Toughing Out Iron

Oxidizing filters combat problematic iron contamination

By Gerry Bulfin

Iron is one of the Earth's most plentiful resources, making up at least 5% of its crust. In well water, iron is usually found as ferrous iron, which is in a dissolved state, potentially causing water to appear clear when first drawn from the tap.

The maximum level of iron recommended in water is 0.3 mg/L, or 0.3 ppm. When the level of iron in water exceeds this limit, water may have a red, brown or yellow color, and can stain laundry and fixtures. The water also may have a metallic taste and an offensive odor. Water system piping and fixtures can become restricted or clogged, and appliances such as water heaters, dishwashers and washing machines can become plugged with rust and sediment.

Solid manganese dioxide media, such as Pro OX, pictured here, contain a higher percentage of manganese dioxide than coated iron filter media.

In some applications, ion exchange resin can be used to remove ferrous iron, but the most common method is to oxidize it to a ferric state, and then filter out the precipitated particles. One way to accomplish this is to use one of many types of oxidizing manganese-based filter media.

Under the proper conditions, when water flows through a tank with this type of media, the dissolved iron oxidizes and becomes trapped. Periodic backwashing and rinsing clean the iron filter media of the trapped substances.

This oxidation and filtration process, called regeneration, can occur continuously or intermittently, and there are advantages and considerations for each type of process.

Various types of iron filter media are available, including Birm, manganese greensand, Pro-OX, Filox and Pyrolox. Birm and greensand are two types of coated iron filter media, whereas Filox and Pro-OX are solid manganese dioxide media.

Oxidizing iron filters use either oxygen injection (with air or pure oxygen), potassium permanganate, chlorine or ozone to aid the filter media in oxidizing the iron.

Manganese Oxide-Coated Media

Birm and greensand are two widely used types of iron filter media. Birm is a trademark of Clack Corp., and is manufactured from a type of natural pumice coated with manganese dioxide. It is lighter in weight than solid manganese dioxide filter media, and therefore often requires less backwash water. It does not remove manganese unless the pH is more than 8.2, however, and is not recommended for use when hydrogen sulfide gas is present. It cannot be used if the water is chlorinated.

In most cases, Birm requires an air induction system to work effectively. It will not work well if the pH is less than 6.9. It may last for many years under some conditions, but the coating can wear off. The media may need to be replaced every three to five years.

Similar to Birm, greensand filter media have a special coating of manganese dioxide, which oxidizes iron, manganese and iron in water upon contact.

Unlike Birm, chlorination aids in the filtration process and does not harm the filter media. Greensand works under more acidic conditions, down to a pH of 6.2. Filters using this media remove manganese and hydrogen sulfide.

To provide the oxidizing power to precipitate iron and manganese, greensand iron filters are commonly automatically cleaned and restored with potassium permanganate during each backwash cycle. This is known as intermittent regeneration.

As an alternative to potassium permanganate powder, a chlorine injector pump can be used ahead of the greensand filter to regenerate the filter media continuously, a process known as continuous regeneration. Greensand media generally need to be replaced every four to six years, although under the right conditions and proper maintenance, it has been known to last for 10 years or more.

For some applications in which the water has hydrogen sulfide "rotten-egg" odor and/or iron bacteria, a good practice is to chlorinate the water prior to the greensand

A water treatment system utilizing Pro-OX media for iron removal

filter. The injection of chlorine (or hydrogen peroxide or ozone) substantially increases the effectiveness of the greensand media, and allows it to work without the use of potassium permanganate and remove higher levels of iron and manganese.

Manganese Dioxide Solid-Core Media

Unlike Birm and greensand, which are coated with manganese oxide, manganese dioxide solid-core iron filters use natural mined solid manganese oxide ore in a relatively pure form. Most mined manganese ore is found in concentrations of less than 50% manganese, and is widely used in the manufacture of batteries and other industrial applications. In some areas of the world, there are mines that contain manganese with a high concentration of manganese oxide. This mineral is selected and carefully graded especially for water treatment.

Manganese dioxide iron filter media utilize an oxidation-reduction reaction and filtration process similar to greensand, but at a higher level of performance. The Pro-OX, Filox and MangOX brands, for example, contain more than 85% manganese dioxide, whereas greensand contains around 1%.

This type of solid manganese dioxide media is heavy and requires a strong backwash flow rate to lift and clean the oxidized particles from the filter bed. Because of the higher performance, faster throughput can be realized, and higher flow rates with smaller filter vessels can be used, which compensates somewhat for the higher backwash flow required. This type of solid manganese dioxide is long lasting, usually requiring replacement after 10 to 15 years.

These filters can use either intermittent or continuous regeneration. With intermittent regeneration, a solution of chlorine bleach or potassium permanganate automatically cleans and restores the media. The filter media is first backwashed to clean out any trapped oxidized particles. A concentrated solution of chlorine or potassium permanganate is then automatically fed into the filter system to clean and regenerate the media. In continuous regeneration, compressed air, or, more commonly, chlorine, is fed into the water continuously ahead of the filter.

For many applications in which the oxidation-reduction potential (ORP) can be raised to more than 200 mV with aeration alone, no chemical regeneration is required. A typical treatment plant will include air injection under pressure, where the water flows through the tank containing dissolved air. This increases the dissolved oxygen in the water and raises the ORP so the manganese dioxide media can be regenerated with simple backwashing and rinsing.

Hydrogen peroxide is not recommended with manganese dioxide filter systems due to the interaction between peroxide and manganese, which can cause manganese to leach into the water.

A chlorine feed ahead of the iron filter super-charges the media and allows it to remove high levels of iron, manganese and hydrogen sulfide. Coliform and iron bacteria are killed, and tannins are oxidized.

A chlorinator metering pump automatically injects a small amount of chlorine ahead of the iron filter. The chlorine pump is installed so that when the well pump turns on, the chlorine pump also turns on and injects a small amount of chlorine bleach.

For water high in iron, hydrogen sulfide gas or coliform bacteria, a contact tank is recommended. *wqp*

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