



FILMTEC Membranes

Water Chemistry and Pretreatment: Prevention of Iron and Manganese Fouling

Prevention of Iron and Manganese Fouling

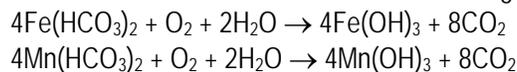
Iron fouling is very common. Like any fouling, it causes a performance loss of the membrane system, specifically flux loss. In addition, the presence of iron makes the membrane more susceptible to oxidation damage. Fortunately, iron fouling can be cleaned fairly easily - see [Iron Fouling \(Section 6.9.4\)](#). Some operators deliberately accept iron fouling up to 10% flux loss and then clean the membranes with a predetermined frequency.

Typical sources of iron fouling are

- Anoxic aquifers containing soluble divalent iron and/or manganese
- Hydroxide flocs of oxidized iron and/or manganese from raw water
- Natural organic matter (NOM) containing iron complexes
- Hydroxide flocs from coagulation process
- Corrosion products from piping materials used for the feed water
- Silicates containing iron

The methods to prevent fouling with colloidal and particulate iron have been described in *Colloidal and Particulate Fouling Prevention (Section 2.5)*. Iron silicates have been discussed in [Silica Scale Prevention \(Section 2.4.7\)](#). The pretreatment of water containing ferrous (divalent) iron is described below.

Anoxic waters typically contain divalent iron, manganese, or both. If water containing iron or manganese has taken up more than 5 mg/L of oxygen, or has been chlorinated, Fe²⁺ (ferrous) is converted into Fe³⁺ (ferric), which forms insoluble colloidal hydroxide particles that may foul RO/NF membranes. The oxidation of iron and manganese is given by:



Iron fouling occurs more frequently than manganese fouling because the oxidation of iron occurs at a much lower pH. Thus, a fouling problem can be created even if the SDI is below 5 and the level of iron in the RO feed water is below 0.1 mg/L. Waters with low alkalinity usually have higher iron concentrations than waters with high alkalinity, because the Fe²⁺ concentration is usually limited by the solubility of FeCO₃.

One approach to avoid membrane fouling is to prevent oxidation and precipitation of iron and manganese by keeping the water in the reduced state. The exposure of the water to air or to any oxidizing agent (e.g., chlorine) through the whole RO process must be prevented. A low pH is favorable to retarding Fe²⁺ oxidation. At pH <6 and oxygen <0.5 mg/L, the maximum permissible Fe²⁺ concentration is 4 mg/L.

If the anoxic process is used, care must be taken to avoid:

- Oxygen leakage into the feedwater
- Reaction of iron with silica to form insoluble iron silicate
- Oxidation by iron reducing bacteria resulting in acceleration of biofilm growth and iron deposit
- Blending of ferrous iron containing water with water containing hydrogen sulfide (H₂S), since this could form an insoluble black ferrous sulfide, FeS

Regular iron cleaning (see [Iron Fouling, Section 6.9.4](#)) will be necessary with the anoxic process.

The alternative method of handling anoxic waters is by oxidation-filtration as described in [Oxidation-Filtration \(Section 2.5.3\)](#).

FILMTEC™ Membranes
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