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Studies on Some Physico-Chemical Characteristics of Ground Water Used in Some Rural Areas of Surat District (Gujarat)

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A physico-chemical study of the ground water of some villages of Surat, India has been made for parameters as temperature, pH, conductivity, TDS, total hardnes, calcium, magnesium, chloride. sulphate, total alkalinity, nitrate, fluoride, iron, sodium and potassium. It was found that these water samples have higher TDS, chlorides and alkalinity than the permissible limits.

Key Words: Physico-chemical, Characteristics, Ground water, Surat.

INTRODUCTION

With the advent of development, there is an exponential increase in the demand for water. The main source to fulfill this demand for irrigation, industrial and drinking purposes is ground water. About 95% of the total available water all over the world is in the form of ground water. Thus the quality of ground water is of vital concern for mankind since it is directly linked with human existence and welfare. In villages, the main source of water is ground water available from wells, borewells or handpumps. Most people of such areas use water directly from available sources without any treatment and hence are exposed to a variety of water-related diseases. India, being the second highest populus in the world, the quality of ground water is deteriorated day by day due to rapid increase of urbanization and industrialization. Many authors[1–6] have studied the physico-chemical characteristics of ground water of different parts of the country. The objective of the present study was to determine the quality of drinking water supplied to the rural community in order to estimate the health implications.

EXPERIMENTAL

Water samples were collected in the first week of May 2002 (Table-1) and the first week of August 2002 (Table-2). The villages selected were Parvat (S-1), Kharvasa (S-2), Bonand (S3), Vesu (S-4), Amroli (S-5), Kadodara (S-6), Chaithan (S-7), Variyav (S-8), Gaviyar (S-9) and Bhairav (S-10). All the samples were collected in sterile glass bottles. The results included in the present investigation are the means of the results obtained by independent experiments. Standard procedures were adopted for the determination of physico-chemical parameters[7–9].

For spectrophotometric determination of fluoride, iron, nitrate and sulphate,

"Hach" Odyssey (USA) spectrophotometer was used. Sodium and potassium were determined on a flame photometer. Conductivity bridge and pH-meter of ELICO (India) were used.

RESULTS AND DISCUSSION

All metabolic and physiological activities and life processes of aquatic organisms are generally influenced by water temperature. In the present study temperature ranged from 28–31°C.

The pH value of drinking water is an important index of acidity, alkalinity and resulting value of the acidic-basic interaction of a number of its mineral and organic components. In the present study pH ranged from 7.37 to 8.33 which lies within the range prescribed by APHA[7]. The pH values observed are slightly alkaline showing the presence of sufficient carbonates in water.

The electrical conductivity, which measures the dissolved ion concentration, was much higher than the permissible limits. In the present study it ranged from 428 to 5017 μs/cm.

According to WHO and Indian standards, TDS values should be less than 500 mg/L for drinking water. In the present study TDS ranged from 160 to 2266 mg/L. Most of the samples have higher values of TDS than prescribed by WHO and ISI.

Total hardness is the sum of polyvalent cations present in water. Total hardness ranged from 90 to 500 mg/L. Some samples have higher values of total hardness than the values prescribed by WHO and ISI.

The limits of calcium and magnesium have been prescribed in the range 75–200 mg/L and 50–100 mg/L respectively. Calcium and magnesium contents in all samples collected fall within the limits prescribed. Calcium is needed for the body in small quantities, though water provides only a part of the total requirement.

It was observed that total alkalinity of all samples ranged from 352 to 532 mg/L except sample S-9. It is higher for all the samples than the prescribed limits. Such values may cause excessive encrustation in distribution pipes.

The chloride content in the samples ranged from 74 to 1292 mg/L. The findings indicate that most samples have higher values of chlorides than prescribed by WHO and ISI.

The concentration of sulphate in water samples is observed to be within the limits prescribed for sulphate content and it varies from 15.36 to 176.64 mg/L. The high concentration of sulphate may induce diarrhea.

Nitrate nitrogen is one of the major constituents of organisms along with carbon and hydrogen as amino acids, proteins and organic compounds in ground water. In the present study nitrate nitrogen levels show lower values than the prescribed values.

Fluoride limits in drinking water are from 1.0 to 1.5 mg/L. In the present study fluoride ranged from 0.05 to 1.10 mg/L, which is within the range prescribed by Indian standards.

Iron is one of the most abundant elements in the earth's crust. Iron deficiency

TABLE-1
PHYSICO-CHEMICAL ANALYSIS OF GROUND WATER OF SOME VILLAGES OF SURAT DISTRICT (MAY-2002)

Sr. No.	Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1.	Temperature (°C)	28	29	27	26	28	27	29	30	29	30
2.	pH	8.29	8.07	8.03	8.33	8.08	8.14	8.19	8.18	7.98	7.92
3.	TDS	836	1060	906	1576	1142	710	556	430	160	730
4.	Total hardness as $CaCO_3$	150	400	310	260	470	120	150	90	90	380
5.	Calcium	24	64	52	36	64	24	20	20	20	48
6.	Magnesium	21.87	58.32	43.74	41.31	75.33	14.58	24.30	9.72	9.72	63.18
7.	Total alkalinity	376	356	440	532	520	440	410	360	100	444
8.	Chloride	522	732	592	1224	588	296	256	80	75	240
9.	Sulphate	74.88	176.64	15.36	59.52	138.24	42.24	49.92	48	48	51.84
10.	Nitrate	52.717	7.708	18.606	8.86	12.183	8.86	8.417	8.417	1.108	74.424
11.	Fluoride	0.14	0.14	0.14	0.17	0.31	0.61	0.05	1.10	0.68	0.33
12.	Specific conductivity (µs/cm)	1722	1877	1749	3136	2116	1573	1407	1061	428	1690
13.	Sodium	140.0	119.5	135.0	375.0	105.5	145.0	138.0	100.5	18.5	60.0
14.	Potassium	8.0	6.5	6.8	180.0	60.0	7.0	6.0	6.5	14.0	6.80
15.	Iron	1.10	1.05	1.00	1.10	1.05	0.96	1.0	0.96	0.92	0.88

Except pH and specific conductivity, all the values are expressed in mg/L.

TABLE-2
PHYSICO-CHEMICAL ANALYSIS OF GROUND WATER OF SOME VILLAGES OF SURAT DISTRICT (AUGUST-2002)

Sr. No.	Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
1.	Temperature (°C)	30	31	29	29	30	31	29	28	27	30
2.	pH	8.27	8.13	7.84	8.23	7.62	7.76	7.85	8.12	7.88	7.37
3.	TDS	894	1022	1018	2266	978	828	632	553	252	730
4.	Total hardness	172	444	382	242	470	144	132	104	102	500
5.	Calcium	26.8	53.6	53.2	40.0	40 0	26.8	20.8	14.8	24.0	37.6
6.	Magnesium	25.515	75.816	60.507	34.506	89.91	18.71	19.44	16.28	10.206	98.658
7.	Total alkalinity	366	352	482	478	470	438	406	358	106	410
8.	Chloride	308	450	380	1292	280	184	138	74	50	188
9.	Sulphate	65.28	61.4	17.28	132.48	67.2	49.92	11.52	38.4	21.12	38.4
10.	Nitrate	3.898	5.405	1.551	0.310	0.310	4.119	1.816	2.171	0.443	46.515
11.	Fluoride	0.24	0.30	0.49	0.48	0.43	0.49	0.60	0.95	0.27	0.31
12.	Specific conductivity (µs/cm)	2005	2365	2364	5017	2293	1920	1587	1218	555	734
13.	Sodium	120.0	105.5	110.0	530.0	90.0	110.5	115.0	98.0	30.0	62.0
14.	Potassium	8.5	2.0	5.0	95.0	44.0	2.5	6.5	3.0	6.0	2.5
15.	Iron	1.24	1.28	1.44	1.32	1.52	1.16	1.12	1.12	1.24	1.12

Except pH and specific conductivity, all the values are expressed in mg/L.

in the human body causes anaemia. The iron content in the samples is ranging between 0.88 to 1.52 mg/L. The iron content of all the samples was found higher than the values prescribed by WHO and Indian standards.

Conclusions

It is seen that in the samples of Vesu (S-4) all the values are higher than the limits. This is due to its location near the sea (about 10 km). Sampling point S-9 of Gaviyar is nearer to sea than Vesu, however, due to the treatment plant established by Gujarat Water Supply and Sewerage Board, Gandhinagar , the values of parameters are within the limits.

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