DEALING WITH IRON AND MANGANESE

By Joe Redmond

Iron and manganese are common metallic elements bound in the earth's crust. Water percolating through soil and rock can dissolve minerals containing iron and manganese and hold them in a solution commonly found in groundwaters and some surface waters that have significant groundwater input. These compounds are mostly present in the soluble reduced deviant form as Ferrous and manganous ions. In some deep lakes and reservoirs, the existence of dissolved iron and or manganese may be due to stratification which results in the development of anaerobic conditions in the bottom water zone and the dissolution of iron and manganese from floor deposits. These deposits can then be dispersed into the general water body by the annual overturn.

Waters containing iron and manganese when exposed to air or oxygen, become cloudy and turbid due to the oxidation of iron and manganese which form colloidal precipitates. The iron and manganese in the raw water source if not treated can result in staining of fixtures as well as offensive tastes and appearances. These issues can be particularly challenging to the water treatment plant operator. To comply with the United States Environmental Protection Agency's maximum contaminant levels, some operation specialists have been required to remove much of the iron and manganese from the drinking water.

The removal of iron and manganese is comprised of two stages, an oxidation process in which the soluble forms of iron and manganese are oxidized to a form of insoluble precipitates, and a solid separation process in which the precipitated material is removed from the water stream. The most common chemical oxidants in water treatment are chlorine, chlorine dioxide, potassium permanganate, and ozone. Because of the formation of disinfection by-products with chlorination, potassium permanganate is widely used for the oxidation process. As an oxidant, potassium permanganate is normally more expensive than Chlorine and ozone, but for iron and manganese removal it has been reported to be as efficient and it requires considerably less equipment and capital investment. The dose, however, must be carefully controlled. Too little permanganate will not oxidize the iron and manganese, and too much will allow permanganate to enter the distribution system causing a pink coloration.

Removal of the oxidized iron and manganese can be accomplished with the use of green sand filtration. In this type of filtration, the pH needs to be over 7, and preferably over 7.5 to assure full precipitation of iron and manganese. If the source water pH is too low, a chemical and feed pump may be needed to raise the pH. A contact tank may be needed to allow more time for the oxygen and the iron and manganese contaminants to produce a sizeable rust particle that can be captured by the filter. Green sand filters need to be backwashed periodically and the rusty backwash water is typically discharged into an approved drywell, septic tank, or sewer.

The advantages of using green sand oxidizing filters are that they can be backwashed and recharged for reuse, they can consistently remove high concentrations of iron and manganese to extremely low levels, they significantly reduce odors, and there are minimum flow rates required for backwashes.

The disadvantages and limitations of green sand filters are that the pH of the water is critical to the filters effective operation and may require chemical addition to adjust to a higher pH, and during times of high iron and manganese in the source water, frequent backwashes will be needed. This can pose a problem in areas where source-water levels are low. 💧💧💧

Green Sand Filters

Why is Water Black After Aeration

Sources of information were obtained by:

USEPA, University of Cincinnati Dept. of Civil and Environmental Engineering, Carlson, Kenneth H., and William R Knocke. 1999. "Modeling Manganese Oxidation with KMnO4 for Drinking Water Treatment" and William R Knocke. 1991. "Kinetics of Manganese and Iron Oxidation by Potassium Permanganate and Chlorine Dioxide."

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