IRON REMOVING

BRIEF DESCRIPTION OF THE PROCESS

Iron can be contained in water as a dissolved matter or as a precipitate suspended.

Obviously, the removal of suspended iron, normally consisting of ferric hydroxide, is not very complicated; it can be made by mean of a common mechanical filtration (mechanical sediment filters, sand dual media filters).
The removal of the dissolved iron, normally consisting of ferrous ion, instead, means first of all to oxidize it to ferric ion, then its precipitation, and at least the mechanical filtration of the suspended form.
Indeed, the dissolved iron, as Fe^{++} can be converted, by chemical oxidation, to Fe^{+++}
It is important to note that pH of raw water must be over than neutral (pH ≥ 7); indeed if it was acid, it make difficult the precipitation of iron.

TREATMENT PROCESS

Some of the most used systems to remove iron from water are mentioned below:

1. *Oxidation followed by filtration through quartz sand (dual media) filter*

Whether the quantity of iron in water is almost low (0.5÷1.0 ppm) and raw water alkaline (pH >7.5), it is possible to oxidize and make precipitate of dissolved iron by the addiction of air in water inside a proper sized tank, upstream of a filtration stage.
This way of treatment can give good results only when the chemical conditions, as above, are very favourable; the action can be improved by the addiction of a strong oxidizing agent (like sodium hypochlorite) to the water, upstream of a tank (oxidation tank). The capacity of this tank should be proper sized according to a proper oxidation time.
Nobel dual media filters, series FCV and FCD are suitable to remove the suspended solids produced by the oxidation.

2. *Cathalytic oxidation with addiction of permanganate*

In most common cases, pH of raw water is around neutral and the quantity of iron is over than 1 ppm. In these cases, it is preferable to make a cathalityc oxidation in conjunction with filtration. This process can be made by a special media filter, able to feature both oxidation and filtration.
The media filter includes a supporting bottom layer of selected quartz-sand, a layer of the special oxidizing media and a top layer of inert material to improve filtration.
The oxidizing capacity of the media filter is kept and/or re-built by injection of potassium permanganate, which is a strong oxidizing agent.
The injection of potassium permanganate can be made continuously, by mean a proportional dosing unit, upstream of the filter unit, or, otherwise, in a discountinuous way, usually performed immediately after a backwashing of the filtering bed.

The correct choice of the continuous injection mode or, instead, the discontinuous one, should be made according to several factors, i.e. the dimensions of the plant, the quality of raw water, the presence in water of manganese, which is often contained in water together with iron.
Whether the filtration by oxidizing media is used, the pH of raw water must be over than neutral (pH ≥ 7) and it should not be too much free chlorine.
***Nobel** iron removal filters series **FDV** and **FDD**, are designed to work according to discountinuous regeneration (injection) of potassium permanganate.*

3. *Cathalytic oxidation <u>WITHOUT</u> addiction of permanganate*

The availability of potassium permanganate is becoming very difficult in last time being, and subject to restriction and limitation in many countries.
Hence, the utilization of a new filtering media, not requiring any regeneration with permanganate, has been widely diffused.
The *new* media simply requires the dosing of chlorine upstream of the filter itself.
Since the chlorine addiction (normally dosed as sodium hypoclorite), is often used also for disinfection of water, the iron removing process is very simple and inexpensive to be handled.
The used filtering media is manganese dioxide (pirolusite), made from natural mineral, properly selected for this special application, activated in a special oven and screened at correct size.
The standard composition of the filtering bed is a mixture of pirolusite (approx 25 % in volume) and quartz-sand.
Their grain sizes must be properly selected in order to obtain the best mixture and avoid the separation during the backwashing.

During filtration, when the water get in touch with cathalitic media, the oxidation of iron and manganese happens; they precipitate as insoluble compounds ($Mn^{2+} \rightarrow MnO_2$, $Fe^{2+} \rightarrow Fe(OH)_3$) and then are filtered by mean of the filtering action of the filtering bed itself.
The cathalitic action of pirolusite, supported by a strong chemical oxidizing agent (sodium hypochlorite or oxigen) is self-regenerating.
The involved reactions are substanthially the following:

- $NaClO + 2\ Fe^{2+} \rightarrow 2\ Fe^{3+} + Cl^{-} + NaOH$
- $NaClO + 2\ Fe(OH)_2 + H_2O \rightarrow 2\ Fe(OH)_3 + NaCl$
- $2\ Fe^{2+} + ½\ O_2 + 5\ H_2O \rightarrow 2\ Fe(OH)_3 + 4\ H^{+}$
- $2\ Mn^{2+} + ½\ O_2 + 3\ H_2O \rightarrow 2\ MnO(OH) + 4\ H^{+}$.

During backwashing the precipitates of iron hydroxides and exceeding quantity of manganese dioxide are carried away to drain.
The value of pH of raw water is very important for the correct working of the process.
Indeed, with pH values < 6, phenomenon of solubilization of the oxidized manganese and of the manganese dioxide itself happen, affecting the working of the process.
Hence, the application range must concern values of pH between 6.5 and 8.5.
***Nobel** iron removal filters series **FFV** and **FFD**, are designed to work according to countinuous injection of sodium hypoclhorite.*

DIRECTIONS FOR SELECTION

The operating features to be considered for a correct selection are:

- best linear flow: < 10 $m^3/m^2/h$
- max linear flow: 20 $m^3/m^2/h$
- max allowable pressure drop across the filter: 0.9 bar (90 kPa)
- backwashing flow rate at a linear flow of approx: 30 $m^3/m^2/h$

It should be noted that, often, the iron removal process is combined with other treatment process; for example, the addiction of sodium hypochlorite for the oxidation of iron also makes the sterilization of raw water, while the cathalytic filtration makes also the filtration of other suspended solids.
The cathalytic oxidation by the pirolusite also allows to remove sulphur dioxide, arsenic and other heavy metals if contained in the water.
In order to select properly the process of treatment, it is recommended to identify, by the analysis test the presence in water of suspended iron and dissolved iron; indeed the quantity of suspended iron can only influence the filtration system, while the other one will influence the oxidation way.

The above informations are only for general directions about principles and applications of the process.

Apply Nobel Service or Technical Centers for further informations or about special application.