogs in faucets	Iron or manganese bacteria	Kill bacteria masses by shock treatment with chlorine or potassium permanganate, then filter; bacteria may originate in well, so it may require continuous feed of chlorine or potassium permanganate, then filter
Reddish or black color that remains longer than 24 hours	Colloidal iron/manganese; organically complexed iron/manganese	Chemical oxidation with chlorine or potassium permanganate; followed with filtration

**Note: mg/L = milligrams per liter.*
Adapted from "Iron and Manganese in Household Water," Water Treatment Notes. Fact Sheet 6, Cornell Cooperative Extension. (1989).

Resources

UMass Extension

This fact sheet is one in a series on drinking water wells, testing, protection, common contaminants, and home water treatment methods available on-line at the University of Massachusetts website: http://www.umass.edu/nrec/watershed_water_quality/watershed_online_docs.html and Cape Cod Cooperative Extension: 508-375-6699 http://www.capecodextension.org

MA Department of Environmental Protection, Division of Environmental Analysis

Offers assistance, information on testing and state certified laboratories: 617-292-5770 For a listing of MassDEP certified private laboratories in Massachusetts: http://www.mass.gov/dep/service/compliance/wespub02.htm

U.S. Environmental Protection Agency, New England Office

Information and education on where drinking water comes from; drinking water testing and national laws; and how to prevent contamination: http://www.epa.gov/ne/eco/drinkwater

US Environmental Protection Agency

For a complete list of primary and secondary drinking water standards: http://www.epa.gov/safewater

MA Department of Conservation and Recreation, Division of Water Supply Protection

Maintains listing of registered well drillers, information on well location and construction: 617-626-1409 http://www.mass.gov/dcr/waterSupply/welldril/index.htm

NSF International

The NSF International has tested and certified treatment systems since 1965. For information on water treatment systems: 800-NSF-MARK (800-673-6275) http://www.nsf.org/consumer/

Water Quality Association

The Water Quality Association is a not-for-profit international trade association representing the household, commercial, industrial, and small community water treatment industry. For information on water quality contaminants and treatment systems: http://www.wqa.org

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