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Determination of Iron and Manganese in Various Water Sources from Selected Areas in Balaghat District

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Abstract:- The main sources of fresh water are often ground water and surface water. Iron and manganese concentrations can be found in both surface and ground water. Concentration of these metals gives water a metallic taste and stains various items like paper, clothing, and plastics. When the concentration is high, it can occasionally have an impact on consumer health. The water we drink needs to be free of toxins in order to safeguard consumer health. Any water supply should be inspected or tested for physical, chemical, and biological contaminants. As a result, the Bureau of Indian Standards (BIS) has recommended that water should be treated if iron and manganese concentrations exceed 0.3 mg/L. The Wainganga River is the main source of water for the Balaghat district and its surroundings. Groundwater is a source of water in some towns and villages where treated water has yet to arrive. In this study, iron and manganese two chemical contaminants are examined in groundwater and Wainganga River water of Balaghat region. This study provides data on the presence of iron and manganese in the water collected from the selected area of Balaghat district.

Keywords:- *Surface Water, Ground Water, Iron, BIS Manganese, Determination.*

I. INTRODUCTION

In some areas of India, the groundwater is contaminated with excessive levels of iron and manganese, endangering human health. In addition to natural or geochemical contamination, there are other ways that groundwater can become contaminated. Water is necessary for the survival of all living beings. It is necessary for the water to be potable. A significant environmental issue is the accumulation of iron and manganese compounds in groundwater and subsequently in drinking water. Even at low quantities, iron and manganese compounds can be connected to a number of water quality issues, so getting rid of them is crucial. This is true for both surface and groundwater. The water shouldn't be consumed until it has undergone testing. India evaluates the quality of its water according to BIS recommendation, which are described in detail in IS 10500 : 2012. According to BIS, water with a range of parameter concentrations is suitable for human consumption. In this research work, it was determined to investigate the presence of iron and manganese in water.

II. OBJECTIVE OF RESEARCH WORK

The main purpose of this study is to investigate iron and manganese concentrations from water sources which are selected and situated in Balaghat. This study will help to know the current state of water quality with respect to iron and manganese.

III. MATERIALS AND METHODOLOGY

A. Study area

The Balaghat district, which is part of the Madhya Pradesh state in central India, is the focus of this study. Six sites in the Balaghat district were chosen for the study to determine the concentration of iron and manganese in surface and ground water. The Department of Public Health Engineering Waraseoni was contacted and requested to extend their cooperation for this research work. The testing of samples was done by direct co-operation of the Department of Public Health Engineering staff.

B. Sample Collection and Location

Accurate sampling is crucial for understanding the relevance of water analysis. Water samples were taken in clean plastic bottles that had been cleaned and cleansed twice with the water to be collected, once with tap water, and once with distilled water. The water samples were obtained, and as quickly as feasible after that, they were analysed. In February 2022, water samples were taken for this study at 6 distinct locations throughout the Balaghat Region.

The location of all of the sites are as follows:
Site 1 - Public hand pump in Waraseoni (A)
Site 2 - Wainganga River, Bajrang Ghat (A)
Site 3 - Wainganga River near bridge (B)
Site 4 - Chandan River Mehndiwada
Site 5 - Public tap water in Waraseoni
Site 6 - Public hand pump in Waraseoni (B)

Fig. 1. Site 1 is a public hand pump in Waraseoni (A

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Fig. 2. Site 2 Wainganga River, Bajrang Ghat (A)

Fig. 3. Site3 Wainganga River near bridge (B)


Fig. 4. Site4 Chandan River Mehandiwada

Fig. 5. Site5 Public tap water in Waraseoni
Source: Google Earth

Fig. 6. Site6 Public hand pump in Waraseoni (B)

IV. EXPERIMENTAL METHODS

A. Determination of iron from Water Sample

Iron in water is determined by the Phenanthroline method. Stepwise process is as follows-

1) Using a graduated cylinder, add 50 mL of the water sample to the flask.
2) Using a pipette, measure and add 2.0 mL of each Hydrochloric acid and Hydroxylamine hydrochloride solutions to the same flask.
3) Add 3-4 glass beads, shake the solution and boil on the heating plate to reduce the volume to 20-30 ml and Cool at room temperature.
4) Finally, add 10ml Sodium Acetate and 2ml 1:10-Phenanthroline solution and to make up to 100ml use distilled water and mix well.
5) Fill the cuvette with a blank solution of iron and place it in the spectrophotometer. Set the wavelength to 510nm by adjusting the wavelength control knob and setting transmittance at 100%.
6) Fill the cuvette with the prepared sample, then put it in the spectrophotometer to measure the transmittance and record the result.
7) Determine the concentration of iron in the unknown solution by locating its transmittance on the reference/ (standard) graph (in fig. 7).
8) Make a note of the graph reading and use the formula for iron calculation.

B. Formula

Iron (mg/l) = (Standard matched *0.01*1000) / 50

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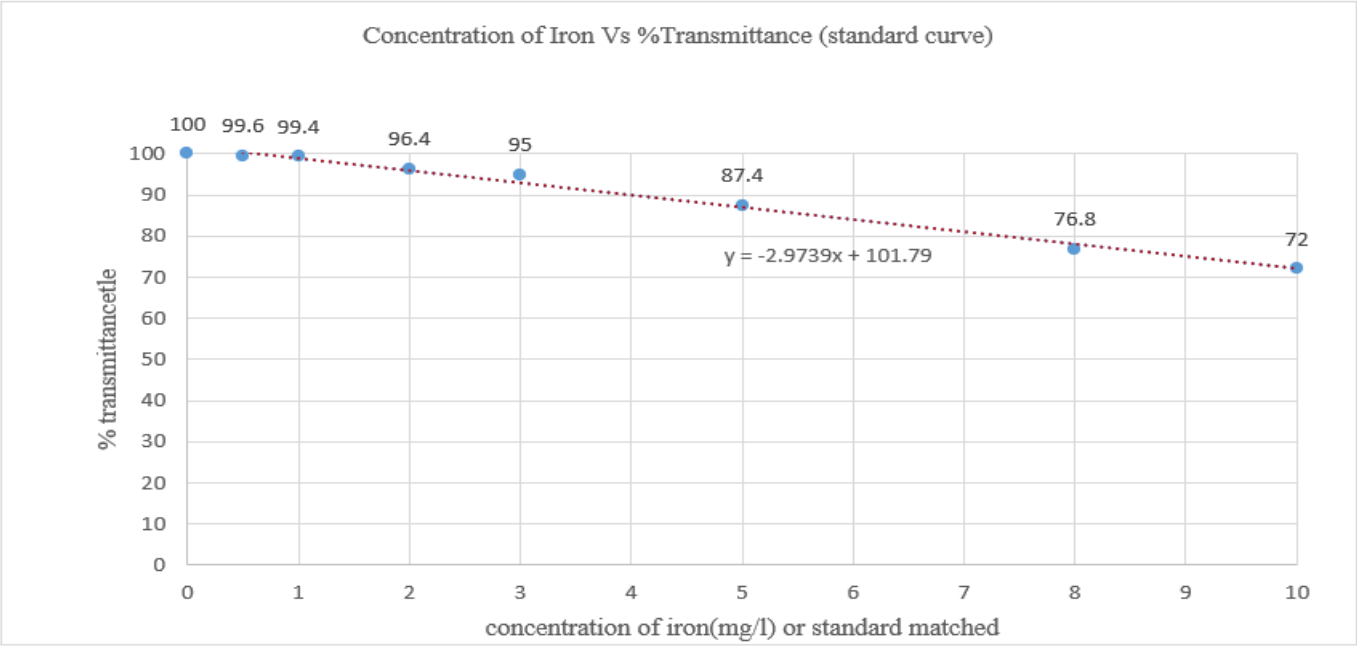

Fig. 7- Standard/Reference curve for Iron

C. Determination of Manganese from Water Sample

Manganese in water is determined by the Per Sulfate Method. Stepwise process is as follows-

1) Pour 100 mL of the water sample into a conical flask using a graduated cylinder.
2) Take 5ml of the "Special Reagent for Manganese" with a pipette and place it in the same flask. Shake the mixture.
3) Add 3–3 glass beads, and boil the mixture on the heating plate to reduce the volume to 80–90 ml. Before putting the flask back on the heating plate to continue boiling for an additional 10-15 seconds.
4) Add 4-5 grams of ammonium per sulphate to the solution that is already boiling. Make it up to 100ml with distilled water after allowing it to cool at room temperature.
5) Place the cuvette in the spectrophotometer after filling it with manganese blank solution. Record the transmittance reading that you take.
6) Locate the unknown solution's transmittance on the calibration curve using a reference/ standard graph, and then work out its manganese concentration.
7) Make a note of the graph reading and use the manganese calculation formula.

D. Formula

Manganese (mg/l) = (Standard matched *0.01*1000)/100

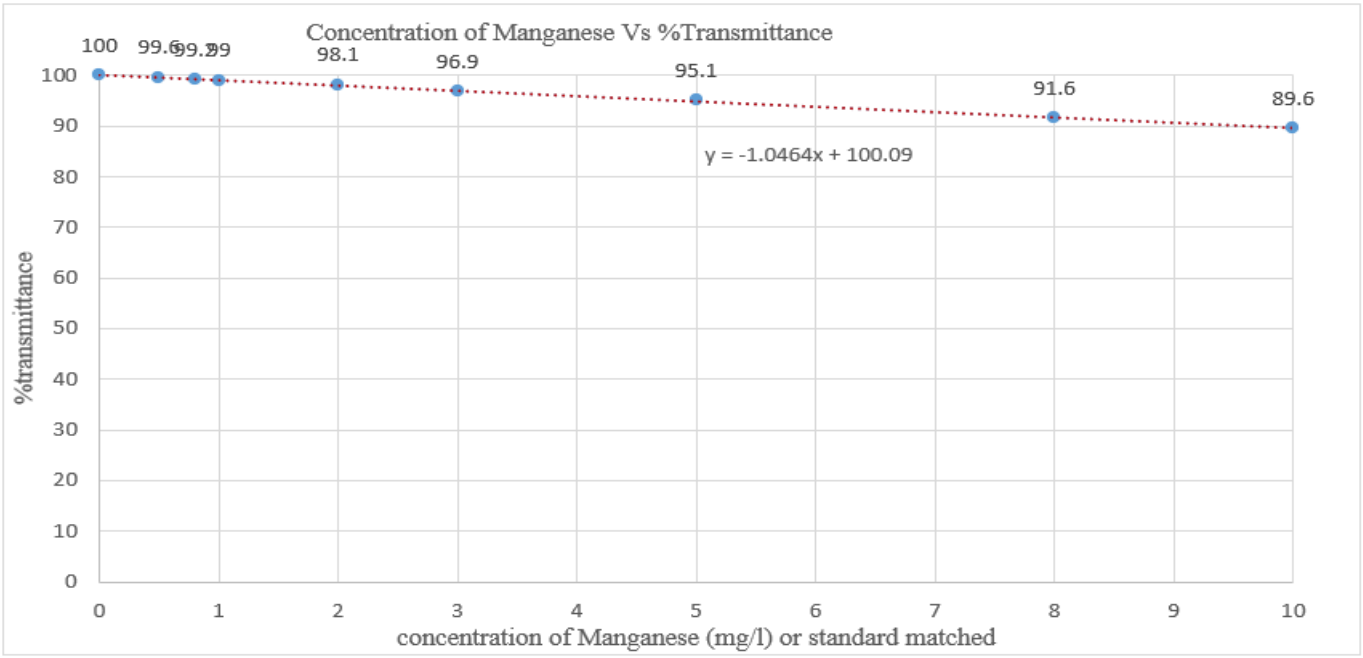

Fig. 8- Standard/Reference curve for Manganese

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V. OBSERVATIONS

Following observations were taken by using above mentioned methods.

A. For Iron –

Table No.1 Iron test observations

Sample/ Site No.	Sample name	%transmittance(using spectrophotometer)(on y axis)	Standard matched(in graph) (on x axis)
1	**Public hand pump water (A) Waraseoni**	**65%**	**12.26**
2	Wainganga river water Bajrang Ghat(A)	99%	0.97
3	**Wainganga river water, Bridge (B)**	**87.5%**	**4.79**
4	Chandan river water Mehandiwada	98%	1.30
5	Tap water Waraseoni	99.5%	0.81
6	**Public hand pump water(B) Waraseoni**	**78%**	**7.95**

B. For Manganese –

Table No.2 Manganese test observations

Sample/ Site No.	Sample name	%transmittance(using spectrophotometer) (on y axis)	Standard matched(in graph) (on x axis)
1	**Public hand pump water (A) Waraseoni**	**91.5%**	**8.20**
2	Wainganga river water Bajrang Ghat (A)	99.7%	0.38
3	Wainganga river water Bridge (B)	98%	2.00
4	Chandan river water Mehandiwada	100%	0.09
5	Tap water **Waraseoni**	100%	0.09
6	**Public hand pump water(B) Waraseoni**	**96%**	**3.91**

VI. RESULTS AND DISCUSSION

The results of laboratory tests are shown in Table No.3.

A. For Iron

According to the table 3 below, sites 1, 3, and 6 have more iron than is recommended.

B. For Manganese

According to the table 3 below, sites 1 and 6 contain more manganese than is recommended

Table No.3 Iron and Manganese Test Results

No	Physical Parameters	Site 1	Site2	Site3	Site4	Site5	Site6	BIS Recommendation	
								Acceptable limit (mg/l)	Permissible limit(mg/l)
1	Iron(mg/l)	**2.45**	.19	**.96**	.26	.16	**1.59**	0.3	No relaxation
2	Manganese(mg/l)	**.82**	.04	.20	0	0	**.39**	0.1	0.3

VII. CONCLUSION

In February 2022, the samples were collected and tested for iron and manganese concentrations. Based on the research and findings, the following conclusion could be reached:

The findings show that sites 1, 3, and 6 are iron-polluted. As a result, it is not rcommended to use these sources untreated. Although sites 2, 4 and 5 are iron free. Manganese pollution has affected Sites 1 and 6. Therefore, these two sources need to be treated before use. Sites 2, 3, 4 and 5 are manganese free. Overall we can say that sites 2, 4 and 5 are completely safe against iron and manganese.

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