ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

WD-DWGB-3-8 2013

Iron and/or Manganese in Drinking Water

Occurrence

Iron and manganese minerals occur naturally in the earth's crust and are released into water by weathering processes. Both elements are very common in both shallow and deep wells in New Hampshire. Concentrations in groundwater vary widely depending on the local geology, from barely detectable concentrations of 0.05 mg/L or less, to more than 1.0 mg/L manganese or greater than 10 mg/L iron. Depending on localized pH and oxygen levels in the aquifer, these constituents may be found in their reduced, soluble forms (Mn^{2+}, Fe^{2+}), or as oxidized, colloidal, particulate forms such as MnO_2 or Fe_2O_3. Simple laboratory analyses of total versus filtered metals may be used to establish their relative presence as dissolved or particulate in order to establish applicable treatment options.

Standards

The federal and state **secondary** or **aesthetic standards**, established under the Safe Drinking Water Act of 1974, are: **iron at 0.30 mg/L and manganese at 0.05 mg/L**. There are no health-based standards for iron in drinking water in New Hampshire.

Manganese is also present in many foods and infant formulas, and because infants are unable to purge excess manganese, recent studies suggest that infant exposure to manganese in drinking water should be avoided. Based on these studies, DES recommends that water used to reconstitute/dilute infant formula should have the lowest level of manganese available. Private well users should have their water tested, and customers of community water systems should contact their water supplier or DES to become informed about their own drinking water quality. If manganese is present in the water supply, parents of infants should consider treatment (see below), or the use of bottled water (if water quality data are available from the bottler indicating no detectable manganese). For information about the health effects of manganese, particularly the potential neurotoxic effects on children, please see NHDES Fact Sheet ARD-EHP-15, Manganese: Health Information Summary.

Treatment Options

The appropriate treatment technologies for iron and manganese depend on raw water concentration levels and whether the minerals are dissolved, particulate, or both. Co-occurrence with other common secondary or primary contaminants such as hardness, sulfide or arsenic also affects the selection of the appropriate multi-contaminant treatment options. When levels are above the secondary standards (0.3 mg/L iron or 0.05 mg/L), **whole-house** treatment is recommended in order to control staining throughout the home, as opposed to point-of-use (POU) equipment, which is intended for a single location such as the kitchen sink.

Common Water Treatment Methods for Iron and/or Manganese

Raw Water Iron/Manganese	Whole-House Oxidation-Filtration	Whole-House Softening	POU Reverse Osmosis
Any levels, dissolved and/or particulate	**X**		
Co-occurrence w/sulfide and/or arsenic	**X**		
Dissolved Iron or Manganese plus Hardness		**X**	
Dissolved levels above secondary standards	**X**	**X**	
Trace levels below secondary standards			**X**

Oxidation-Filtration treatment

Commercial filter media brands for this treatment include Birm, Greensand, Filox, Clack MTM and other manganese dioxide-based catalytic filter media.

If ***manganese*** is present, a strong pre-oxidant such as potassium permanganate ($KMnO_4$) or chlorine bleach is required for filtration to be effective. Residential systems can be equipped with permanganate or chlorine feed for either intermittent (batch) or continuous pre-oxidation. Air is also used as a pre-oxidant for **iron,** but is insufficient for manganese oxidation.

If ***iron alone*** is present, aeration followed by filtration provides effective treatment, without the need for permanganate or chlorine pre-oxidant. In some cases, some very fine "colloidal" iron may pass through the standard filtration step. If so, a redundant filter bed or a deeper, multi-layer filter (typically comprised of anthracite, greensand and garnet filter layers) may be used.

Whole house oxidation-filtration costs range from $1,500 to $3,000. Maintenance costs are approximately $100 per year for permanganate or chlorine pre-oxidant, if needed.

Softening treatment

Cation exchange softening is commonly used for iron and manganese removal especially when there is co-occurrence with ***hardness*** (calcium Ca^{2+} and magnesium Mg^{2+}). As its name indicates, the cation resin targets all positively-charged molecules in the water, favoring the larger, more concentrated constituents. The advantages of softening are that it is simple and inexpensive to operate, as it regenerates with salt pellets. Disadvantages are that it increases sodium levels (sodium is exchanged as other cations are removed), is non-selective so it removes other desirable minerals even if they are low, and produces a brine waste discharge that adds additional chloride and sodium to your groundwater. DES recommends that softening be used in conjunction with iron or manganese treatment only if hardness levels are causing scaling (white mineral) deposits, which is generally at levels of 150 mg/L (9 grains per gallon) or higher.

Whole-house softening costs are similar to those of other whole-house treatment technologies at $1,500 to $3,000. Maintenance costs are around $100 per year or less for salt pellets.

Point-Of-Use Reverse Osmosis (POU-RO)

RO filtration retains the larger dissolved molecules by applying pressure on one side of a selective membrane, forcing purified water to pass to the other side. The "reject" water is discharged to the home septic system or a drywell, while filtered water is stored in a small pressure tank and dispensed through a dedicated tap. The advantage of POU-RO is its widespread availability from home improvement stores, water treatment firms and online. Disadvantages include high waste (3 or more gallons of waste for every gallon treated), and its

non-selective removal of the targeted contaminant. Current equipment costs begin at $150 + installation.

For More Information

Please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov or visit http://des.nh.gov/organization/divisions/water/dwgb/index.htm. All of the bureau's fact sheets are available at: http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm.

For information on having your private well water tested, go to www.des.nh.gov and search for "well testing index."