ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Iron and/or Manganese in Drinking Water

INTRODUCTION AND OCCURRENCE

Iron and manganese occur naturally in 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 and groundwater chemistry, from barely detectable levels 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. Laboratory analyses of total versus filtered metals may be used to establish their relative presence as dissolved or particulate in order to evaluate treatment options.

HEALTH EFFECTS

Iron and manganese are generally considered secondary or aesthetic contaminants due to their staining of plumbing fixtures and laundry. This still holds true for iron, however, the US EPA issued a manganese Health Advisory Level of 0.3 mg/L in 2004 indicating that infant exposure should be avoided because of their inability to purge excess manganese. Based on these studies, NHDES recommends that water used to reconstitute/dilute infant formula should have no detectable manganese. Private well users should have their water tested, and customers of community water systems should contact their water supplier or NHDES 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 that shows no detectable manganese. For information about the health effects of manganese, particularly the potential neurotoxic effects on children, please see NHDES Fact Sheet EHP-15, "Manganese: Health Information Summary."

HEALTH STANDARDS OR ADVISORIES

In addition to EPA's Manganese Health Advisory of **0.3 mg/L for infants**, New Hampshire's ambient groundwater quality standard (AGQS) for manganese is **0.840 mg/L**. The AGQS is a health based standard and is enforceable for public water systems and groundwater discharges. There are no health-based standards for iron in drinking water in New Hampshire. 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**. Secondary standards are reference levels where the contaminant may contribute to taste or staining of plumbing fixtures or laundry.

TESTING

Obtain water sample bottles by contacting an accredited laboratory from the list provided at des.nh.gov, or a web search for "NHDES Private Wells." NHDES recommends testing for the Standard Analysis suite of parameters which includes iron, manganese, bacteria, arsenic, lead, uranium and other important water quality parameters. NHDES recommends testing for the standard analysis suite **every 3 to 5 years**.

MITIGATION AND TREATMENT

Treatment for iron and/or manganese depends on raw water levels and whether the minerals are dissolved, particulate, or both. Co-occurrence with other contaminants such as hardness, sulfide or arsenic also affects the selection of treatment. Whole-house treatment is recommended in order to control staining of fixtures and laundry. Installation cost for a typical residential whole-house system is $1,500 to $3,000 for a single filtration step, regardless of technology. Common options are:

a) Oxidation-Filtration – filter tradenames for this technology include Birm®, Greensand®, Clack MTM® and Filox®. This is the preferred option for residential and public water supplies regardless of contaminant levels, due to its selectivity to iron and manganese, and avoidance of brine discharge to the environment.

When ***manganese*** is present, a strong pre-oxidant such as potassium permanganate ($KMnO_4$) or chlorine pellets are required for filtration to be effective. Residential systems can be equipped with a permanganate or chlorine pellet feed tank for either intermittent (batch) or continuous pre-oxidation.

For **iron only**, AIR pre-oxidation is adequate. In some cases, fine colloidal iron may pass through the filter. If so, a deeper filter bed, or multi-layer bed including a fine garnet layer may be used to improve iron capture.

b) Softening – cation exchange "softening" may be used when there is iron or manganese co-occurrence with high hardness over 150 mg/L. This process exchanges all cations (calcium, magnesium, iron, manganese) with the 'softer' minerals sodium or potassium. The softener is regenerated with standard salt (sodium chloride), with the brine waste discharged to your septic system or a drywell. Advantages of softening systems are their simplicity and low maintenance cost. However, they are highly inefficient for iron/manganese because they must remove all the "good minerals" calcium and magnesium first, which are present at two to three orders of magnitude higher concentration. Other disadvantages are the high volume of brine discharges which contaminate the groundwater including your own well and those of your neighbors, and the increased sodium levels which may be a concern for those on a sodium-restricted diet.

Reducing Salt Use – if a softener must be used, reducing salt discharge to the environment is extremely important to protect groundwater and nearby streams. Recommendations to reduce salt discharges are:

- Avoid water softeners unless water hardness is over 150 mg/L AND causing aesthetic issues.
- Use non-salt treatment technologies such as Birm or Greensand filtration for Iron or Manganese.
- Use a "demand-based" unit which backwashes based on actual water use rather than on a fixed timer.
- Reduce the brine loading to 6-8 pounds salt/CF instead of the factory setting of 10-12 pounds/CF.

FOR MORE INFORMATION

Contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov, or visit us at www.des.nh.gov. You may also input your water test results to the "***NHDES Be Well Informed"*** water treatment application (available via a web search) to interpret your results and identify appropriate treatment options.

Note: This fact sheet is accurate as June 2019. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.