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Physico-Chemical Parameters with their remedies of Ground Water Samples of Berla Tehsil of Durg District Chhattisgarh, India

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Abstract: The physico-chemical analysis of ground water and its adverse health effect in Berla Tehsil of Durg district of Chhattisgarh, India are undertaken. In the present study, fifteen water samples, were collected from the different sites during June 2012 to Dec 2012 from deep bore well and hand pump. Physico-chemical parameters analyzed for pH, EC, TDS, alkalinity, turbidity, total hardness and content of fluoride, lead, arsenic, iron, sulphate and chloride were studied and compared with the standard values prescribed by World Health Organization (WHO) and Bureau of Indian Standard (BIS). The ground water is characterized by slight high fluoride content in two sample and slightly rich in iron probably due to industrial effluents of Bhilai steel plant. However, most of the water samples did not have high concentrations of the toxic contaminants. The present investigation revealed that some of the ground water sample of Berla village of durg district is not suitable for drinking purpose and they need to proper treatment before use**.** The process of removal of excess fluoride from water is reverse osmosis, ion exchange devices and bio-remedies. One of bio remedies method is natural adsorption such as Mangrove plant(*Sonneratia Apetala*) leaf powder (MPLP) and Coconut(*Cocos nucifera*) coir pith (CCP).

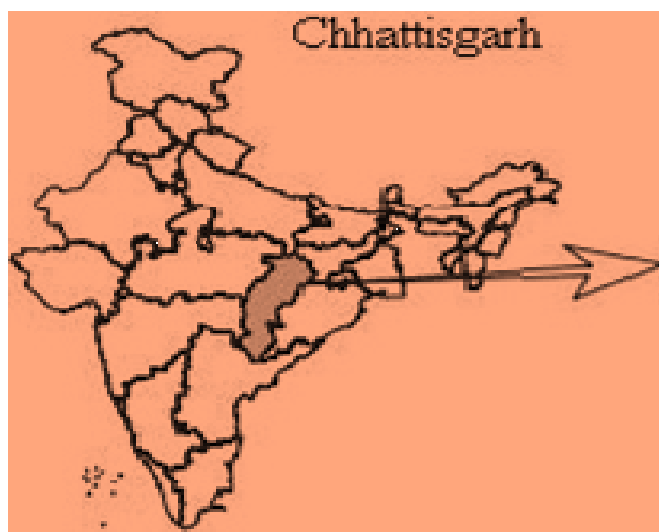**Key words:** Physicochemical analysis, Ground water, pH, TDS, WHO and BIS.

INTRODUCTION

The water may be contaminated by natural sources or by industrial effluents. Ground water is highly valued because of certain properties not possessed by surfaces water[1]. Safe drinking water is a fundamental human need and it is an important factor that determines the physical and social health of the people. Bullard[2] inferred that polluted surface water always results in an unhealthy socio-economic environment. Hence, physico-chemical analysis of water is important to assess the quality of groundwater in any rural areas that influences the suitability of water for drinking, domestic, irrigation, and industrial needs. Because of the importance of groundwater in drinking and in other uses, its environmental aspects such as contamination transport have been significantly studied. Many researchers have focused on hydro chemical characteristics and contamination of groundwater in different basins as well as in urban areas that resulted due to anthropogenic intervention mainly by agricultural activities and industrial and domestic wastewater[3-4]. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water[5].

Increases in living standard, growing population, rapid industrialization and wide spread human activities have increased the demand for water[6]. The quality of water also depends on agricultural land use pattern[7-9].Due to increase in population, uses of chemical fertilizers, pesticides, industrialization and many other anthropogenic factors, the water from various sources becoming polluted to a larger extent day by day[10-12]. Animal and human excrement is also a dangerous cause for water pollution in the under developed countries. Consumption of polluted water directly from the sources may cause waterborne diseases like flurosis, diarrhea, dysentery, typhoid and hepatitis, gastroenteritis, liver and intestinal infection, skin rash[13-17]etc. Chemical contamination of drinking water may not cause immediate health problem, but their long time intake may be fatal for human health. The objective of this study is to investigate physicochemical analysis of groundwater samples in this study area. (Figure1).

STUDY AREA

ArcGIS (version 9.0) software has been used for the present study to locate the sampling sites. The current study area Berla Tehsil of durg district., located at 21.50°N 81.53°E and has elevation of 290 m (951 ft).
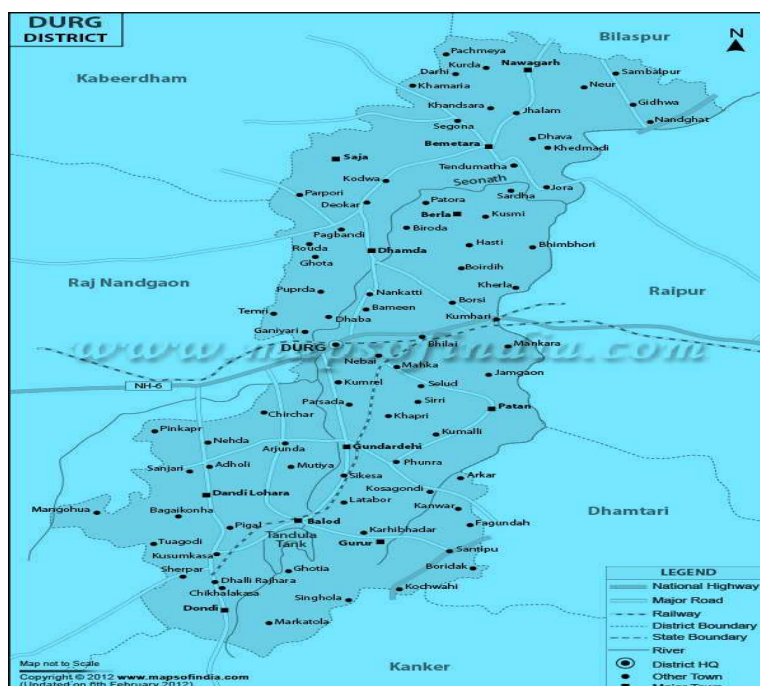
Fig. 1: Locations of groundwater Berla Tehsil of durg district

Hence the present work draws the conclusion on the quality of water and provides information about suitability of water for drinking purpose. Comparison of water test results with WHO Guideline[18] values and Bureau of Indian Standard[19] helps to address the specific problem of water sources and to select the appropriate method of water treatment before use.

MATERIALS AND METHODS

Ground water samples were collected from sixteen locations of durg city during post monsoon, in polyethylene bottles of 100 ml. The samples were collected and analyzed as per the standard methods prescribed by, Goltman et al.[20] and Trivedi and Goel[21]. Borosil glassware, double distilled water and E-Merck reagents were used throughout the testing. Samples were collected in sterilized screw capped laboratory for their physicochemical parameters. Total alkalinities of the water samples were determined by titrating with 0.02N H_2SO_4 using phenolphthalein and methyl orange as indicators. The chloride ions were generally determined by titrating the water samples against a standard solution of $AgNO_3$ using K_2CrO_4 as an indicator. The total hardness of the water samples was determined by complexometric titration with EDTA using Eriochrome black-T as an indicator. The dissolved oxygen (DO) content in the water samples was determined by titrating with standard sodium thiosulphate using starch as indicator. TDS of water sample were measured by using TDS-3 HM digital meter. Sulphate ion content in the water samples was determined by titrating against EDTA as prescribed by Jackson. Fluoride(F^-) content of the samples was determined by measured by ELICO-52 Spectrophotometer method[22].Turbidity, Electrical Conductance (EC) and pH of the ground water samples were determined on the day of collection to minimize the alteration of original sample condition, using Systronics Digital Turbidity Meter-132, Systronics Digital pH Meter MK-VI and Systronics Digital Conductivity Meter-304, respectively. Heavy Metals like Mn, Fe, Zn, Ni, Cu, Pb

and Arsenic present in the ground water samples were determined by the help of metal testing kit of E. Merck.

Table -1: Ground Water Quality Monitoring at Berla Tehsil of durg district

Sample No.s	Locations	Types of Water
S_1	Anandgaon	Bore well
S_2	Bargaon	Bore well
S_3	Berla	Bore well
S_4	Biroda	Bore well
S_5	Dargaon	Handpump
S_6	K. Mohrenga	Handpump
S_7	Khudmuda	Bore well
S_8	Kusmi	Bore well
S_9	Lawatara	Bore well
S_{10}	Lenjwara	Bore well
S_{11}	Pahanda	Bore well
S_{12}	Patora	Handpump
S_{13}	Sarda	Handpump
S_{14}	Semaria	Handpump
S_{15}	Sondh	Handpump

RESULTS AND DISCUSSION

The physicochemical parameters of the ground water samples of Berla Tehsil of Durg district with their standard values prescribed by WHO and Bureau of Indian Standard are given in the **Table 2**.The results of the physiochemical analysis of the groundwater samples S_1 to S_{15} collected from 15 different locations in the range of 20 km are presented in **table 3** and heavy metals in **table 4.**

Turbidity: Turbidity of the water samples were in the range from 0.03 to 1.20 NTU. Samples No S_3, S_6, S_{10},S_{11}, S_{12}, S_{13}, S_{14} and S_{15} showed the turbidity above the permissible limit, while rest of the samples showed within the desirable limit.

pH: The pH of the samples was in the range from 7.8 to 8.7. So that slightly alkaline in location $S_{11}$and S_{15} ,but within the permissible BIS limit (6.5 to 8.5). Higher pH value imparts bitter taste to the water.

Electrical Conductivity: Here the Electrical conductivity of the sample was in the range from 2.3 to 17.2 μs /cm. Sample S_{15} has highest EC of 17.2 μs/cm while sample S_3 has lowest EC of 2.3μS/cm. which indicates that the content of soluble and high conducting salts present in the water sample.

Total Dissolved Solids(TDS): TDS of the water samples were in the range from 298 mg/L to 825 mg/L. Sample S_1, S_4 ,S_5, S_7, S_{12} and S_{15} contains the TDS within the desirable limit and sample S_2,S_3,S_6,S_8,S_9,S_{10},S_{11},S_{13} and S_{14} contains above the permissible limit, while rest of the samples have the TDS within the highest permissible limit large quantity of alkalinity imparts bitter taste to water.

Total Hardness: Total hardness of water samples were in the range from 119 mg/L to189 mg/L. Samples S_1-S_{15} contain total hardness, within the permissible limit WHO and BIS. Total hardness is imparted mainly by calcium and magnesium ions which apart from sulphate, chloride and nitrate are found in combination with carbonates.

Fluoride: Fluorine is widely distributed in nature and is a normal constituent of bones. Excess of fluorine ingested leads to a mottling of teeth. The teeth can be protected and tendencies to caries reduced about 40% by topical applications of fluoride solution. When fluorine is absorbed, it unites with calcium and reduces the blood calcium level. Concentration of fluoride present in the water sample S_{15} is slightly high within the permissible limit. High fluoride concentration causes dental fluorosis and other dieases shown in **Figure 2**,while low concentration causes dental caries. Hence it is essential to maintain moderated concentration of fluoride in drinking water.

Table- 2: The Standard values of ground water samples
(All values except PH is in mg/L)

S. No	Parameters	WHO standard	Bureau Indian standard
1.	Turbidity(NTU)	0.02-0.05	0.01-0.05
2.	pH	7.0-8.5	6.5-8.5
3.	Conductivity(μs/cm)	5.0-50	4.5-50
4.	TDS	300-500	500
5.	Total hardness	500	300
6.	Total alkalinity	120	120
7.	COD	255	255
8.	DO	4.0-8.0	4.0-8.0
9	Chloride	200-600	250-1000
10	Fluoride	0.5-1.5	1.0-1.5
11.	Sulphate	200-400	200-400
12.	Nitrate	45	1-45

Table- 3: Physiochemical parameters of ground water samples Berla Tehsil of Durg district

S.No.	pH	Turbidity	EC	TDS	TH	COD	DO	Cl	SO$_4$	F	NO$_3$
S$_1$	7.8	0.05	4.7	456	134	19.9	6.1	105	114	0.61	0.37
S$_2$	7.9	0.03	6.2	607	153	20.1	4.2	123	189	1.01	0.32
S$_3$	8.5	1.02	2.3	825	189	13.3	5.3	129	202	1.00	0.42
S$_4$	8.3	0.09	6.1	335	126	12.1	6.5	177	209	0.83	0.12
S$_5$	7.8	0.07	16.8	298	119	29.9	4.6	119	218	0.77	0.21
S$_6$	8.5	1.04	12.5	805	175	42.3	7.2	331	123	0.94	0.63
S$_7$	8.3	0.90	8.4	478	128	52.1	3.2	121	84	0.74	0.72
S$_8$	8.1	0.80	18.2	672	155	15.2	2.2	95	59	0.51	0.56
S$_9$	7.8	0.50	11.7	786	179	12.3	2.6	265	114	0.34	0.83
S$_{10}$	8.5	1.0	3.1	567	142	13.5	3.4	179	174	0.21	0.47
S$_{11}$	8.7	1.2	3.8	775	171	11.4	4.2	243	152	1.10	0.54
S$_{12}$	8.0	0.80	13.9	490	130	9.5	3.2	197	173	0.72	0.36
S$_{13}$	8.5	1.05	21.2	814	186	17.8	2.7	213	198	0.98	0.43
S$_{14}$	8.2	0.70	15.6	572	145	16.4	2.5	187	213	0.90	0.53
S$_{15}$	8.6	1.1	17.2	457	129	10.3	2.1	210	165	1.55	0.87

Table- 4: Heavy metal concentration in ground water samples of Berla Tehsil of durg district

S.No.	Fe	As	Cu	Pb	Zn
S$_1$	1.14	0.001	0.02	0.02	2
S$_2$	2.12	0.002	0.04	0.06	3
S$_3$	1.31	0.001	0.06	0.1	5
S$_4$	0.98	0.004	0.01	0.08	-
S$_5$	0.83	0.003	-	0.02	2
S$_6$	1.0	0.005	0.07	-	4
S$_7$	1.79	0.009	-	0.05	-
S$_8$	0.41	0.001	-	-	1
S$_9$	0.83	0.002	0.05	0.07	4
S$_{10}$	1.52	0.003	0.04	-	3
S$_{11}$	1.92	0.001	0.09	0.02	5
S$_{12}$	0.36	0.004	0.03	0.06	2
S$_{13}$	0.67	0.007	1.0	0.04	1
S$_{14}$	0.51	0.004	0.08	0.02	-
S$_{15}$	0.29	0.003	0.03	0.03	5
WHO	0.5mg/l	0.01mg/l	0.05-1.3mg/l	0.1mg/l	5mg/l
BIS	0.3-1mg/l	0.05mg/l	0.05-1.5mg/l	0.1mg/l	5.0-10mg/l

Chloride : The chloride content in the water samples varied from 95 mg/L to 331mg/L. Samples form S_1 to S_{15} contain chloride within the permissible limit. The chloride content indicates pollution status of water body due to contamination of animal and human waste. Chloride is a common constituent of all natural water and is generally not classified as harmful constituent.
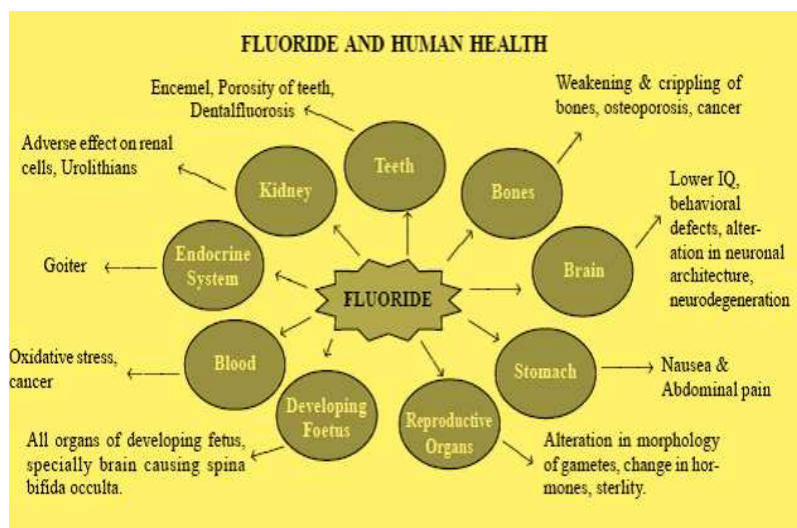

Fig. 2: Impact of Fluoride on Human health

Sulphate: Here the concentration of sulphate was in the range of minimum 59 mg/L and maximum 218 mg/L. Sulphate ion concentration in the samples within the desirable limit of WHO guidelines. Higher concentration of sulphate has laxative effect which is enhanced when sulphate is consumed with magnesium.

Nitrate: The tolerance limit for nitrate is 45 mg/L but in the present study nitrate ranged from 0.12 to 0.87 mg/L. The samples are found less than within the permission limit as per WHO and BIS guidelines.

Dissolve Oxygen: D.O ranged from 2.1 to 7.2 mg/L, which shows that the ground water was found to be within the permissible limit. DO determine the quality of drinking water.

COD: In the present study the C.O.D is found blow the permissible ranged 255 mg/L.

Iron: Here the concentration of iron was in the range of minimum 0.21 mg/L and maximum 2.12 mg/L, which shown the high range of iron as per WHO and BIS. In acute poisoning the symptoms are due to a local irritation of the gastro-enteric mucous membrane which may even proceed to necrosis and consequent shock.
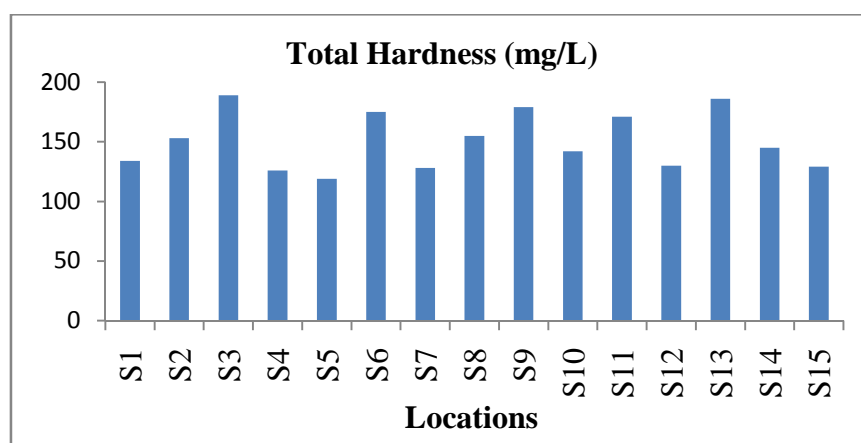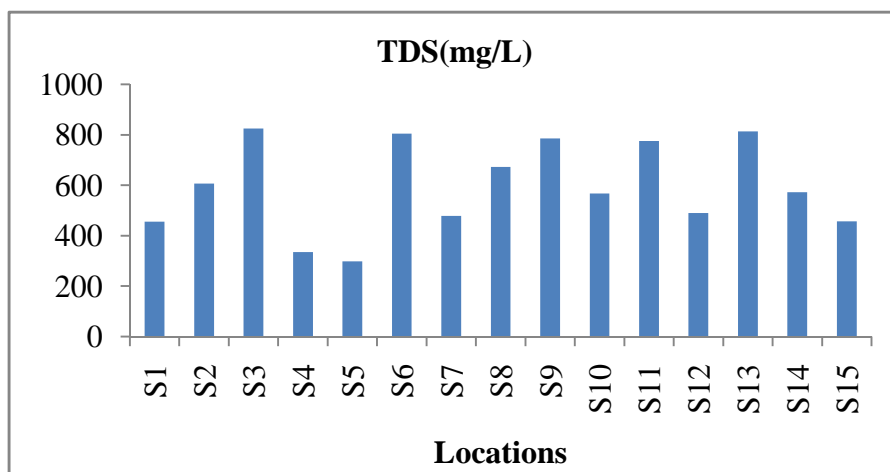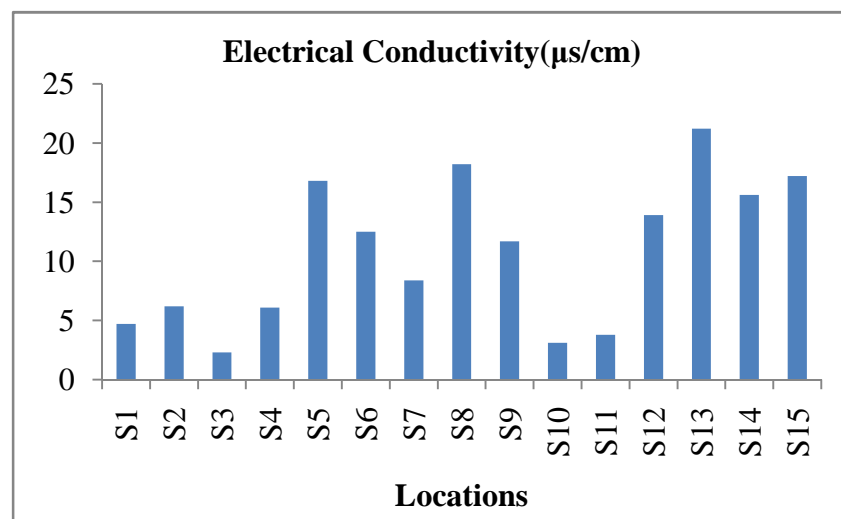
Arsenic: The maximum value (0.009 mg/L) obtained in the ground water , which is less than WHO permissible limit (0.01 mg/L).
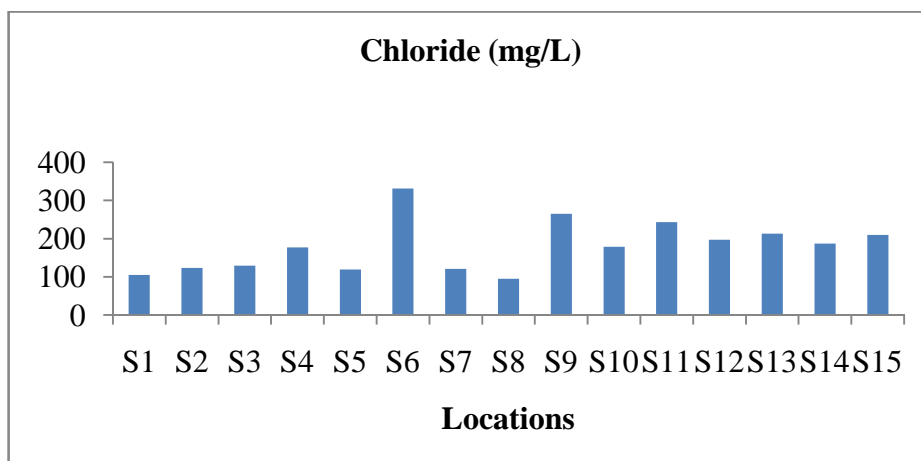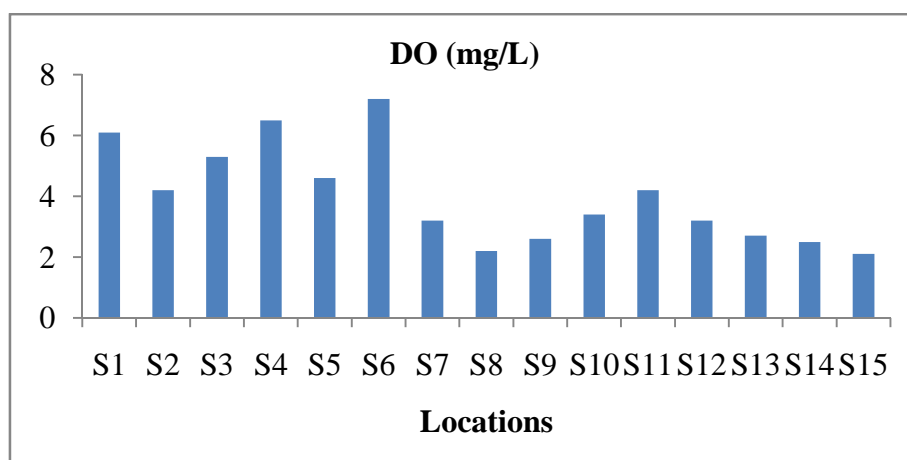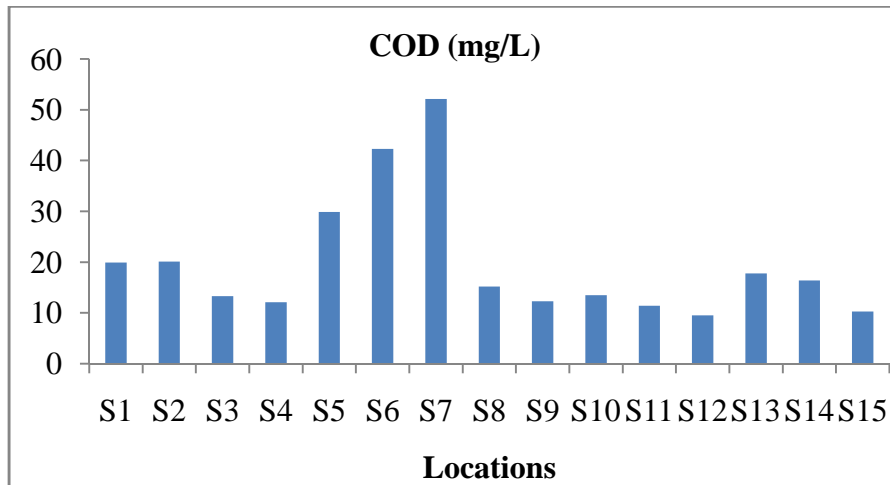
Copper: Concentration of copper was in the range of minimum 0.01 mg/L and maximum 1.0 mg/L. Copper concentration in the samples S_{13} is moderately high while in rest of the samples it is within the desirable limit. Copper in large doses is dangerous to infants and people with certain metabolic disorders.

Lead: The normal ranges prescribed for adult for lead is 0.1mg/l as per WHO standard. Result shows that the concentrations of lead was found to range from 0.02mg/l to 0.1mg/l.

Zinc: In the present study, result shows that the concentrations of zinc are within desirable limits in all the samples so it is not going to cause ill effects on the nearby population. The normal range in adult male for zinc is 5-10 mg/l.
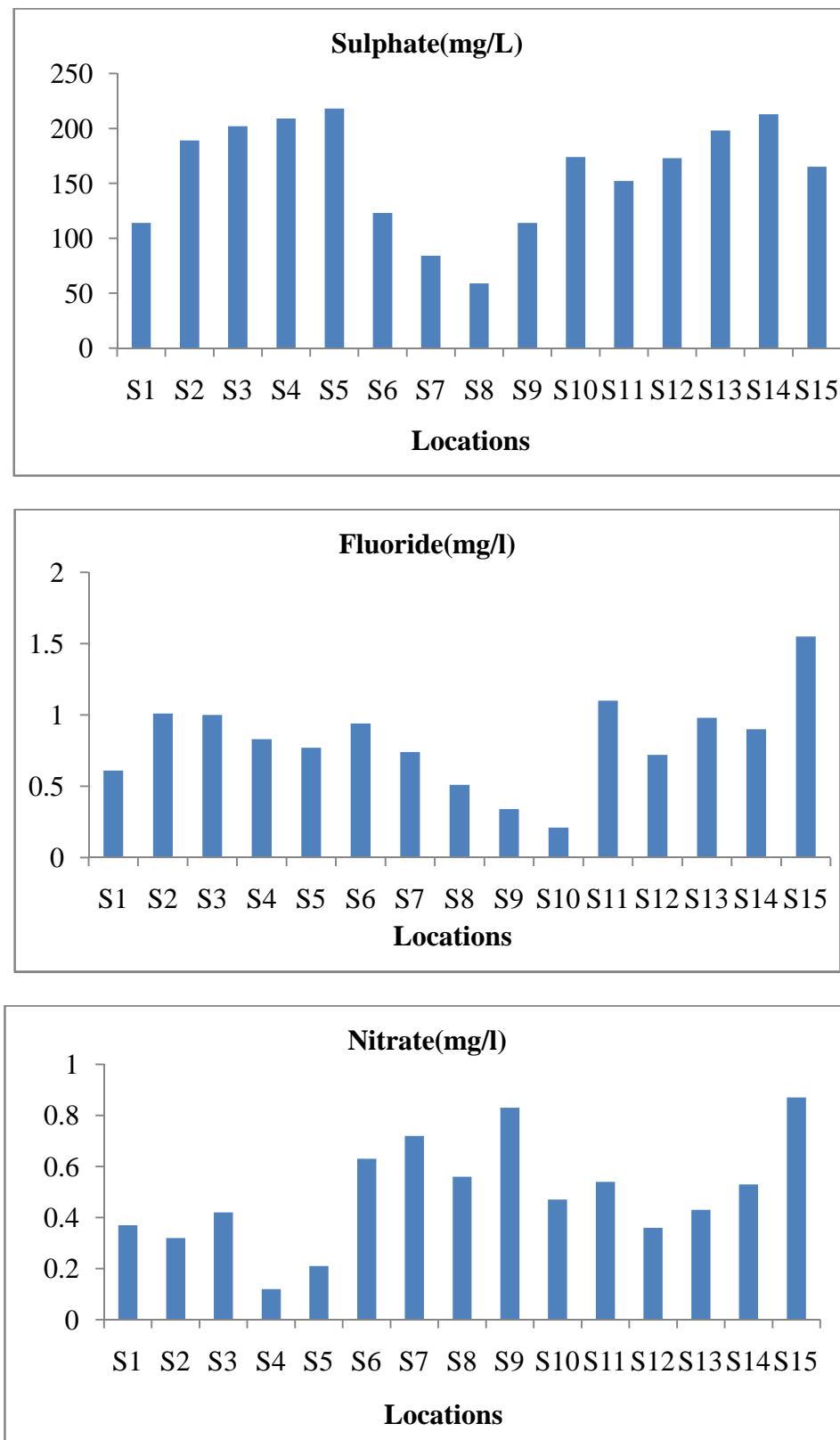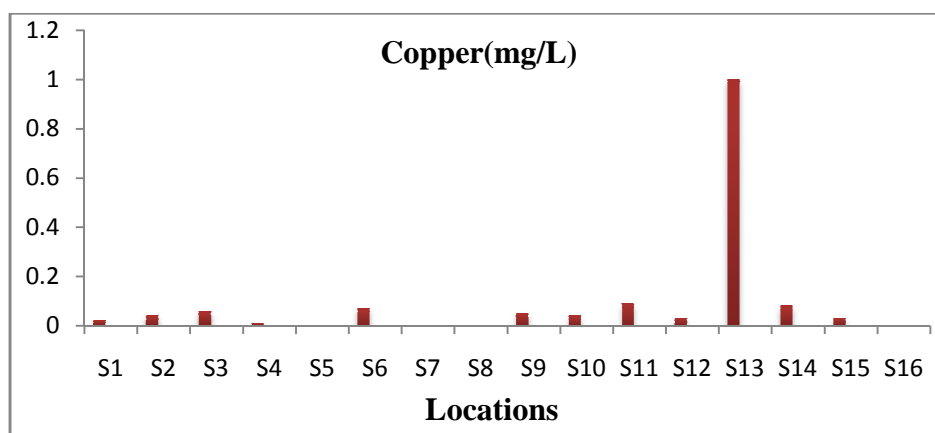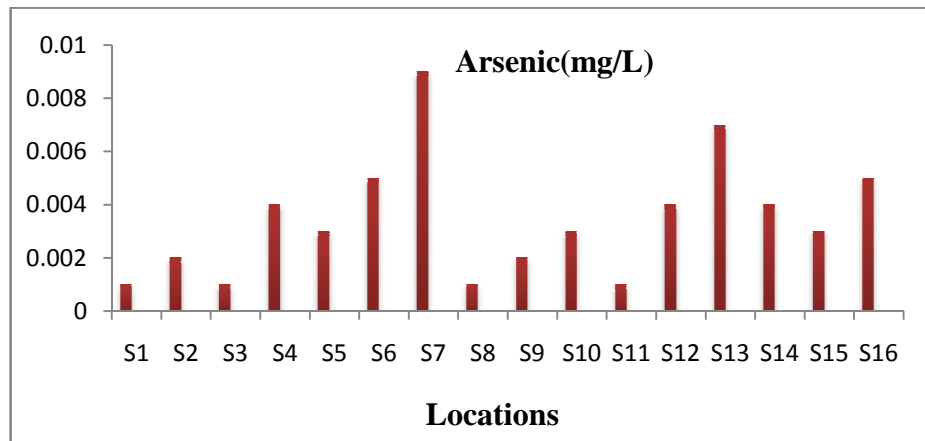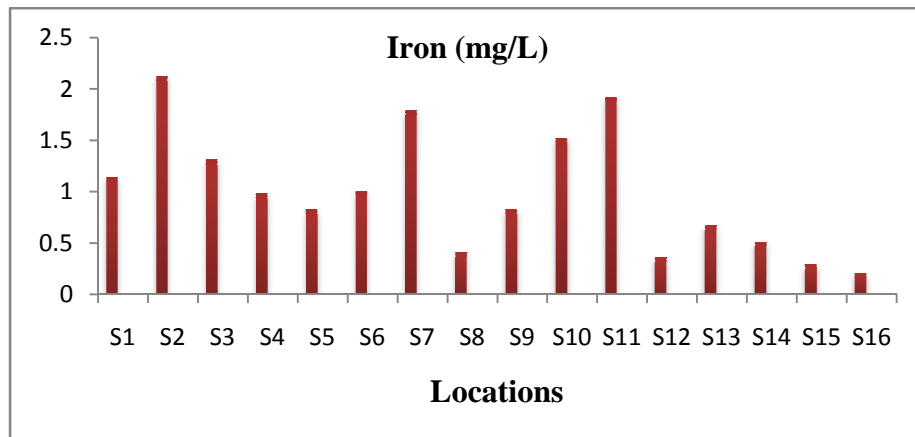
Electrical Conductivity(μs/cm)

TDS(mg/L)

Total Hardness (mg/L)

COD (mg/L)

(Bar chart: y-axis 0–60, x-axis Locations S1–S15)

Locations

DO (mg/L)

(Bar chart: y-axis 0–8, x-axis Locations S1–S15)

Locations

Chloride (mg/L)

(Bar chart: y-axis 0–400, x-axis Locations S1–S15)

Locations

Fig. 3: Flow charts of various parameters of groundwater samples of Berla Tehsil of durg district
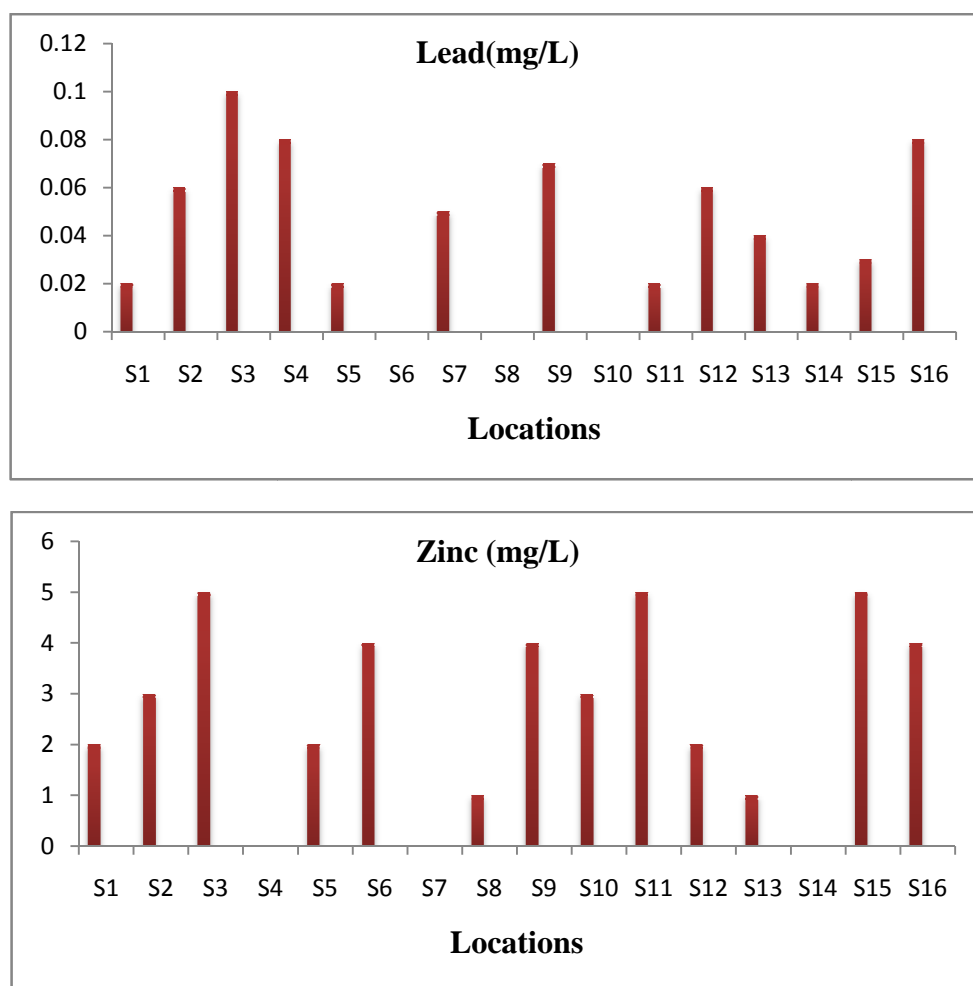
Iron (mg/L) by Locations (S1–S16)

Arsenic (mg/L) by Locations (S1–S16)

Copper (mg/L) by Locations (S1–S16)

Figure 4: Flow charts of heavy Metal concentration in ground water samples of
Berla Tehsil of durg district

CONCLUSIONS

The present study, analyzed samples of ground water of Berla Thesil of durg district, Chhattisgarh, India , shows that few samples are not within the desirable limit. From the above study, it is observed that values of most the parameters are within the WHO and BIS permissible limit. Maximum values of pH of some samples lie above the higher level. Although lead and arsenic contents are very low in most of the sources. One sample of the fluoride was found slightly high than maximum permissible limit. Excess fluoride may lead to tooth decay and kidney disease. The groundwater is slightly rich in iron shows the ground water quality is very poor and consumption is not suitable for drinking purpose peoples living in these regions. Thus the Reverse Osmosis, zeolite or ion exchange treatment method and bioremedies can be used to reduce fluoride and iron concentration.

ACKNOWLEDGMENT

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