



Plants, Animals and Humans with Iron Free Water

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ABSTRACT: Water is the greatest gift of nature and necessity of living organisms. Water is regarded as an universal solvent because more things can be dissolved in water than in any other liquid. Plants require iron at the source from the soil in the form of ferric salts to perform their functions for the synthesis of chlorophyll and formation of carotenoids. Animals especially humans obtain iron at the source of human diet. Though iron in traces is too important means of our life but at some places excessive iron is found in water causing serious problems.

The method of removal of iron from water consists in oxidation of Fe^{2+} to Fe^{3+} metal and its precipitation as $\text{Fe}(\text{OH})_3$. If iron is present in water as hydrocarbonate, it can be removed by aeration. Iron can be removed from water by a mixed coagulant consisting of sodium aluminate and ferric chloride (Molar ration, NaAlO_2 to FeCl_3 is 1:1). Another method to remove iron is to pass water through a bed of highly dispersed suspension of chalk and aluminium hydroxide. Ferric iron can be removed from water by cation exchange method.

The removal of iron from subsoil sources of filtration is combined with one of the preliminary methods of purification of water, such as simplified aeration, adding oxidants with or without aeration.

KEYWORDS: Hydrosphere, Universal solvent, Chlorophyll, Haemoglobin, Menstrual discharge, Oxidation, Cation exchanger, Autocatalytic process, Chlorosis, Iron deficiency.

INTRODUCTION

Water is the greatest gift of nature and necessity of living organisms. Hydrosphere, the component of environment, covers more than 75 percent of the earth's surface either as oceans (salt water) or as fresh water. Water is regarded as an universal solvent because more things can be dissolved in water than in any other liquid. The inorganic compounds are mostly soluble in water and also dissociate to form electrically charged particles, called ions. It is probable that all natural elements are soluble in water at least in trace amounts, and they are all found in natural water at some place or the other on the earth's surface.

Importance of iron to living organism

Plants require 10-1500 ppm of iron at the source from the soil in the form of ferric salts to perform their functions for the synthesis of chlorophyll and formation of carotenoids, as a constituent of cytochromes activating a number of enzymes. Iron deficiency in plants shows symptoms of interveinal chlorosis, localized or generalized chlorosis etc. [4]. Animals specially humans obtain iron at the source of human diet like liver meat, green vegetables, eggs,

whole grains, legumes, nuts etc. meant for major functions as an inactive site of many redox enzymes and electron carriers; haemoglobin; myoglobin etc. Iron deficiency in human diet leads to deficiency of haemoglobin because iron is necessary for the production of haemoglobin; this disease is called microcytic anaemia.

Pregnant and lactating mothers need additional dose of iron for the foetus and the infants. Women of child bearing age also require extra dose of iron because of loss of blood at each menstrual discharge [3].

Excessive Iron in Water.

Though iron in traces is too important means of our life but at some places excessive iron is found in water causing serious problems like

- i. Yellowing of teeth, clothes, cooking pots, toilets and bathroom floors etc,
- ii. Loss of appetite,
- iii. Stomach disorders,
- iv. Excessive weakness human males in comparison to females etc,
- v. Damage of liver causing jaundice,
- vi. Ulcer of intestine.

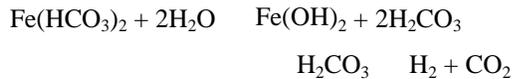
EXPERIMENTAL

With the purpose to remove iron from water- oxidation, precipitation, aeration, coagulation, filtration and autocatalytic process etc. being applied separately as well as steps in combination.

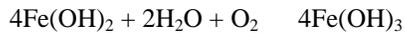
Removal of Iron from Water-

The method of removal of iron from water consists in oxidation of Fe^{2+} to Fe^{3+} metal and its precipitation as $\text{Fe}(\text{OH})_3$.

If iron is present in water as hydrocarbonate, it can be removed by aeration. This salt is hydrolysed in the following way.

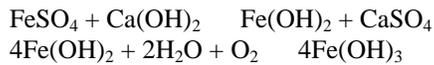


CO_2 is removed from water by aeration and, therefore, hydrolysis can be completed to the end. Ferrous hydroxide is oxidized by atmospheric oxygen to $\text{Fe}(\text{OH})_3$.



This method can be used to reduce the iron content upto 0.1 to 0.3 mg/litre. Humans interfere with the precipitation of iron, because they act as protective colloids with respect to $\text{Fe}(\text{OH})_2$. In such cases, water is treated with chlorine, which oxidizes Fe^{2+} iron to Fe^{3+} iron and destroys humans.

FeSO_4 is removed from water by treating it with lime.



Iron can be removed from water by a mixed coagulant consisting of sodium aluminate and ferric chloride (Molar ration, NaAlO_2 to FeCl_3 is 1:1). The concentration of residual iron does not exceed 0.3 mg/litre. Iron present in organic and inorganic compounds can be removed by this method.

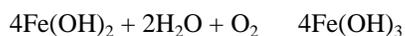
Another method to remove iron is to pass water through a bed of highly dispersed suspension of chalk and aluminium hydroxide. The iron salts are converted into ferrous carbonate by chalk.



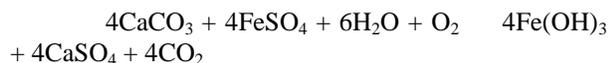
FeCO_3 is hydrolysed into ferrous hydroxide.



The Fe^{2+} iron is then oxidized to Fe^{3+} iron.

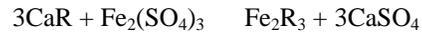


The overall reaction can be represented as,



Ferric hydroxide is retained in the suspended filter which contains 16 parts by weight of $\text{Al}(\text{OH})_3$ per 100 parts of CaCO_3 . About 95% of iron present in water can be removed by this method [2].

Ferric iron can be removed from water by the cation exchange method. For example, when water passes through calcium form of cation exchanger, the following reaction occurs.



The iron content can be decreased by this method upto 0.05 mg/litre and even lower.

It has also been observed that ferrous iron is converted into ferric iron when passed through a granular filter (without preliminary oxidation of iron). The process is accompanied by the formation of a ferric oxide film on the grains of the filter, which acts like a catalyst. Hence water is purified from iron by filtration and is an autocatalytic process.

There is, however, no universal method to remove iron from sub soil water, and the selection of a particular method depends on the analysis of water taken from the source.

The removal of iron from sub-soil sources by filtration is combined with one of the preliminary methods of purification of water, such as simplified aeration, adding oxidants with or without aeration.

The simplified aeration consists in that water falls on the filter from a height of 0.5 to 0.6 m. The method is convenient for water containing upto 10 mg/litre of total iron, of which the ferrous iron content should not be less than 70%, because no film is formed on the grains in its absence. [Ref.6]

The investigations have shown that only the presence of ferrous iron in water delivered on the filter provides the conditions under which the film is formed to ensure the high iron-removal effect.

DISCUSSION AND CONCLUSION

WHO International Standard recommended a permissible limit of 0.3 mg/L and an excessive limit of 1.0 mg/L iron in drinking water. Iron tends to precipitate as hydroxides and stain laundry and porcelain fixture. Iron oxides form adherent coatings and lead to tube failures. Heavy metal like iron in water acts as cumulative poisons and accumulates in the bodies of living organisms causing chronic diseases. Iron causes skin and stomach diseases in man. Intestine is unable to absorb suspended iron of water as it is found in the form of ferrous ions. Thus removal of iron from water is necessary for easy consumption and assimilation.

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