ALABAMA A&M AND AUBURN UNIVERSITIES

ANR-790-2.3.3

# Typical Contaminants And Problems

## Iron And Manganese

Iron is one of the most troublesome elements in water supplies throughout the United States. In a recent survey in Alabama, iron was ranked as the number one naturally occurring water quality problem. Iron contamination of Alabama water is widespread. See Figure 1.

Neither iron nor manganese pose any health risks. In fact, small concentrations are essential to human health. But iron water is a nuisance. Water that is high in iron and manganese has a metallic or medicinal taste. Water that is high in iron causes most of the staining problems so familiar to many areas. These brown-yellow-red stains appear around toilet bowls or on fixtures where water stands or drips. They also appear on laundry, particularly if chlorine bleach is used. Tea or green leafy vegetables may become very dark when prepared with water that is high in manganese. Iron bacteria in the system produces an oily film on water and a gelatinous growth in water tanks or toilets.

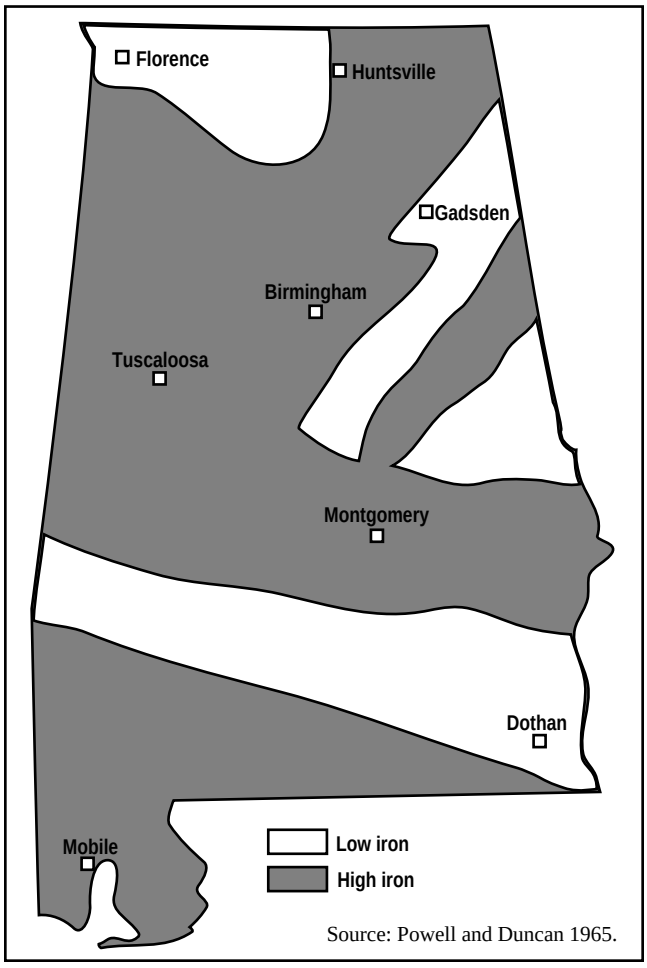


Figure 1. Iron content of Alabama groundwater.

### Sources Of Iron And Manganese

Since iron is present in varying quantities in most soils and rocks, it is also found in most surface water and groundwater. Iron and manganese occur naturally in groundwater, but some iron can be added from corroded water pipes. The more corrosive the water (the lower the pH) the more iron and other minerals will be dissolved from metallic surfaces the water contacts.

The four forms of iron commonly found in drinking water are ferrous ($Fe^{2+}$), ferric ($Fe^{3+}$), organic, and iron bacteria. Water contaminated with ferrous iron appears clear when first drawn at the cold water faucet because the iron is completely dissolved. When ferrous iron is exposed to air, it turns into ferric iron, which forms a precipitate. Water contaminated with ferric iron turns cloudy and contains particles of a reddish-brown substance which settle to the bottom. Organic iron may give the water color but does not precipitate or settle out.

Iron bacteria are living organisms that feed on iron in the water and on iron in pumps, pipes, well casings, tanks, and fixtures. They also form slime in toilet tanks and water heaters and clog pipes and pumps.

Manganese acts in a manner similar to iron but forms a brownish-black precipitate. Manganese is rarely found alone in a water source but is generally found with dissolved iron.

**Table 1. Summary Of Treatment Options For Iron In Drinking Water.**

| Iron Form | Concentration | Treatment Method |
|---|---|---|
| Ferrous ($Fe^{2+}$) (dissolved) | Up to 1 mg/L | Chemical feed pump; cation exchange |
| | 2 to 10 mg/L | Oxidizing filter; reverse osmosis; distillation |
| Ferric ($Fe^{3+}$) (precipitated) | 2 to 10 mg/L | Mechanical filter; reverse osmosis; distillation |
| Ferrous<br>Ferric<br>Organic<br>Iron bacteria | More than 10 mg/L | Superchlorination or aeration followed by filtration; may require pH adjustment |

Source: Plowman 1989.

## Treatment Of Iron And Manganese

**When To Treat.** A chemical analysis of water should be obtained which will show the type and concentration of iron and manganese present. Dissolved iron concentrations as high as 60 parts per million (ppm) have been known to exist, but usually no more than 5 ppm are present. Unfortunately as little as 0.3 ppm (the current drinking water standard) can create serious difficulties in the home.

High levels of manganese (levels greater than the current drinking water standards of 0.05 mg/L) may cause brown or black stains on porcelain fixtures and laundry. Manganese at this concentration should be treated.

**How To Treat.** Several methods may be used to treat iron and manganese in home water supplies. These include polyphosphate chemical feed pumps, cation exchange (water softeners), oxidizing filters, chlorination, reverse osmosis, and distillation. A summary of treatment options appears in Table 1.

Many of the water treatment processes for iron are pH dependent. Iron can easily be removed when the pH is 7.5 or higher, but manganese is very difficult to remove at pH values below 8.5.

Polyphosphate chemical feeders do not remove iron or manganese from water. The iron and manganese are held in solution so the troublesome precipitate is not formed. The mineral taste will remain. This process will not work for iron bacteria or iron that has already oxidized to its insoluble form.

Cation exchange and oxidizing filters vary in design and in the amount of metallic minerals they will effectively remove. Most work best for small concentrations of iron and manganese, in the range of 2 ppm or less. However, some manufacturers advertise high capacity units claimed to handle larger amounts.

Iron or manganese bacteria should be treated only by shock chlorination or continuous chlorination (by chemical feed pump) followed by filtration.

If you suspect that you have an iron problem, have your water tested. The test will show the kind and the amount of iron in the water. Then get professional help to select the treatment method that will best eliminate the problem.

## Iron And Manganese At A Glance

**Symptoms:** Reddish-brown stains on laundry, sinks, and other objects touched by water.

**Causes Of The Problem:** *Iron:* Acidic water where pH is less than 6.5.; iron-bearing geologic formations; groundwater that lacks oxygen; iron bacteria which attacks the well casing or plumbing; corroded pipes. *Manganese:* Water that is acidic and low in oxygen; landfills or other waste disposal which acidifies the groundwater or reduces the oxygen content.

**Suggested Treatments:** Chemical feed pump, cation exchange, oxidizing filter, reverse osmosis, or distillation. Choose a method of treatment based on the concentration and the form of iron.

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***The following articles in the Water Quality series may be helpful:***

Possible Treatments

- Filters
- Reverse Osmosis
- Distillers
- Ion Exchange Units: Cation Exchange (Softeners) And Anion Exchange
- Chemical Feed Pumps

This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist,* assisted by Leigh Stribling, *Technical Writer.*

**For more information,** call your county Extension office. Look in your telephone directory under your county's name to find the number.



UPS, **New June 1995,** Water Quality 2.3.3

ALABAMA COOPERATIVE Extension SYSTEM

**ANR-790-2.3.3**