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ASSESSMENT OF DRINKING WATER QUALITY OF SURGUJA DISTRICT (C.G.)

1.KOMAL KUMARI, 2. MANISH UPADHAY

1. *Research Scholar,*
Department of Chemistry, Dr.C.V.RAMAN University Kargi Road, Kota, Bilaspur
(C.G.), India,
e-mail : likho2komal@gmail.com

2. *HOD & Associate Professor,*
Department of Chemistry, Dr.C.V.RAMAN University Kargi Road, Kota, Bilaspur
(C.G.), India

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ABSTRACT

Ground water quality of Surguja District was studied for a period of one year (2012 to 2013) to assess its suitability for drinking purposes. Twenty eight ground water samples were collected for the study. Four samples from each block were collected. Thirteen physico-chemical parameters were analyzed and observed values were compared with standard values recommended by Bureau of Indian Standards (BIS). Analysis of result showed that water is not suitable for drinking purpose because fluoride content was observed above the permissible limit (BIS).

INTRODUCTION

Water, the unique substance, occupies the three fourth of world's area for which earth is indeed a water planet. In India, there is heavy reliance on ground water for drinking purpose. The existing ground water resource in India is estimated to be more than 45000 Million cubic meter (Rao,1979). Man's life is directly or indirectly sustain by water and is intimately associated with it. The Man and Biosphere programme (MAB) of UNESCO has laid emphasis on the studies on impact of various human activities in water and other resources (Sharma et al.,1978 and Alemaw, 2003). The physical (pH, TS, TDS and TSS) and chemical (DO, SO₄ and Cl₂ etc) components help to understand the level of water pollution (Angadi et al.,2005; Dwivedi and pandey, 2002). Qualitative changes in ground water due to population, large scale over drafts on the reserves, in discriminate disposal of industrial, human and agricultural wastes, pose great threat to the usefulness of the ground water. Therefore it becomes necessary to find out periodically, the levels of pollution in water sources and examine if they are hazardous to human health. From several studies, a rough estimate of total daily fluoride exposure in a temperate climate would be approximately 0.6 mg/adult per day in an area in which no fluoride is added to the drinking water and 2 mg per adult per day in a fluoridated area (WHO, 1984). In many countries this can be potentially increased for children from the use of fluoridated dental products but there will be significant variation in individual exposure. In hot climates the much higher consumption of water will also increase the intake and this is frequently highly significant. In addition, fluoride exposure in

many areas is considerably higher as a consequence of a range of practices.

Thus the present investigation is aimed to assess the ground water quality of Surguja district with special reference to fluoride ion concentration. During this examination, mainly the physico-chemical parameters were taken in to consideration.

STUDY AREA

Surguja district is a great table land of numerous hills and plateau. The two important physiographic features of the district are the Mainpat plateau and the Jamirpat plateau. The former is 28.8 km long and 12.8 km wide and rise to a maximum height of 1152.45 meters. It forms the southern boundary with Raigarh district. The Jamirpat is about 3 km wide. It forms the eastern boundary of Sarguja with Jharkhand state. The maximum elevation of Jamirpat is 1219.2 meters. The principal rivers of the district are the kanhar, the Rihand, the Morna, the Mahan, the Geur, the Geger, the Neur and the Gej. There are two distinct drainage systems in the district. One is northerly and the other is southerly. The district has subtropical climate characterized by hot summer and monsoon rainfall followed by dry and cold winter season. The normal rainfall of the district is 1600.9 mm. The annual temperature varies from 39.6⁰ C to 43⁰C in summer and 8.6⁰ to 23.9⁰C in winter.

MATERIALS AND METHODS

In this study, 28 drinking water samples from seven blocks of Surguja district were collected. Four samples were collected from each block during January 2012 to

December 2012. Conductivity, Turbidity, pH, TA, TDS, Calcium, Magnesium, Total Hardness, DO, Nitrate, Fluoride, Chloride and Sulphate content of water samples were the analyzed parameters. Standard Methods of collection, preservation and analysis were adopted. Samples for chemical analysis were collected in polythelene container's. Some of the parameter like pH, Conductivity, DO, TDS were analyzed on site using portable water analysis kit. The other parameters were analyzed at laboratory. Samples were analyzed as per APHA (1998).

RESULT AND DISCUSSION

The maximum and minimum value of the physico-chemical characteristic of ground water of Surguja District are presented in Table 1. The observed pH values show that the experimental waters are Batauli block and Lakhanpur block are slightly acidic to moderately alkaline (6.40-8.50 and 6.40 - 9.20 respectively) but other blocks have more alkaline in nature. These values are within the maximum permissible limits as per BIS drinking water. The deviation of pH from the neutral water pH may be due to dilution of alkaline substances. (Kumari Sunita, 2009).

The conductivity of water samples are highest value of 2213 $\mu\text{mho/cm}$ during the june in mainpat block and lowest electrical conductivity of 187 $\mu\text{mho/cm}$ was observed during august in sitapur block. Most of the samples, it is well within the range of ISI (1000 $\mu\text{mhos/cm}$) except few samples in which it was above the maximum permissible limit. The importance of conductivity shows its measure of salinity, which greatly affects the taste and thus

significant impact on the user's acceptance of the water as potable (WHO,1984).

In Ambikapur block the turbidity range vary from 1.00-3.90 NTU, 1.20-2.10 NTU in Lundra block, 1.20 -2.00 NTU in Sitapur block, 1.20 -2.50 in Batauli block, 1.20-4.70 in Udaipur block, 1.10- 2.90 NTU in Lakhanpur block and 1.0 -2.50 NTU in Maipat block. The value of turbidity are all blocks have as per BIS and WHO Guidelines. The WHO recommendation for turbidity is 5 NTU.

In Ambikapur block the dissolved oxygen value is 6.30 mg/l and Lundra block and Batauli block have same DO value which is 7.40 mg/l. The maximum value of hardness is 230 mg/l in Ambikapur block and minimum value of hardness is 112 mg/l in Mainpat block. Hardness is mainly due to the presence of carbonates and bicarbonates. A high concentration of hardness may be due to the leaching the soil. Mohanta and Patra (2000) opined that addition of sewage detergents and large scale human use might be the cause of elevation of hardness. Hardness below 300 mg/l is considered as potable but beyond this limit produce gastro intestinal irritation (ICMR, 1975). Total Alkalinity varied from 150-300 mg/l in Ambikapur block, 120-280 mg/l in Lundra block 120-180 mg/l in Sitapur block, 90-220 mg/l in Batauli block, 140-280 mg/l in Udaipur block, 80-260 mg/l in Lakhanpur block and 80-170 mg/l in Mainpat block. The sources of alkalinity in water are CO_3 , HCO_3 , OH , HSiO_3 , HPO_4 , and HS . In the natural water, carbonate and bicarbonate along with hydroxides tends up to make up most of the total alkalinity due to dissolution of carbonate rocks from soil. Alkanity itself is not harmful to human

being; still the water supplies with less than 200 mg/l of alkalinity are desirable for domestic use. Large quantity alkalinity imparts bitter taste to water (Garg et al., 2007). Observed values of the water samples are within the permissible limit. The TDS content of the samples analyzed showed variation from in Ambikapur block is 104-390 mg/l, 82-296 mg/l in Lundra block, 90-210 mg/l in Sitapur block, 196-460 mg/l in Batauli block, 140-450 mg/l in Udaipur block, 190-290 mg/l in Lakhanpur block and 96-282 mg/l in Mainpat block. No sample exceeded the IS limit (500 mg/l). The calcium ranged from in Ambikapur block is 28-180 mg/l, in Lundra block ranged from 26-101 mg/l, in Sitapur block ranged from 20-96 mg/l, in Batauli block 36-160 mg/l in Udaipur block 24-162 mg/l, in Lakhanpur block ranged from 20-150 mg/l and in Mainpat block ranged from 30-182 mg/l. None of the water samples exceeded the maximum permissible limit. Calcium has no hazardous health effects. Small concentration of calcium carbonate protects metal pipes from corrosion by laying down a protective coating. However high level of calcium salt causes scales formation in pipes and boilers etc. According to Trivedy and Goel, (1984) calcium may not impair physiological reaction in man up to the level of 1800 mg/l. Magnesium content of the sample of Ambikapur block is ranged from 20-150 mg/l, Lundra block ranged from 14-140 mg/l, Sitapur block ranged from 18-66 mg/l, Batauli block ranged from 16-60 mg/l, Udaipur block ranged from 24-110 mg/l Lakhanpur block ranged from 10-120 mg/l and Mainpat block ranged from 6-28 mg/l. The highest permissible limit of magnesium in drinking water as per BIS 1991 is 150 ppm. All the samples are within the maximum permissible limit as per BIS,

Magnesium occurs in all kind of natural waters with calcium but its concentration always remains lower than calcium and with calcium it contributes to total hardness of water. The concentration of chloride was found to vary between in Ambikapur block 24-40 mg/l, in Lundra block 28-80 mg/l, in Sitapur block 20-40 mg/l, in Batauli block 25-50 mg/l, in Udaipur block 15-45 mg/l, in Lakhanpur block 25-75 mg/l, and Mainpat block 18-40 mg/l, which is indicating low chloride content in the area.

The sulphate content of the analyzed samples in Ambikapur block varied from 18-125 mg/l, in Lundra block varied from 8.50-50 mg/l, in Sitapur block varied from 9.0-32 mg/l, in Batauli block varied from 10-50 mg/l, in Lakhanpur block 10-60 mg/l and Mainpat block varied from 20-70 mg/l, which is within the permissible limit according to BIS and WHO. The range of nitrate concentration was found in Ambikapur block 0-10.6 mg/l, in Lundra block 0-0.40 mg/l, in Sitapur block 0-0.30 mg/l, in Batauli block 0.30-5.0 mg/l and Mainpat block 0-0.3 mg/l, which is within the permissible limit according to BIS and WHO. The BIS and WHO limit of nitrate is 45 mg/l and 50 mg/l respectively. No samples exceed this limit. Nitrate has long been associated with the occurrence of blue baby disease in infants or infantile methamoglobinaemia, which is caused due to bacterial reduction of nitrate in to nitrite in stomach. The concentration of fluoride was found to above the permissible limit in all samples of Surguja District. In Ambikapur block ranged between 1.80-4.80 mg/l, in Lundra block 2.30-3.25 mg/l, in Sitapur block 2.06-3.10 mg/l, in Batauli block 2.16-4.56 mg/l, in Udaipur block 1.80-4.50 mg/l, in Lakhanpur block 1.66-4.80 mg/l and in Mainpat block 2.50-3.21 mg/l.

Table 1. Physico-chemical properties of water samples of Surguja District

S. N	Parameter	Ambikapur Block	Lundra Block	Sitapur Block	Batauli Block	Udaipur Block	Lakhanpur Block	Mainpat Block
1	pH	7.47-8.50	7.40-8.70	7.00-8.70	6.40-8.50	7.20-8.60	6.40-9.20	8.40-9.10
2	EC	200-1230	190-1870	187-1870	240-1900	210-2400	240-2800	230-2213
3	Turbidity	1.00-3.9	1.2-2.10	1.2-2.0	1.20-2.5	1.2-4.7	1.10-2.9	1.0-2.5
4	TA	150-300	120-280	120-180	90-220	140-280	80-260	80-170
5	TDS	104-390	82-296	90-210	196-460	140-450	190-290	96-282
6	TH	230	80-220	80-156	-	100-200	-	113
7	Ca ⁺⁺	28-180	26-101	20-96	36-160	24-162	20-150	30-182
8	Mg ⁺⁺	20-150	14-140	18-66	16-60	24-110	10-120	6-28
9	DO	6.30	7.40	-	7.40	-	-	-
10	NO ₃ ⁻	0-10.6	0-0.40	0-0.3	0.30-5.0	0-0.30	0-5.0	0-0.03
11	F ⁻	1.80-4.80	2.30-3.25	2.06-3.10	2.16-4.56	1.80-4.5	1.66-4.80	2.50-3.21
12	Cl ⁻	24-40	28-80	20-40	25-50	15-45	25-75	18-40
13	SO ₄ ⁻⁻	18-125	8.50-50	9.0-32	8.0-30	10-50	10-60	20-70

Table 2. Showing Permissible limit for Drinking Water

S.N	Parameter	Drinking water Standard *IS: 10500-1991, BIS Highest Desirable	Maximum Permissible
1	pH	6.5-8.5	No Relaxation
2	Conductivity	-	2000
3	Turbidity	5	10
4	Total Alkalinity	200	600
5	TDS	500	2000
6	TH	300	600
7	Calcium	75	200
8	Magnesium	30	150
9	DO	-	-
10	Nitrate	45	100
11	Fluoride	1.0	1.5
12	Chloride	250	1000
13	Sulphate	200	400

* All values in mg/l except pH, conductivity (μ mhos/cm) and turbidity (NTU).

The maximum permissible limit of fluoride concentration in drinking water is 1.5 mg/l. The evidence suggest (Singh, 1994) that with gradual depletion in water level below the earth's crust greater concentration of fluoride is found in water because of greater dissolution of fluoride from rocks and soil in to it.

CONCLUSION

From the above study it can be safely concluded that ground water of Surguja district is not fit for drinking purpose. Most of the physico-chemical parameters fall under the permissible limit of WHO and BIS standards. Only the fluoride concentration is found to be crossing the permissible limit.

In few water samples the conductivity is found to be above (2000 μ /mhos) maximum permissible limit.

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