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Hydrochemical characteristics of ground water (well & tube well) in the slum area of Bhoogaon, Wardha district, Maharashtra

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ABSTRACT

The chemical characteristics of ground water (well & tube well) in the slum area of Bhoogaon, Wardha district, Maharashtra state has been studied to evaluate the suitability of water for domestic and agricultural purpose. Water samples were collected and analyzed for Temperature, pH, EC, TS, TDS, Turbidity, Total hardness, Total alkalinity, Ca, Mg, DO, BOD, Chloride, Sulphate. The results indicate that most of the ground water samples are of good quality and within the permissible limit prescribed by BIS (1991) for pH, Turbidity, TS, Total hardness, Ca, Mg, Total alkalinity, Chloride, Sulphate.

Key Words: Chemical characteristics, Total hardness, Total alkalinity.

INTRODUCTION

Water, the precious gift of nature to human being is going to be polluted day by day with increasing urbanization. Although three-fourth part of earth is being surrounded by water but a very small portion of it can be used for drinking purposes. Studies of chemical characteristics of ground water (well & tube well) from various places of Bhoogaon, Wardha district in Maharashtra state has been carried out for 1st time. In this region, generally well and tube well water is used for drinking, domestic and for agricultural purpose. Exhaustive use of fertilizers, pesticides, manure, lime, refuse dumps etc. is main source of well water pollution in many villages. So we carried out a study on hydrochemical parameters of wells and tube wells water of village Bhoogaon.

EXPERIMENTAL SECTION

The water samples were collected from six different wells and tube wells situated at different places in Bhoogaon, Wardha district, which is used for drinking and agricultural purpose. The samples were collected in 2 liter plastic container during month of May 2007 and were brought to laboratory for study. The Temperature, pH, EC and Dissolved oxygen were measured immediately. The water samples were stored in refrigerator to avoid any microbiological decomposition. Various physico-chemical parameters like Total solids (TS) , Total dissolved solid (TDS), Total hardness (Th), Total alkalinity, Calcium , Magnesium, BOD, Chloride, Sulphate were analyzed by standard procedures described in APHA (1992) [1] and Trivedy and Goel (1986) [2],(Table 1).

AR grade reagents and double distilled water were used for reagent preparation.

Table 1:- Methods used for Physico-chemical analysis of water samples[3]

S. No.	Parameters studied	Methods used
1.	pH	Systronic-361 pH meter.
2.	Electrical conductivity (EC)	Systronic conductivity meter.
3.	Total solids (TS) and total dissolved solids (TDS)	Evaporation method.
4.	Total hardness (Th)	EDTA Titration.
5.	Total alkalinity (Ta)	Neutralization with standard HCl.
6.	Turbidity	Nephelometric method.
7.	Calcium hardness	EDTA titration.
8.	Magnesium hardness	Calculation.
9.	Dissolved oxygen (DO)	Winkler's method.
10.	Biological oxygen demand (BOD)	Winkler's method.
11.	Sulphate	Gravimetric method.
12.	Chloride	Mohr's method.

RESULTS AND DISCUSSION

The values of hydrochemical characteristics of drinking water samples collected from six different wells and six different tube wells situated at Bhoogaon are represented in Table 2. These characteristics were examined in light of the IS: 10500, 1991 standards represented in Table 3 prescribed by BSI (1991) for potability of water wholly accepted by the ministry of health, Government of India [4].

The pH values of the well & tube well water samples varied from 7.1 to 7.6, the values of the pH throw light on alkaline nature of water. The alkalinity of the water from all the samples may be due to presence of carbonate & bicarbonates as well as due to contamination of dissolved gases [5]. The lower values of pH of tube well water samples as compared to well water samples indicate that the percentage of bicarbonate & carbonate decreases at higher depth. The pH values of water samples are within the recommended range of drinking water sample that is 6.5- 8.5 as per IS: 10500, 1991, prescribed by BIS.

The electrical conductivity of all the water samples varied from 0.4 to 0.8 mhos.cm⁻¹ which correspond to good quality of water. The electrical conductivity is always related to amount of dissolved solids (Soundara Pandia, p.61) [6]. The amount of dissolved solids varied from 30 mg/l to 55 mg/l which also support the electrical conductivity data obtained in these investigations.

The obtained values of TDS are within the desirable limit of 500 mg/l prescribed by WHO; 1984 [7].

All the water samples possess turbidity beyond the permissible limit of 10 NTU except water samples W-4, W-5, T-4, & T-5 having turbidity 8 NTU to 9 NTU which is also beyond the desirable limit of 5 NTU, only water sample T-6 have turbidity within desirable limit i.e. 4 NTU.

The total alkalinity value of water is important in calculating the dose of alum & biocides in water (Trivedy & Goel, 1986). Total alkalinity value of water samples presented in Table 3 varied from 136 mg/l to 215 mg/l. All the water samples have total alkalinity value within the desirable limit of 200 mg/l except W-4, W-5 and T-1 & T-4 samples however all the water samples have total alkalinity value within the permissible limit of 600 mg/l.

No.	Water parameter	Well water samples						Tube well water samples					
		1	2	3	4	5	6	1	2	3	4	5	6
1)	Temperature, °C	29	30	29	29.7	29	29.5	28	28	27.7	27	28	28.5
2)	pH	7.5	7.6	7.6	7.5	7.6	7.4	7.2	7.1	7.1	7.3	7.3	7.4
3)	Conductivity mhos. cm ⁻¹	0.8	0.8	0.7	0.8	0.6	0.7	0.7	0.6	0.4	0.5	0.5	0.4
4)	Total solid(TS) mg/l	300	250	190	285	320	325	250	180	160	210	240	155
5)	Total Dissolved solid (TDS), mg/l	50	41	35	30	55	46	42	30	30	41	29	40
6)	Alkalinity, mg/l	185	174	180	202	210	165	210	180	136	215	160	155
7)	Total Hardness, mg/l.	195	200	310	220	240	320	302	309	260	290	200	240
8)	Calcium, mg/l	71.0	60.9	59.3	78.1	81.2	66.1	86.0	68.9	72.0	57.8	66.9	70.6
9)	Magnesium, mg/l	19.3	21.1	17.1	34.5	32.1	14.1	36.2	10.9	11.5	14.4	15.5	14.5
10)	Dissolved oxygen, mg/l	5.1	5.9	2.3	3.1	5.8	4.5	4.4	3.2	4.9	5.1	2.6	4.8
11)	Biological oxygen demand, mg/l	13.1	12.2	18.1	25	11.3	38	11.2	18.1	13.2	12.0	30	11.3
12)	Sulphate, mg/l	106	110	108	96	89	75	83	72	98	102	48	80
13)	Chloride, mg/l	270	286	368	210	220	450	180	212	290	200	480	210
14)	Turbidity (NTU)	18	22	23	09	08	11	18	12	19	08	09	04

Table 3

S. No.	Parameters	IS :10500, 1991	
		Requirement(Desirable limit)	Permissible limit in absence of alternate source
1	Temperature	–	–
2	pH	6.5 -8.5	No relaxation
3	Turbidity	5	10
4	EC	5	10
5	Total solids (TS)	500	2000
6	Total hardness as CaCO ₃	300	600
7	Total alkalinity	200	600
8	Calcium	75	200
9	Magnesium	30	100
10	DO.	30	100
11	Chloride	250	1000
12	Sulphate	400	400

Note: - No standards, units: - Except Temperature (°C), pH (units), Turbidity (NTU), EC (mho. cm⁻¹) rest of the values are in mg/l

The sum of Calcium & Magnesium ion concentration in water is termed as total hardness. Total hardness value of well & tube well water samples varied from 195 mg/l to 320 mg/l. All the water samples have total hardness within the desirable limit of 300 mg/l except W-3, W-6, T-1 & T-2 but these values are within the permissible limit of 600 mg/l. Total hardness of water obtained in these results are useful in classifying all these water samples.

The calcium hardness value of water samples ranges from 57.8 mg/l to 86.1 mg/l. The entire water sample possesses calcium hardness within desirable limit of 75 mg/l except water samples W-4, W-5 & T-1 but these values are within the permissible limit of 200 mg/l. The Magnesium hardness values of water samples ranges from 11.5 mg/l to 36.2 mg/l. The entire water samples possesses Magnesium hardness within the desirable limit of 30 mg/l except water samples W-4, W-5, & T-1 but are within the permissible limit of 100 mg/l.

The value of dissolved oxygen (DO) of well & tube well water samples ranges from 2.3 mg/l to 5.9 mg/l. All the water sample possesses DO values beyond the desirable limit of 3 mg/l prescribed by ISI (Indian Standard Institute) except water samples W-3 & T-5 i.e. 2.3 mg/l and 2.6 mg/l respectively. The high value of DO for water sample may be due to high temperature, wave action, pollution load, organic matter and photosynthetic activity.

BOD represents the amount of oxygen required for microbial degradation of organic matter. In the present study, the values of BOD ranges form 11.2 mg/l since no prescribed standards are suggested by IS: 10500, 1991 for parameters like BOD, EC for drinking water purpose, hence no comparison can be made from observed values.

The values of sulphate content in well & tube well water samples ranges between 72 mg/l to 110 mg/l. All the water samples possess sulphate content within the desirable limit of 200 mg/l. All the water samples are free from sulphate pollution.

The values of chloride content in well & tube well water samples ranges from 180 mg/l to 510 mg/l. All the water samples shows chloride content beyond the desirable limit of 250 mg/l but within the permissible limit of 1000 mg/l except water samples W-4, W-5, T-1, T-2 and T-4. The high chloride concentration in presence of Mg^{+2} ions produce corrosion of utensils used for domestic purpose. The high value of chloride may be due to suspended particles, animal dung, human waste & other organic matter in water sample.

CONCLUSION

The pH values of all water samples are within the recommended range of drinking water, lower values of pH of tube well water samples indicate that the percentage of bicarbonate & carbonate decreases at higher depth. All the water samples possesses turbidity beyond the permissible limit of 10 NTU, thus use of coagulant like alum is recommended in this region. The electrical conductivity, TDS, total hardness and total alkalinity values of all the water samples are within the desirable limit, prescribed by WHO; 1984

DO value for all samples is beyond the desirable limit, except water samples W-3 & T-5. The higher value of DO may be attributed to high temperature, wave action, pollution load, organic matter and photosynthetic activity.

Chloride content in almost all samples is beyond the desirable limit of 250 mg/l, which may be due to suspended particles, animal dung, human waste and other organic matter in water sample.

This leads to corrosion of utensils and metal body of tube well in presence of Mg^{+2} ions. All the water samples are free from sulphate pollution.

Over all, the water samples collected from six different wells and tube wells of Bhoogaon, Wardha district, is good for agricultural purpose, while drinking water needs pretreatment.

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