Vital Role of Iron in the Parameter to Increase the Quality of Water

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Abstract: ***Iron is one of the most abundant elements of the rocks and soil. All kinds of water including ground water have appreciable quantities of iron. Because of its more solubility at acidic pH, therefore, large quantities of iron are leached out from the soil by acidic waters.***

Keywords: Man has tried to cope up with the scenario and has rapidly advanced its efforts to counteract this malady. A large number of parameters signifying the quality of waters in various uses have been proposed. A regular monitoring of them not only prevents diseases and hazards but also checks the water resources from going further polluted.

1. Introduction

Iron, having a functional role in living system, is an essential elements for plant and animal lives & present in a number of biologically significant proteins. It participates in two main processes: oxygen-transfer and electron-transfer. There are other molecules functioning as storer and tranporter of iron itself in the biological processes. The deficiency of iron in human body causes anaemia and weakness but large quantities result in haemochromatosis when tissue damage occurs due to excess of iron accumulation. Higher Fe^{+2} content found in drinking water of some areas caused red colouring of teeth of the inhabitants.

A concentration of iron as low as 0.3mg L-1 in water makes it unpalatable and stains laundry and plumbing fixtures. Higher concentrations are undesirable in water distribution systems as the flow of water is reduced due to the deposition of iron compounds. The growth of “iron bacteria” is also promoted, as these micro-organisms derive their energy from the oxidation of Fe (II) and, on this account, a slimy coating deposits on the piping.

Iron occurs in conjunction with molybdenum in enzymes catalyzing nitrogen fixation. The chief heme-proteins are the hemoglobins, myoglobins, cytochromoes and some enzymes such as catalase and peroxidase, the functions and mechanisms of which are well documented in literature.

Iron is involved with copper in the natural selection of aerobic cells and in the evolution of metalloproteins and metalloenzymes. The evolution resulted in the development of copper-zinc enzymes (superoxide dismutase), heme enzymes, iron-copper enzymes and oxygen-carrying proteins. The adaptation demanded elaborate storage and transport proteins, exclusively for iron and copper. Ceruloplasmin represents the latest example of the link between iron and copper in the vertebrates.

The pale blue-green colour of the aqueous iron (II) solution is on account of the species $[Fe(H_2O)_6]^{+2}$. The potential of the Fe^{+3}–Fe^{+2} couple is such that molecular oxygen converts Fe (II) to Fe (III) in acid solution:

$$2Fe^{+2}+\frac{1}{2}O_2+2H^{+}=2Fe^{+3}+H_2O,$$

$$E^{o}=0.46V$$

In basic solution, the oxidation is still more favourable:

$$\frac{1}{2}Fe_2O_3.3H_2O+e=Fe(OH)_2(S)+OH^{-}$$

$$E^{o}=-0.56V$$

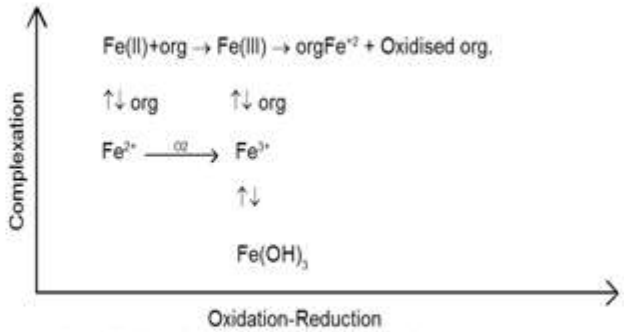
Thus, ferrous hydroxide, when precipitated in presence of air, rapidly becomes dark and is finally converted into $Fe_2O_3.nH_2O$. Because of Fe(III) remaining in the form of hydroxo-complexes, except in extremly acid solution, and for kinetic reasons, oxidation becomes less rapid with increasing acidity.

The oxidation of Fe(II) to Fe(III) by molecular oxygen in neutral solutions may involve a reaction between $Fe(OH)_2^{+}$ and O_2. The related problem of oxidation of Fe^{+2} by H_2O_2 (Fenton’s reagent) is complicated and involves radicals generatred by the reaction:

$$Fe^{II}+H_2O_2\rightarrow Fe^{III}(OH)+OH^{-}$$

In the absence of strong complexing agents, iron selectively combines with OH^{-} available at pH>7 and alternates between the forms $Fe(OH)_2^{+}$, $Fe(OH)_4^{-}$.

Complex formation has a direct bearing on the toxicity of the metal, it can also affect the redox potential of the system and eventually, many other properties including biochemical. Theis and Singer (1974) have shown that various humic acids as tannic and gallic acids, can completely retard the oxidation of Fe(II) for several days. They describe the behaviour of Iron in the presence of organic matter and oxygen according to the following scheme.



Both Fe(II) and Fe(III) can be stabilized by organic matter.

In water, iron occurs both in the divalent and trivalent states. In surface water, it is generally present as Fe(III). The concentration of iron in the well aerated water is seldom high but under reducing conditions which may exist in some ground water, lakes or reservoirs and in the absence of sulphate and carbonate, high concentrations of soluble Fe(II) may be found.

The presence of iron in natural water can be attributed to the leaching of rocks and minerals, acid mines drainage, ferrous metallurgy, landfill leachates, sewage and engineering industries. Ferrous metallurgy is the principal anthropogenic source of iron starts right from the handling and sintering of the ore, hematite. Blast furnace in itself was a great source of iron emission. However the high CO^- content of the waste gases now makes them a valuable fuel for other kinds of operations in the steel works. The tremendous evolution of fine orange brown fumes from the oxidative processes in steel converters pose a great threat to environment.

2. Conclusion

Iron is an essential element for plants and animals. It involves in some very important process such as – Oxygen transfer and electron transfer. Iron is very essential element for drinking water because it is also need of human body in the formation of haemoglobin. It has biological activity such as – with Molybdenum it present as enzyme which catalyzing nitrogen fixation.

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