



## Evaluation of some physicochemical parameters of groundwater in Bhilai industrial area

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### Abstract

Sample was collected in different locations of central industrial area bhilai durg district for physico-chemical studies. Analysis of samples for water quality parameters such as pH, EC, TA, TH, Cl, F and So<sub>4</sub>, Cr, Zn for industrial area of bhilai were within permissible limit of WHO. The concentrations of TA, TDS, Ca and Pb exceeded in sample area. On comparing results with drinking water quality standards by WHO, it is found that most of the water samples are not suitable for human beings due to high concentration of one parameter.

**Keywords:** ground water, WHO, heavy metals, physicochemical analysis, drinking water quality

### 1. Introduction

Water is nature's ultimate wonderful, generous and valuable compound. Clean harmless and plenty fresh water is vital to the persistence of all living organisms and the smooth functioning of environment. Most of the population depends on the groundwater as it is the only source of drinking water supply. Water quality is important to observe the suitability of water for use (Sinha. R.M *et al.* 2011) <sup>[11]</sup> the groundwater is believed to be comparatively much clean and free from pollution than surface water. Residential, municipal, commercial, industrial, and agricultural activities can all affect groundwater quality. The quality of ground water depends on a many factors like hydrological, physical, chemical and biological factors. The quality of water is important concern for mankind since it is directly linked with human welfare. The problem of ground water pollution in several parts of the country has become so acute that unless important steps for detailed identification and decline are taken, extensive ground water resources may be damaged. The quality of water is important concern for mankind since it is directly linked with human welfare. Ground water is being polluted due to day to day the increase in the garbage, industrial waste and drainage linkages.

The selection of physico-chemical parameters is important part in analysis of water. Selection of parameters for analysis of water is depends upon research work, for what purpose we going to use that water and what level we need its quality and purity. Thus in this present study an attempt has been Central industrial area of bhilai, due to industrialization ground water has contaminated. The present study is related with the assessment of the quality of the ground water of some selected area of industrial area of Bhilai. The investigations were performed on the sample collected in the month of performed on the sample collected in the month of January 2016 To June 2016. The parameters studied are conductivity, pH, EC, TH, TDS, TA, Cl, F, So<sub>4</sub>, Fe, Pb, Zn, and Cr.

### 2. Material & Methods

#### a) Study area

Bhilai city is situated in Durg District, C.G (the eastern central part of India). The city is located within the 32 km<sup>2</sup>/ Km west from the Raipur city. The population of the city is 1,006,407. The recorded temperature was ranged from 37 to 21°C and annual rainfall was 1247.0.mm. This is city which produced steel in large scale. Sampling sites were setup in Bhilai-Durg area which was in range of 10kms close to industrial area.

**Map of Study Area**



**Fig 1**



**Fig 2**

**b) Sample Collection**

In present study 33 water samples were collected by a polyvinyl chloride 250ml bottle at sampling area. Water samples were collected from these area including effluent (n =3), surface water (n= 1) and ground water (n=29) during Jan-June, 2016. The locations of sample area were determined by

GPS receiver. The samples were kept in refrigerator at 4°C. Collected sample were immediately brought to laboratory and preserved for the further analysis. Details of ground water sampling location along with their longitude and latitude are presented in Table -1

**Table 1:** Ground water sampling location along with their longitude and latitude are presented.

S. No.	Sampling area	Source of water	Latitude	Longitude
S1	KOHKA	Hand pump	N - 21°13' 29.92"	E - 81°20' 24.95"
S2	KOTRABHATA	Hand pump	N - 21°14' 18.73"	E - 81°19' 10.22"
S3	JUNWANI	Hand pump	N - 21°13' 14.79"	E - 81°19' 08.28"
S4	KATULBOD	Tube well	N - 21°12' 17.65"	E - 81°18' 44.12"
S5	BORSI	Hand pump	N - 21°09' 55.44"	E - 81°18' 35.80"
S6	HANODA	Hand pump	N - 21°08' 14.06"	E - 81°18' 08.48"

**c) Methodology**

The samples were analyzed using standard methods of analyses to assess various physicochemical parameters

according to APHA & WHO norms. The method used for estimation of various physicochemical parameters are tabulated in table 2

**Table 2:** Methods used for estimation of physicochemical parameters

S.NO	Parameters	Method
1	PH	PH Meter
2	TDS	EDTA Titration Method
3	TH	EDTA Titration Method
4	TA	Titration Method
5	EC	Conductometer
6	SO <sub>4</sub>	Spectrophotometer
7	Ca	UV-VIS NIR Spectrophotometer
8	F	UV-VIS NIR Spectrophotometer
9	Cl	Silver Nitrate titration
10	Zn, Fe, Cr, Pb	AAS

**3. Result & Dissection****Table 3:** All parameters are in mg/l except pH & EC.

S. No	Parameters	Sampling Points					
		S1	S2	S3	S4	S5	ISI 10500-91
1	pH	7.5	6.5	7.0	6.8	7.1	7.0-8.5
2	EC	400	390	410	350	330	250
3	Total Alkalinity	160	350	130	250	320	200
4	Total Dissolved Solids	624	1152	520	612	804	500
5	Total Hardness	260	290	240	200	310	300
6	Calcium	163.9	126	86.6	145	155	75
7	Lead	0.04	0.052	0.16	0.067	0.076	0.01
8	Iron	0.39	0.024	3.25	0.10	0.15	0.05
9	Chromium	0.25	0.05	0.03	0.041	0.011	0.3- 1
10	Zinc	0.1	0.5	3	0.052	1.3	3
11	Fluoride	0.46	0.52	0.43	0.53	0.13	0.6 -1.2
12	Chloride	100	320	50	60	40	250 -1000
13	Sulphate	75	89	63	90	64	150 – 400

**Table 4:** Chemical characteristics of Ground water of Central Industrial Area Bhilai Comparison with WHO guidelines.

S. No.	Parameter	WHO permissible limit	Minimum value	Maximum value	Mean	SD*
1	pH	6.5-8.5	6.5	7.5	6.98	2.86
2	Alkalinity	Desirable limit -200mg/l Permissible limit -600mg/l	130	350	235	88
3	Hardness	Desirable limit -100 permissible limit -500mg/l	200	310	267	42
4	TDS	Desirable limit -500- permissible limit 1500mg/l	520	1152	702	245.67
5	Cl	Desirable limit -200- permissible limit 600mg/l	40	320	114	114.3
6	F	Desirable limit - 1- permissible limit 1.5mg/l	0.02	0.38	0.41	0.22
7	Ca	Desirable limit -75- permissible limit 200mg/l	86.6	163.3	126	36
8	SO <sub>4</sub>	Desirable limit -200- permissible limit 400 mg/dm <sup>3</sup>	63	90	76.2	33.8
9	Zn	3mg/l	0.05	3.0	1.32	1.34
10	Fe	0.024mg/l	3.25	1.628	0.66	0.045
11	Cr	0.05mg/l	0.011	0.25	0.07	0.63
12	Pb	0.01mg/l	0.04	0.16	0.069	0.02
13	EC	250	330	410	355	60

\*SD = Standard deviation

**pH:** It relates with the acidity or alkalinity of the water. A sample is considered to be acidic if the pH is below 7.0. Meanwhile, it is alkaline if the pH is higher than 7.0. The pH values of all the drinking water samples were found to be in the range between 6.5 and 7.5. This indicates that the pH value for the sample area is within permissible limit of WHO.

**Total Alkalinity:** The alkalinity of water can be described as

its capacity to neutralize acid. The alkalinity values for water samples were found to be in the range between 130mg/l to 350 mg/l. This indicates that the alkalinity value for the sample area is within permissible limit of WHO.

**Total Hardness:** In the present study result showed that the TH of the water samples fall into the range from a minimum 200 mg/l & maximum 310 mg/l. It has been observed that all

the water sample concentration exceeds from desirable limit of WHO (100) but they all have found within permissible limit of WHO (500).

**Total Dissolved Solid:** High TDS generally indicate hard water. In the present study result showed that the TDS of the water samples fall into the range from a minimum 520 mg/l & maximum 1152 mg/l and all the water sample concentration exceed from desirable limit of WHO (500).

**Calcium:** The concentration of Ca exceeding in all the sample area as prescribed by WHO.

**EC:** The electrical conductance of the sample area was exceeded in all the sample area.

**Chloride:** In present study, the results of chlorides in all sampling sites ranged from 40 mg/l to 320 mg/l. The sampling sites were within the permissible limit of drinking water quality of WHO.

**Fluoride:** In this study the measured value of Fluoride of the water samples were ranged from 0.16 to 0.52 mg/l. The measured value of Fluoride in sampling site was within permissible limit as compared to the levels of WHO.

**Sulphate:** The concentration of sulphate in water sample was in ranges from a minimum of 63 mg/l and maximum of 90 mg/l and all the water samples analyzed have concentration within the safe limit of standard set by the WHO (200).

**ZINC:** Zinc is necessary to man but if consumed in large amounts it has an emetic effect. The zinc levels in sample area was come in range of minimum 0.05 and Maximum 3 were exceeding the WHO (3mg/l) permissible limit.

**IRON:** The concentration of iron ranges from a minimum of 0.024 mg/l and maximum of 3.25 mg/l. The concentration of water samples is exceeding from the prescribed limit of WHO.

**Lead:** The toxic effect of lead is very well known for living being so that firm limits on its presence in raw and finished drinking waters must be compulsory. The concentration of lead ranges from a minimum of 0.04 mg/l and maximum of 0.16 mg/l. This may suggest that the important decision should be taken for lead contamination.

**Chromium:** The concentration of chromium ranges from a minimum 0.011 mg/l and maximum of 0.25 mg/l and all the water samples analyzed have concentration within the safe limit of standard set by the WHO.

#### 4. Conclusion

The groundwater of Industrial Area of Bhilai Durg District was evaluated for the suitability for drinking purposes. The values of water quality parameters such as pH, TA, TH and Cl, F, So<sub>4</sub> for industrial area of bhilai were within permissible limit of WHO. The value of EC, TDS exceed the limit of WHO. The concentration of alkalinity was exceeded in majority of the sample area. The concentrations of Fe and Pb

was exceeded in most of sample area, but the concentration of Zn and Cr was in within permissible limit. The quality of water samples are non-potable for human beings due high concentration of one parameters or the other. Hence, it can be concluded that consumption of ground water in the industrial area of Bhilai durg dist. needs to be redressed by proper treatment before it is consumed by living beings as well as for other purpose.

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