ORIGINAL RESEARCH PAPER

Environmental Science

ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS AND REMOVAL OF SOMEA DIVALENT ELEMENTS IN SURFACE WATER

KEY WORDS: Surface water, iron and manganese treatment, aeration, chlorination, KMnO4.

Kulkarni C.P.

Department of Chemistry, Kirti M. Doongursee College of Arts, Science and Commerce, Dadar (W), Mumbai - 400028, INDIA

ABSTRACT

Water resources have been the most exploited natural system since the world begun and it is used for domestic, agricultural activities and industrial purpose. Water intended for human consumption must conform to standard magnitude of physicochemical parameters such as pH, hardness, conductivity and turbidity. The increase in concentration for iron and manganese case change in the taste of water and sometimes effect on the human health. In the present study, some physicochemical parameters such as temperature, pH, total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), calcium, magnesium, chloride, nitrate, nitrite, fluoride, Iron and Manganese were analyzed using standard methods. The results expressed that the pH was in minimum limits. Fluoride concentrations in the study area were very low. Iron (0.281) and Manganese (0.963) was found above the limit before treatment, whereas after treatment by Oxidizing agent and chlorination, the level of Fe and Mn reduced. Water quality in the area should be analyzed continuously due to potential risk of pollution. Study shows that the treatment surface water by Treatment by KMnO4 and Oxidizing agent are the best method of removal of removal of some divalent elements in Surface water

Introduction

Water is vital to life. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth. The main sources of fresh water are ground and surface water. These sources of freshwater resources are threatened by overexploitation, poor management and pollution. Water intended for human consumption must conform to standard magnitude of physicochemical parameters such as pH, hardness, conductivity and turbidity. It must also abide to certain permissible levels of heavy metals (Hanaa *et al.*, 2000; Maigari *et al.*, 2014). Actually specific drinking water standards are not given or not mentioned for all the four parameters by WHO. Access to a safe and reliable supply of drinking water is essential for the wellbeing of all human beings. However, the availability of fresh water is getting scarce let alone its quality, which becomes a major issue in our world. Though water is important to life, it is one of the most poorly managed resources in the world (Fakayode, 2005). Besides the shortage, the pollution of water by different agents is also a threat to human health and economic growth. These critical drinking water problems are more pronounced in the underdeveloped and some developing countries.

High content of iron and manganese in groundwater has no negative effects on human health, but they often cause technical difficulties in public water supply systems, aesthetic quality problems for domestic users and complaints from industrial users. Iron and manganese have no negative effects on human health, but they cause technical difficulties such as clogging of water supply well screens and the water delivery pipelines, and taste and odour problems detectable at very low concentrations. Small amounts seriously affect the use of water for domestic purposes because iron and manganese in water stains plumbing fixtures and clothes during laundering, causing aesthetic water quality problems for the users. The presence of iron and manganese in a water supply may also cause complaints from industrial users (e.g. paper mills, petrochemicals, bottlers, textiles, commercial laundries) (Ibrahim *et al.*, 2015).

Higher concentrations of iron and manganese in water cause technological problems, failure of water supply systems operation, water quality deterioration and, in water with slightly higher concentrations of oxygen, they form undesirable incrustations that result in the reduction of pipe flow cross-section(McFarland and Dozier, 2001). Moreover, previous studies have indicated that the presence of Fe and Mn in surface water, but analysis and the removal of Fe and Mn from surface water; it was an objective of the present study.

Materials and Methods

Sample Collection: One sample was collected from Mithi River of Kalina location Mumbai. Samples for chemical analysis were collected in clean plastic containers (500 ml capacity). The sample bottles were clearly labeled and the required information was recorded in a form and supplied with the sample.

Determination of Physicochemical Parameters:

Analysis was carried out for various water quality parameters such as Temperature, pH, total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), calcium, magnesium, chloride, iron, nitrate, nitrite, fluoride. Total Dissolved Solids meter was used to measure the temperature of water and the total dissolved solids while pH is measured by a pH meter. Concentration of chemicals was measured using standard method (APHA, 1998).

Methods of Iron and Manganese Removal:

The principle of most methods used for iron and manganese removal is that originally dissolved iron and manganese are transformed into undissolved compounds that can be removed through single-stage or two-stage separation. Oxidation and hydrolysis of these compounds is done under strict conditions with respect to water properties and type of equipment for iron and manganese removal. Single-stage water treatment (filtration) is designed for iron and manganese concentrations to 5 mg•l-1, and the two stage treatment (settling tanks or clarifiers and filters) is used for water with iron and manganese concentrations higher than 5 mg•l-1. In case water contains higher concentrations of Ca, Mg, and CO2 (eventually H2S), aeration is done before settling or filtration. Removal of Fe and Mn from groundwater and surface water can be done by several methods: oxidation by aeration, removal of Fe and Mn by oxidizing agents (O2, Cl2, O3,KMnO4), removal of Fe and Mn by alkalinization (by adding thelime), contact filtration for removal of Fe and Mn, removal of Fe and Mn by ion exchange, removal of Fe and Mn using membrane processes, removal of Fe and Mn using biological filtration, removal of Fe and Mn using in situ method.

Results and Discussion:

The findings of our study illustrated that hardness of water in Mithi river, the main source of water, was 84 mg/l; while in ground water samples that taken from different wells in the study area, the hardness was found within the range from 84 to 232. There was association between the concentrations of calcium, magnesium and hardness. We found high concentrations of these parameters in all samples as well as high level of hardness, compared to the Indian guidelines of drinking water. The degree of hardness of drinking water is important for aesthetic acceptability by consumers and for economic and operational considerations. Many hard waters are softened for those reasons using several applicable technologies, and the mineral composition will be significantly affected.

The presence of some heavy metal and minerals with certain concentrations is important to supply the human body with essential nutrients. Despite this importance, the high concentration of heavy metals in the water could lead to adverse effect and influence the beneficial use of the water 4 this why the WHO stated a guideline for quality of water. The potential risk of chemicals is important because it is too difficult to treat them in water and metabolically degrade in human body. Most of developing countries have no means of chemical treatment due to limited financial ability. The minerals predominantly determining total hardness, namely calcium and magnesium, remained of interest for the World Health Organization (WHO, 2006)

Adverse effects of higher Fe and Mn concentrations in drinking water can be summarized as follows: • iron (II) and manganese (II) ions are oxidized to higher forms in a water distribution system and this results in the formation of hydroxide suspensions causing undesirable turbidity and colour of water, the presence of iron and manganese bacteria in water supply system causes change in water quality (smell) and bacterial growth in pipes, • in the case of the occurrence of iron (II) and manganese (II) ions at the consumer's point, iron manganese are oxidized and precipitated under suitable conditions (e.g. in washing machines, boilers). Following the above-mentioned facts, higher concentrations of iron and manganese in water cause technological problems, failure of water supply systems operation, water quality deterioration and, in water with slightly higher concentrations of oxygen, they form undesirable incrustations that result in the reduction of pipe flow cross-section (WHO, 2008).

Table 1: Physicochemical analysis of surface water

No	Parameter	Unit	Results
1	Temperature	O C	27.8
2	pH	--	6.57
3	Turbidity	NTU	0.84
4	Total dissolved solids (TDS),	Mg/l	112.7
5	Total alkalinity (TA),	Mg/l	80
6	Total hardness (TH),	Mg/l	156.3
7	Calcium,	Mg/l	17.2
8	Magnesium	Mg/l	66.8
9	Chloride	Mg/l	11.7
10	Fluoride	Mg/l	0.13
11	Iron	ppm	0.302
12	Manganese	ppm	0.115

Treatment by Chlorination: Chlorine is the most commonly used disinfectant employed for killing bacteria in water. In addition chlorine, as an oxidizing agent, is used to remove undesired inorganic species such as ammonia, iron and manganese.

Chemical treatment by KMnO4: Potassium permanganate (KMnO4) is used primarily to control taste and odors, remove color, control biological growth in treatment plants, and remove iron and manganese. In a secondary role, potassium permanganate may be useful in controlling the formation of THMs and other DBPs byoxidizing precursors and reducing the demand for other disinfectants.

In a secondary role, potassium permanganate may be useful in controlling the formation of THMs and other DBPs by oxidizing precursors and reducing the demand for other disinfectants.

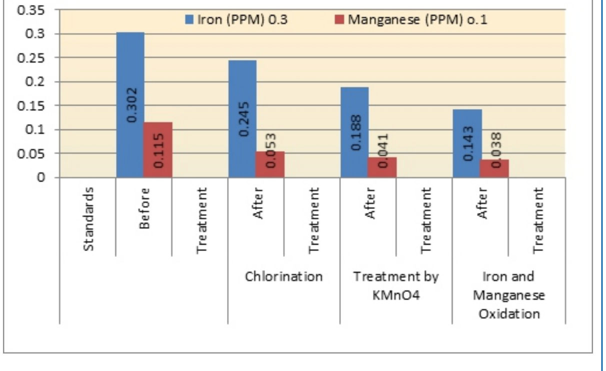
Iron and Manganese Oxidation: A primary use of permanganate is iron and manganese removal. Permanganate will oxidize iron and manganese to convert ferrous (+2) iron into the ferric (+3) state and +2 manganese to the +4 state. The oxidized forms will precipitate as ferric hydroxide and manganese hydroxide (22). The precise chemical composition of the precipitate will depend on the nature of the water, temperature, and pH.

The study results showed that the physicochemical parameters were generally within the permissible levels of the international drinking water guidelines of WHO, although turbidity levels were slightly higher than the desired level of WHO standards. It should be noticed, however, that Cr concentration level is below the WHO standards and guideline levels for Fe and Mn are not given by WHO as they are not considered health hazards in concentrations they are normally present in water. This water, therefore, can be said to be of safe quality measured against WHO standards. However, there is a need for improvement in the water treatment process, especially in the effective removal of turbidity, and reducing the levels of Cr, Fe and Mn to the acceptable levels. Turbidity, although not a health risk, can seriously interfere with the efficiency of disinfection during water treatment(Table 1).

In addition, this study contributes towards understanding of the quality status of the Asmara water supply system, especially regarding the concentration of heavy metals, and can be used by concerned parties to improve the water quality status by introducing advanced treatment and distribution practices and a better management structure.

Table 2: Removal of divalent elements by various method

Methods	Parameters	Iron (PPM)	Manganese (PPM)
	Indian Standards	0.3	o.1
	Before Treatment	0.302	0.115
Chlorination	After Treatment	0.245	0.053
Treatment by KMnO4	After Treatment	0.188	0.041
Iron and Manganese Oxidation	After Treatment	0.143	0.038



Conclusion:

Some physicochemical parameters in the area were not satisfying the requirements in the World Health Organization. Water quality of surface and ground water should be subjected. Water quality in the area should be analyzed continuously due to potential risk of pollution. Study shows that the treatment surface water by Treatment by KMnO4 and Oxidizing agent are the best method of removal of removal of some divalent elements in Surface water

REFERENCES

1. APHA. (1998). Standards Methods for the Examination of Water and Wastewater, 20th edition, American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF). Washington, D.C.
2. Fakayode, S.O. (2005). Impact Assessment of Industrial Effluent on Water Quality of the Receiving Alaro River in Ibadan, Nigeria. AJAEM-RAGEE, 10, 1-13.
3. Hanaa, M. S., Eweida A. E., Azza F. (2000). Heavy Metals in Drinking Water and their Environmental mpact on Human Health. ICEHM2000, Cairo University, Egypt, 542-556.

4. Ibrahim, A. E. M., Osman, B. O., Mohamed-Ali, M. H. (2015). Assessment of Physicochemical parameters of surface water sources in Kusti Town - Sudan. European Journal of Pharmaceutical and Medical Research, 2(4), 44-58.
5. Maigari, A. U., Ekanem, E. O., Garba, I. H., Maigari, F.U. (2014). Physico-Chemical and Trace Element Levels in Water from Dams, Rivers and Boreholes in Gombe State, Nigeria, Physics and Materials Chemistry, 2(1), 25-29.
6. McFarland, M. L. & Dozier, M.C. (2001). Drinking water Problems: Iron and Manganese, Texas Agricultural and Mechanical University, U.S.A. http://extensionenespanol.net/pubs/l5451.pdf. Accessed 14 December 2015.
7. WHO. (2006). Guidelines for drinking-water quality, 3rd ed. incorporating first addendum. Vol. 1, Recommendations. WHO Press, Geneva, Switzerland.
8. WHO. (2008). Guidelines for drinking-water quality [electronic resource]: incorporating 1st and 2nd addenda, Vol.1, Recommendations. – 3rd ed. WHO Press, Geneva, Switzerland.