

Physico-chemical analysis of Ground water of some selected slum areas of Bhopal, Madhya Pradesh

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ABSTRACT

Groundwater samples are taken from selected slums of Bhopal city. Studies of Physico-chemical characteristics of groundwater quality based on physico-chemical parameters have been taken up to evaluate its suitability for drinking purposes. Total 8 samples were collected. In the present study the parameters such as pH, TDS, Alkalinity, Total hardness, Calcium, and Magnesium in some samples exceeds the BIS desirable limit but were found to be within BIS permissible limits of drinking water. Iron and Nitrate in few samples exceeds the permissible limit of drinking water. Thus, an attempt has been made to find the quality of ground water in selected slum areas suitable for drinking purpose.

Key words: Slum, Bhopal, Groundwater, Physico-chemical characteristics, Iron, BIS TDS

Ground water is major fresh water resource and it is more readily available than surface water. The quality of public health depends to a greater extent on the quality of ground water, which should be clean and fresh. The modern civilization, urbanization and prolonged discharge of industrial effluents, domestic sewage and solid waste dump cause the groundwater to become polluted. Hence, there is always a need for and concern over the protection and management of groundwater quality.

Present study is focussed on assessment of groundwater quality.

Groundwater samples collected from dug-wells, tube-wells and hand-pumps from the selected slum areas of Bhopal, during summer season in the year 2008-2009 and analyzed. Samples were collected in pre-cleaned plastic polyethylene bottles. Prior to sampling, all the sampling containers were washed and rinsed thoroughly with the groundwater to be taken for analysis.

The temperature and pH of water sample were recorded at the site itself. The Total Dissolved Solids was analyzed by standard method¹. All other parameters such as Alkalinity, Total hardness, Calcium, Magnesium and Chlorides were determined by titration method. Iron and Nitrate were analyzed by spectrophotometer method¹.

The analyzed physical and chemical parameters are tabulated in table-1. A comparison of the various physical-chemical characteristics of the studied water samples has been made with the BIS³.

The temperature of the groundwater samples ranged between 28.2- 31.5°C. The pH of the groundwater samples ranged between 6.2-8.4. The pH of groundwater samples were slightly alkaline except at S1 which is slightly acidic. Mostly groundwater are dominated by calcium and bicarbonate ions due to limestone weathering in the catchments and under ground water beds⁶. TDS indicates the general nature of salinity of water. The value of TDS varied from 360.0-1415.0 mg/l. Except S3,S5 and S6 all the other samples exceeds the desirable limit. Water with high TDS produces scales on cooking vessels and boilers. Water containing more than 500mg/l of TDS is not considered suitable for drinking water.³. Alkalinity is due to the presence of bicarbonates, carbonates or hydroxides¹⁰. The value of Alkalinity varied from 112.0-525.0mg/l as CaCO₃. Except S5 all other values exceeds the desirable limit³. The value of Chloride varied from 58.0-220.0 mg/l. The Chloride content in all the sampling sites was well within the BIS desirable limit. Total hardness of the collected samples was found to be in the range from

92.0-473.0 mg/l as CaCO₃. Except S1 and S8 all other values were well within the desirable limit. Hardness leads to heart diseases and kidney stone formation². Calcium and Magnesium are the two principal ions of water hardness^{5,9}. The concentration of calcium ranges from 65.0-425.0 mg/l and the concentration of magnesium ranges from 20.0-82.0 mg/l. Except S3 and S7 all other samples showed the higher value of calcium. Only in S3 the value of magnesium was within the BIS desirable limit. Higher concentration of magnesium makes the water unpalatable and act as laxative to human beings⁴. The concentration of Nitrate varied from 28.0-72.0 mg/l. Sample S1 and S8 showed high values of Nitrate exceeding the BIS permissible limit. When Nitrate concentration is above 40 mg/dm³, it may lead to a disease called "Methamoglobinemia" or "Blue baby" in children. The concentration of Iron varied from .09-1.3 mg/l (Table-1). Sample S1 showed higher values of Iron and exceeded the BIS permissible limit of drinking water.

The study was carried out in the selected slums of Bhopal city on the basis of density of population and water availability. Results indicate that pH level of ground water was within limit in all samples except at S1 which was found to be slightly low(6.2) might be due to the discharge of acidic water into ground water sources through sewage and other domestic activities. Data indicates that the value of parameters such as Alkalinity, Hardness, Ca, Mg, and Chlorides were found to be within BIS permissible limit (Tables 1 & 2). Hardness below 300mg/l is considered potable but beyond this limit causes gastrointestinal irritation⁵. According to Sawyer *et al.*,⁹ ground water values of S1 and S8 are very hard water

Table-1. comparison of chemical parameters with BIS (1992).

	S1	S2	S3	S4	S5	S6	S7	S8	BIS,1992
Temp. (°C)	28.7	31.6	28.4	30.3	28.2	28.4	31.3	31.5	
pH	6.5	7.5	7.0	8.0	8.4	8.2	7.5	6.2	6.5-8.5
TDS mg/l	1415.0	512.0	362.0	890.0	360.0	415.0	1010.0	1115.0	500-2000*
T. Alkalinity, mg/l as CaCO ₃	525.0	210.0	275.0	236.0	112.0	232.0	325.0	335.0	200-600*
T. Hardness, mg/l as CaCO ₃	473.0	188.0	92.0	270.0	285.0	230.0	145.0	492.0	300-600*
Ca, mg/l	425.0	145.0	65.0	135.0	125.0	140.0	70.0	382.0	75-200*
Mg, mg/l	82.0	67.0	30.0	42.0	20.0	40.0	35.0	69.0	30-70*
Chlorides, mg/l	195.0	58.0	75.0	220.0	68.0	70.0	82.0	190.0	250-1000*
Nitrate, mg/l	72.0	38.0	28.0	35.0	30.0	42.1	42.0	63.2	1-45*
Iron, mg/l	1.3	.35	.09	.12	.10	.17	.09	.21	0.3-1.0*

- Permissible limit in the absence of Alternate source.

Table-2 classification of water quality on the basis of Hardness

Water quality	Total hardness in mg/l as CaCO ₃
Soft water	0-75 mg/l as CaCO ₃
Moderately hard water	75-150 mg/l as CaCO ₃
Hard water	150-300 mg/l as CaCO ₃
Very hard water	Above 300 mg/l as CaCO ₃

(above 300 mg/l as CaCO₃, (Table-2). The Hardness may be due to decrease in water level by high temperature thereby increasing solubility of calcium and magnesium salts. The

addition of sewage, detergents and large scale human use might be another cause of elevation of hardness⁷. Calcium and Magnesium higher than the desirable limit indicates higher amount of salts of calcium and magnesium. Higher values of Nitrate at S1 and S8 indicate ground water pollution through decayed vegetable and animal waste, sewage sludge disposal to land and industrial effluent rich in nitrate⁸. Higher values of iron at S1 might be due to weathering of rock and discharge of waste effluents on land. According to this study, the ground water quality of the representative slums are suitable for drinking purpose on the basis of physico-chemical parameter except for Iron at S1 and

Nitrate (S1 and S8) which exceed the permissible limits of drinking water.

The present investigation made on the groundwater of selected slum areas revealed that the water quality though exceed the desirable limit for few parameters at some sampling locations but was well within the BIS permissible limits except iron and Nitrate which exceeded the limit at one or two sampling sites. This may be due to addition of waste dumped, deposition of organic matter and intrusion of sewage into the ground water due to improper maintenance of sewage system. Hence, there is need for groundwater treatment before it is used for consumption and to ensure that it meets the standards of drinking water.

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