



# Physico-chemical characteristics of ground water of Tezpur town

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**Abstract** In the present study the physico-chemical parameters like pH, Electrical Conductivity, Total Dissolved Solids, Alkalinity, Hardness, Chloride, Fluoride, Sulphate, Nitrate, Ca, Mg, Cd, Fe, Zn, Ni and Cu of ground water of Tezpur were carried out to assess the quality of ground water. Most parameters were within the permissible limit as prescribed by WHO and USPH. But pH is slightly acidic in nature. The concentration of Zn, Ni and Fe exhibited a lower concentration and stand far below the standards laid down by WHO, USPH and ICI. But the concentration of Cd was found to be slightly above the permissible limit in some places. Therefore, the ground water can be used for drinking purpose after conventional treatment and proper disinfections.

**Keywords** Ground water, physico-chemical parameters, heavy metals, water quality standards

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## 1. Introduction

Ground water is present in the pore spaces of regolith and bedrock below the ground surface. The quality of ground water depends upon the chemical and mineral composition of surface material and rock through which they are percolating underground. The main controlling factors of ground water pollution are lithological characters of sub-soil and sub-surface materials, depth of water table of ground water, nature of aquifer, amount and nature of annual rainfall, general outlook of society, nature and rate of infiltration of rainwater and above all the nature and amount of pollutants,

Ground water is less susceptible to contamination and pollution as compared to surface water. However, in some parts of India ground water resources has become a major concern today [1]. The extent of fluoride above permissible limit occurs in 17 states of India. A recent survey by International Water Management Institute (IWMI) in North Gujarat

shows 42% of people covered in the sample survey were affected by fluoride, while 25.7% by dental fluorosis and 62% by muscular fluorosis & 10% by both [2]. High levels of Arsenic above permissible limit of 50 ppb are found in the 6 districts of West Bengal.

Tezpur is located on the 97° 47' East longitude and 26°37' North latitude. The maximum average temperature is 30°C and the minimum is 10°C.

Its area is 7.10 sq. km. The total population of Tezpur town is 2, 23, 621 in 1991. The area has Precambrian crystalline metamorphic rocks formed during Proterozoic period. In Tezpur town, ground water is the main source of drinking water.

Previously no work has been done regarding the ground water quality of Tezpur town. So, an attempt has been made for the first time to determine the various physio-chemical properties of ground water, being consumed by the people of the Tezpur town. The study will give an idea to what extent the ground water of Tezpur is polluted due to human activities as well as natural phenomenon.

## 2. Materials and methods

In the present investigation, 19 different sampling stations from different part of Tezpur town have been selected to assess the quality of ground water. Ground water samples were collected from tube wells and dug wells in plastic bottle. Analyses of samples were performed as per the procedures described in APHA methodologies [3]. Fluoride in water was determined using ion-meter (Orion make). Cd, Ni, Zn, Cu, and Fe were determined with the help of Atomic Absorption Spectrophotometer (AAS)

## 3. Result and discussions

The pH of groundwater of Tezpur town ranged between 6.17–6.99 and found to be within the permissible limit of standards stipulated by USPH. This type of variation of pH values in different sampling stations are quite expected as shown in the Figure 1. The lowest 7  $\mu$ S and highest 48  $\mu$ S values of EC were recorded at ASTC and Mahabhairab respectively, indicate the presence of low level of ionic salts. The variation is not very high (Figure 2). TDS ranges from 210-480 mg/l, which is within the permissible limit and indicates lower amount of dissolved solids. Hardness in water ranges from 54-150 mg/l, which is within the desirable limit of WHO (150 mg/l). The highest and lowest values of calcium were found in the drinking water samples at station S12 and S13 respectively. Calcium concentrations were also within the permissible limit as shown in the Table 1. Magnesium concentration in all sampling stations was also found to be within the permissible limit as per WHO's standards but in station S2 (48 gm/l) concentration was found to be slightly higher than permissible limit as given by USPH. Chloride in ground water ranged from 2–10.5 mg/l. The chloride concentration values were much below the highest desirable limit as given by WHO [4] for drinking water. Sulphate ion in groundwater was not detected in any one of the sampling sites. Nitrate ion concentration ranges from 0.1–1.05 mg/l, were found to be within the permissible limit as given by WHO but some amount variation of concentration was observed in the different locations of the two (Figure 3). The concentration

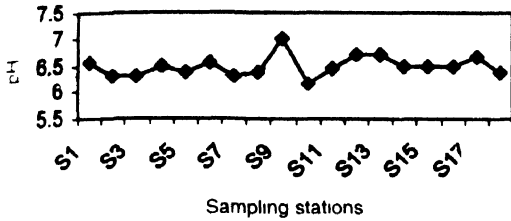


Figure 1. pH in ground water.

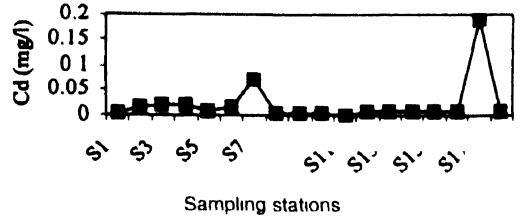


Figure 5. Cadmium (mg/l)

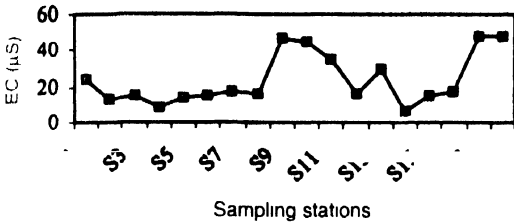


Figure 2. Electrical Conductivity (µS).

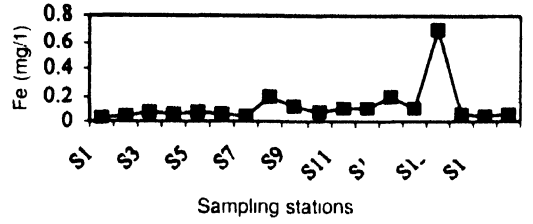


Figure 6. Iron (mg/l)

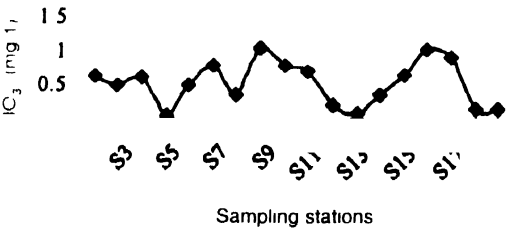


Figure 3. Nitrate (mg/l)

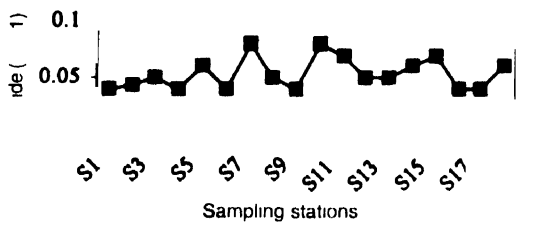


Figure 7. Fluoride (mg/l)

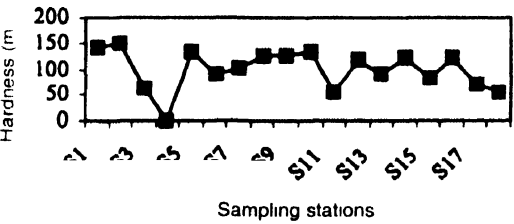


Figure 4. Hardness (mg/l).

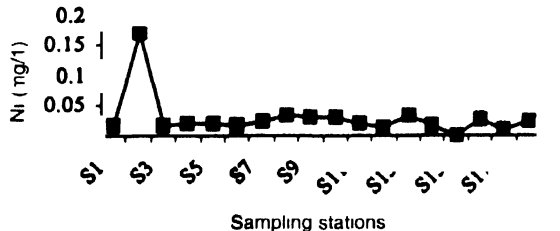


Figure 8. Nickel (mg/l)

of iron in the groundwater samples ranges from 0.03–0.7 mg/l, within the permissible limit as per WHO and shows wide variation in concentration against sampling stations (Figure 4). The fluoride concentrations in all ground water samples ranged between 0.04–0.08 mg/l lies far below the permissible limit of 1 mg/l as given by WHO. This shows that the ground water of Tezpur town is quite safe for drinking with respect to fluoride ion and variation of concentration is not very high as shown in the Figure 5. The cadmium concentrations, which range from (0.001–0.19 mg/l) as presented in the Table 1, was found to be within the permissible limit in most of the sampling stations. However, in some sampling stations viz S2, S3, S4, S6, S17 values were slightly above the permissible limit. This indicates that the ground water of some locations of Tezpur town is polluted

**Table 1.** Physico-chemical parameters of ground water of Tezpur town (mg/l)

Stations*	pH	EC**	TDS	Alkalinity	Hardness	NO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	F <sup>-</sup>	Ca	Mg	Fe	Cd	Zn	Cu	Ni
WHO	6.5-9.0	600	500	150	150	45	500	1.5	100	150	1	0.01	5	1.0	0.02
USPH	6.0-8.5	500	500	150	–	10	250		100	30	0.3	0.01	5	0.05-1.5	–
S1	6.54	24	450	156	140	0.65	10.5	0.04	56	12	0.03	0.002	0.06	0.002	0.015
S2	6.31	13	240	69	150	0.5	6.25	0.042	14	48	0.04	0.015	0.065	0.003	0.17
S3	6.31	15	230	162	62	0.61	3.0	0.05	12	9.2	0.08	0.019	0.16	0.004	0.017
S4	6.36	14	210	261	–	0.045	5.0	0.04	20	12	0.06	0.018	0.03	0.084	0.021
S5	6.37	14	280	261	135	0.5	4.0	0.06	25	18	0.07	0.006	0.02	0.026	0.019
S6	6.54	15	300	228	90	0.8	2.0	0.04	36	12	0.06	0.017	0.05	0.025	0.018
S7	6.30	18	280	280	102	0.35	2.5	0.08	41	20	0.05	0.07	0.2	0.055	0.022
S8	6.38	16	480	110	125	1.05	4.8	0.05	23	19	0.2	0.004	0.255	0.007	0.033
S9	6.99	47	280	180	125	0.8	7.0	0.04	30	28	0.12	0.004	0.241	0.007	0.029
S10	6.17	45	350	80	135	0.7	3.0	0.08	10	8	0.08	0.002	0.21	0.085	0.028
S11	6.45	35	287	180	54	0.2	5.0	0.07	14	4	0.1	0.001	0.05	0.005	0.021
S12	6.70	16	350	150	116	0.1	4.8	0.05	50	12.4	0.1	0.006	0.97	0.006	0.012
S13	6.71	30	300	150	90	0.35	8.0	0.05	18	8.5	0.2	0.007	0.053	0.053	0.032
S14	6.50	7	280	150	120	0.65	6.0	0.06	17	6	0.1	0.008	0.06	0.004	0.018
S15	6.50	15	280	145	84	1.03	5.0	0.07	38	20	0.7	0.007	0.06	0.001	bdl
S16	6.47	18	230	180	120	0.9	4.0	0.04	28	12	0.06	0.006	0.02	0.008	0.027
S17	6.66	48	480	150	70	0.15	2.5	0.04	30	124	0.05	0.19	0.22	0.007	0.01
S18	6.38	48	350	120	54	0.15	10.0	0.06	18	5.28	0.06	0.009	0.06	0.008	0.023

\* Chandman (S1), Rail gate (S2), Hazapara (S3), Rly Station (S4) Tribeni (S5) circuit house (S6) Cotton Road (S7), Mahabhairab (S8), Darrang college (S9) D N Kalita Rd (S10) L B Road (S11) Jail road (S12) ASTC Stn (S13) M D Road (S14) Thana (S15), K C Road (S16) B C Road (S17) and Padmapati Rd (S18)

\*\* in  $\mu$ S

with respect cadmium. It is also interesting to note that there is a wide variation of concentration of cadmium in different sampling stations as shown in Figure 6. Zinc and Copper falls within the permissible limit as prescribed by USPH. Nickel concentration of ground water samples ranges from 0.01–0.17 mg/l. Some sampling sites viz. S2, S4, S7, S8, S9, S10, S13, S16 and S18 have slightly higher level of Ni as compared to the prescribed limit given by WHO. The highest concentration of Ni at S2 was more than ten fold that of lowest concentration at S17 (Figure 8).

#### **4. Conclusion**

The ground water is slightly acidic, moderately saline and slightly hard. The water samples have negligible sulphate content, low ionic strength, low fluoride and heavy metals. An extensive study of groundwater of Tezpur town with many more parameters and study of seasonal variations will give a better understanding of the problem of ground water pollution

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