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Original Research Paper

Iron and Manganese Contents in Godavari River Water at Nanded, Maharashtra

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ABSTRACT

The study describes assessment of iron and manganese in surface waters of Godavari river. The results were compared with the standard permissible limits of WHO, ISI, ICMR (i.e., 0.3 mg/L and 0.1mg/L respectively) and it was found that the concentration of Fe and Mn was below the permissible limits. On an average, the highest concentration of iron and manganese was present in March and lowest in October.

INTRODUCTION

Untreated domestic sewage and industrial effluents when released in surface water bodies create serious water pollution problems as they contain significant amount of heavy metals, which bioaccumulate in the environment and reach man through food chains. Iron occurs relatively abundantly (5%) in the earth's crust, and manganese about 0.085%. Manganese and iron are often found together in water. The two have similar chemical make-up and appear in water that travels through soil and rocks. Well water is particularly affected with manganese contamination. Iron and manganese are transition metals, which rarely exceed 1 mg/L in natural waters.

The common sources of iron and manganese in water are natural such as weathering of iron and manganese bearing minerals and rocks, industrial effluents, acid-mine drainage, sewage and landfill leachate. Iron (Fe) and manganese (Mn) can be present in water in one of three basic forms like dissolved: ferrous (Fe^{2+}) and manganous (Mn^{2+}), particulate: ferric (Fe^{3+}) and manganic (Mn^{4+}), and colloidal: very small particles (difficult to settle and filter).

The presence of iron and manganese in water is not considered health problem. In fact, small concentrations are essential for human health. Iron and manganese deficiency in man causes diabetes, nervous instability, disorder of cartilaginous growth in infants and children, rheumatoid arthritis and anaemia. But, high concentration of iron and manganese may give the water an unpleasant metallic taste while still being safe to drink. Excess of iron causes 'haemochromatosis'. Iron bioaccumulates in living beings, causes rapid increase in respiration, pulse rate, coagulation of blood vessels, hypertension and drowsiness.

Manganese is essential trace element at low concentration. A daily intake of 2.5-5.0 mg of manganese contributes to well being of the cells because it acts as a co-factor in some enzymatic reactions such as those involved in phosphorylation, synthesis of fatty acids and cholesterol. However, higher level of manganese accumulates in kidney, pancreas, intestine, liver and bones, and causes "manganese psychosis" (similar to Parkinson's disease), which is an irreversible brain disease characterized by uncontrollable laghtruphoria, impulsiveness, sexual excitement followed by impotency, etc. Chronic manganese poisoning is known as manganism. Fe and Mn cause reddish-brown and brownish-black

stains respectively. Fe and Mn deposits are build-up in pipelines, pressure tanks, water heater and water softeners reducing the available quantity and pressure of water supply. These are also objectionable to paper industry, laundry work, photographic films and textile industry. The treatment methods for the removal of iron and manganese from water are water softening (cation exchange), aeration**,** chlorination, filtration, oxidation, chemical precipitation, phosphate treatment, zeolite process, biosorption, household filter, etc. The present study deals with concentration of iron and manganese in River Godavari at Nanded.

MATERIALS AND METHODS

The River Godavari originates from Trimbakeshware near Nashik in Maharashtra and after travelling through southern Maharashtra reaches Nanded and then enters Andhra Pradesh and finally opens into the Bay of Bengal. The river covers a total length of 1465 km from its point of origin to the Bay of Bengal. The two sampling stations were selected for the study, i.e., S_1, upstream Goverdhan Ghat (uppermost part of river which has pure natural water) and S_2, downstream old bridge (lowermost part which leaves the city and has been contaminated by domestic wastewater of the city) along the Nanded city.

The samples were collected for a period of 6 months from October 2007 to March 2008 in plastic bottles, which were thoroughly rinsed with nitric acid and then several times with distilled water. The preservatives were added in the bottle. Samples were analysed on the same day of collection. Temperature was measured by thermometer and pH by digital pH meter in laboratory. The iron content was estimated by phenonthroline method, and the manganese by persulphate method**.**

RESULTS AND DISCUSSION

Results of the study are given in Table 1 and Figs. 1 and 2. Highest concentrations of Fe and Mn were 0.28 mg/L in S_1 sample and 0.32mg/L in S_2 sample, and 0.097mg/L in S_1 and 0.1mg/L in S_2 respectively in the month of March. Lowest concentration of Fe and Mn was obtained in October in S_1 (0.04mg/L) and 0.04mg/L in S_2, and 0.008mg/L in S_1 and 0.03mg/L in S_2 respectively. In general, the iron present in S_1 is in an range between 0.04 and 0.28 mg/L, and in S_2 between 0.04 and 0.32 mg/L. The amount of Fe and Mn in the samples was less than permissible limit given by WHO, ICMR and ISI, i.e., 0.3mg/L and 0.01mg/L respectively, and hence the water is suitable for drinking with respect to these parameters. Role of metals in health and diseases are the areas of metal deficiencies or toxicity, therefore, it is necessary to determine the heavy metals in water used for drinking, irrigation and other purposes.

Average iron content in Tungabhadra river was found to be 0.52 mg/L, which was mainly due to effluents discharged from industries. The harmful chemicals reach human population and animals, and bioaccumulate, which may become serious in long run. Iron concentration in Tungabhadra river was 0.34 mg/L at the confluence zone of Tunga and Bhadra. These two rivers flow further, pollutants settle down due to gravity and their amount slowly decrease due to selfpurification capacity. Water of Bhadra river was analysed by Manjappa et al. (2006) where Fe concentration varied from 0.13 mg/L to 0.847 mg/L. Shrivastava & Masood (2007) observed Fe in Kelo river at 1.7 mg/L in premonsoon, which is due to effluent discharge from Nalwa Sponge iron plant. The effluents discharged seem to have concentrated along the stretch due to low water availability throughout summer. Tiwary et al. (2005) analysed the water quality of Ganga river in Bihar region and found maximum Fe concentration of 0.218 mg/L during summer, and minimum of 0.049 mg/L during rainy season. He concluded

Table 1: The results of water analysis during October 2007-March 2008 at the two sites.

Months	Temperature, °C		pH		Iron(mg/L)		Mn(mg/L)	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Oct. 1	25	25	7.1	7.3	0.04	0.04	0.008	0.030
Oct. 15	25	25	7.2	7.3	0.06	0.10	0.009	0.040
Nov. 1	24	25	7.4	7.5	0.10	0.12	0.01	0.052
Nov. 15	23	23	7.3	7.4	0.12	0.12	0.012	0.054
Dec. 1	23	23	7.4	7.5	0.14	0.16	0.018	0.058
Dec. 15	23	24	7.5	7.6	0.18	0.18	0.020	0.060
Jan. 1	26	26	7.4	7.4	0.2	0.20	0.05	0.07
Jan. 15	25	26	7.5	7.6	0.24	0.24	0.06	0.075
Feb. 1	28	28	7.4	7.5	0.24	0.24	0.07	0.09
Feb. 15	28	28	7.8	7.7	0.26	0.24	0.075	0.095
Mar. 1	31	31	7.8	7.8	0.26	0.28	0.09	0.10
Mar. 15	31	31	7.5	7.6	0.28	0.32	0.097	0.10
S.D.					0.08	0.07	0.035	0.022
C.V.					44.8	39.4	60.30	34.0

S.D. = Standard daviation C.V. = Coefficient of variation

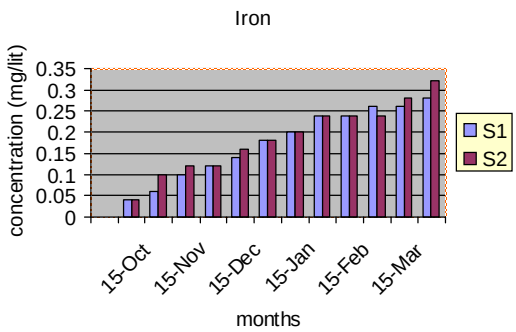

Fig. 1: Concentration of iron in the river at two sites.

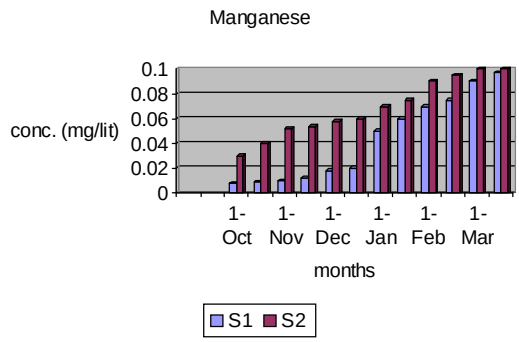

Fig. 2: Concentration of manganese in the river at two sites.

that toxicity of heavy metals is not only dependent on metal concentration but on other nontoxic metals and adsorbing or complexing agents. Kaushik et al. (2001) found Fe ranging from 0.07 to 0.94 mg/L in upper segment of Yamuna river, which is Delhi upstream. The concentration increased many folds in Delhi downstream showing 3.3 mg/L. Fe content exceeding 1.0 mg/L normally affects taste and appearance of water as well as water supply structures as it promotes iron bacteria. The iron content in Double lake water, Chennai ranged from 0.02 mg/L to 1.68 mg/L (Mazher Sultana & Dawood Sharief 2005). The higher values are due to contamination by industrial effluents and domestic sewage disposal.

Tiwary et al. (2005) found Mn concentration in Ganga river in Bihar region up to 0.105 mg/L. The concentration of Mn studied in Bhadra river by Manjappa et al. (2006) ranged from 30 to 178.6 µg/L in water, and 19.7 to 117.4 µg/g in sediments. Manganese is an essential element, which does not occur naturally as a metal, but is found in various salts frequently in association with iron compounds. High levels of Mn found in free flowing waters are usually associated with industrial pollu-

tion. The concentration of heavy metals in lake water after Ganesh-idol immersion was studied, and it was found that the Mn concentration was high 0.384 mg/L before the immersion. The reduction in elemental concentrations can be attributed to adsorption process of dissolved metal ions by the materials, particularly the coloured chemical hydrous metal oxides of Mn and Fe used on the idols. The resultant having settled on the sediment of the lake.

It can be concluded that concentration of iron and manganese in the water samples is mostly lower than the WHO standards. Iron and manganese were found highest in March, and lowest in October. The water is suitable for drinking with respect to iron and manganese.

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