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Physico-chemical Studies on Ground and Surface Water of Manchankoppu, Tiruchirappalli

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Ground and well water samples were collected from Manchankoppu, Tiruchirappalli district. Physical parameters, such as temperature, odour, taste, turbidity, pH and conductivity, and chemical parameters, such as total hardness, calcium hardness, magnesium hardness and alkalinity were determined and compared with ISI, WHO and USPHS. Sulphate, silicate, phosphate, nitrite and nitrate contents were also analysed. The results revealed high degree of hardness, chloride and dissolved solids in some samples, which could be removed by boiling for half an hour filtering the sample to become potable. Phosphate content has been observed to be high in a few samples, which requires special treatment.

INTRODUCTION

Water is a vital and essential entity of the universe and next to air, it is the fundamental component for the existence of living beings. Water finds its use for drinking and all kinds of domestic activities. Hence, it is the most important raw material of civilization, but for which sustain of human life will be difficult. The major sources of water are rainfall, surface water involving rivers, lakes and ground water involving wells, etc. (Sharma, 2001). But man has been instantly adding a lot of toxic substances into these resources through his activities thus destroying the state of water and causing pollution. The excessive discharge of undesirable substances, like industrial wastes and sewage into water (Bhatia, 2000) is called water pollution. The increasing population together with rapid industrialization deteriorate the quality of pure water making it less suitable for all purposes. So, the knowledge of extent of pollution and the status of water become essential in order to preserve the valuable sources of water for future generation.

Area chosen for the study

The area chosen for the present study is 'Manchankoppu' which comes under Andhanallur Panchayat. This village is situated 15 km from Chathiram bus stand, Tiruchirappalli city. It is a very small village containing 100 houses. The population is around 500. About 90 % of the people are illiterates. They lack drainage facilities due to which microorganisms, spread, in air, water and cause many diseases, such as typhoid, cholera, skin problems, hair loss, etc. The main occupation in the village is agriculture. The farmers cultivate grains and cereals. Bore and well water sources are used for drinking purposes. Apart from these water resources there is a canal running near the village in which all the people take bath and wash the animals and hence water becomes unfit for domestic use. At the side of the canal there is a hand pump. The water obtained from this hand pump is used for drinking purposes though its surrounding is fully contaminated with wastes. The water samples were collected from the wells and bore wells and analysed. The physicochemical properties were compared with ISI, WHO and USPHS.

MATERIAL AND METHOD

Eleven water samples were collected using spot sampling procedure (De, 1998) in previously washed and dried polythene containers from different places. The temperatures of the samples were noted at their sampling point itself. The samples were put to examination in the laboratory to determine some physical, chemical and biological parameters. These include conductivity, total solid (TS), total dissolved solids (TDS), total suspended solids (TSS), pH, concentrations of chloride, sulphate, phosphate, carbon dioxide, nitrate, nitrite, iron, total hardness, calcium and magnesium hardness. Standard procedures involving spectrophotometry and volumetry (Trivedy and Goel, 1986; De, 1998) were used for experiment. Presumptive test using lactose broth was performed for drinking water samples to detect the pre-

Table 1. *Physical parameters, in mg/L*

Parameter	Sample						
	1	2	3	4	5	6	7
Depth of the bore well or well, ft	75	75	100	–	75	100	120
Temp., ^{0}C	32	30.5	29.9	30.1	31.8	31.2	30.4
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Taste	Normal	Normal	Normal	Salty	Salty	Salty	Normal
Turbidity	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Conductivity, μmho/cm	1.58	2.60	1.21	0.71	4.93	4.28	1.12
Total solids	896	952	594.962	255.047	2764.7	5949.6	746.87
Total dissolved solids	738	128	460.74	178.36	264.2	2180.74	470.3
Total suspended solids	158	824	134.22	76.687	2500.5	3768.8	276.57

Table 1. (*continue*)

Sample				WHO	USPHS	ISI
8	9	10	11			
75	100	75	75	–	–	–
30.7	31.5	30.2	30.5	–	–	–
Colourless	Colourless	Yellowish	Yellowish	–	–	–
Odourless	Odourless	Odourless	Oodourless	–	–	–
Normal	Salty	Normal	Normal	–	–	–
Clear	Turbid	Turbid	Turbid	–	–	–
2.53	3.15	1.35	2.23	–	1.5	–
1500.8	1708.7	551.0	1068.17	500–1500	–	–
1393.95	1599.05	455.97	931	–	5.0	–
106.58	109.55	95.03	135.17	–	5.0	–

ISI - Indian Standard Institute, WHO - World Health Organization, USPHS – United States Public Health Standard.

sence of bacteria. The results were compared with ISI, WHO, USPHS.

RESULT AND DISCUSSION

All the collected water samples were mainly from borewell except samples 10 and 11, which were collected from well surrounded by trees. The physical ann chemical parameters are tabulated along with the standard values in tables 1 and 2.

Temperature

The temperature of water is important for biological reactions of organism in it. The samples had temperatures ranging from 30 to 32 ^{0}C (Table 1).

Colour, odour, taste and turbidity

All the water samples are colourless except samples 10 and 11, which are collected from open well. The colour may be due to seepage or decomposition of vegetation. The samples 4, 5, 6 and 9 have salty taste (Table 1) In accordance to their high hardness and more chloride content. All the samples collected were clear except 9, 10 and 11 which are turbid due to the suspended solids, like clay and silt.

Conductivity and total solids

Conductance of the samples varied from 0.71 to 4.28 μmho/cm (Table 1). But samples 5, 6 and 9 had relatively higher conductivity, which may be due to contamination of conducting material wastes. For samples 5, 6, 9 and 11 TDS exceeds the WHO permissible limit. The presence of excessive solids in water may be due to agricultural activities and geological parameters.

pH, chloride, dissolved silica

Table 2. *Chemical parameters, in mg/L*

Parameter	Sample						
	1	2	3	4	5	6	7
pH	7.5	7.65	7.5	7.85	7.75	7.5	7.35
Chloride	153.53	402.2	93.16	50.75	909.74	730.83	75.62
Dissolved silica	0.37	0.29	0.31	1.14	0.28	0.29	0.68
Carbon dioxide	15.84	11.88	15.84	3.96	15.84	11.88	3.2
Total hardness	382	552	372	202	922	576	304
Calcium hardness	180	162	176	112	324	220	104
Magnesium hardness	202	390	196	90	598	356	200
Sulphate	173	212	346	132	141	127	635
Phosphate	1.2121	0.7273	0.2424	0.1914	0.4556	0.3637	0.05
Nitrate	33.3	5.21	25	20.8	5.0	8.33	7.58
Nitrite	bdl	bdl	bdl	0.0515	0.0412	0.059	0.2206
Iron	0.705	bdl	bdl	0.4235	0.674	bdl	0.154

Table 2. (*continue*)

Sample				WHO	USPHS	ISI
8	9	10	11			
7.55	7.85	7.95	7.3	6.5–9.2	6.0–8.5	6.0–9.0
386.6	386.99	142.11	263.91	200–600	250	600
0.39	0.28	0.30	0.29	–	–	30
3.96	3.96	11.88	7.92	–	–	–
560	376	404	348	100–500	–	–
130	100	204	124	–	–	–
430	276	200	224	30–50	30	–
212	142	200	180	200–400	250	1000
0.06	0.33	0.18	0.24	–	0.1	–
6.10	bdl	35.7	14.29	45	<10	–
0.165	0.059	0.0068	0.103	<0.1	–	–
0.282	0.564	bdl	bdl	0.1–1.0	<0.3	–

ISI–Indian Standard Institute
WHO–World Health Organization
USPHS–United States Public Health Standard
bdl–Below detectable limit

The collected water samples have pH within the limits ranging from 7.5 to 7.85. The chloride content of water samples collected lies in the range 50.75 to 909.7 mg/L. Samples 5, 6 and 9 have very high concentration of chloride content and exceeds the permissible limit proposed by ISI and USPHS. High chloride content in water bodies harms metallic pipes and structure as well as agricultural crops. All the samples have silica from 0.29 to 1.14 mg/L which is well below the ISI standard.

Carban dioxide and hardness

The water samples have carbon dioxide content ranging from 3.96 to 15.84 mg/L. Dissolution of carbon dioxide in water leads to alkalinity in water. Collected samples have total hardness in between 202 to 922 mg/L. Sample 5 exceeds the permissible limit whereas samples 6 and 8 vary marginally. The calcium hardness is in the range 112 to 324 mg/L. The range of magnesium hardness is in between 90 to 598 mg/L which exceeds the standard values for all the samples.

Sulphate and phosphate

Discharge of industrial waste and domestic sewage into water tends to increase sulphate concentration. The concentration of sulphate ranges from 132 to 635 mg/L. Sample 7 exceeds the WHO limit. If the

concentration exceeds above 500 mg/L it has laxative effect and causes gastro intestinal irritation. This laxative effect leads to dehydration in infants.

Domestic sewage, detergents and agricultural effluents are the main sources of phosphate. High concentration of phosphate leads to increase in the growth of algae and eutrophication. The permissible limit of USPHS is 0.1 mg/L. All the samples were found to have phosphate concentration ranging from 0.05 to 1.25 mg/L. Except 7 and 8 all other samples exceed the proposed USPHS limit. Very large variation is found in samples 1, 2 and 4 compared to other samples. The excess causes risk to human beings as algae produces toxins, which damage neurological system.

Nitrate, nitrite and iron

Nitrate in water may be due to oxidation of organic nitrogeneous substances and sewage disposal (Suresh *et al.*, 1992). The concentration of nitrate is in between 5.0 to 35.7 mg/L. There is marginal variation from USPHS limit for samples 1, 4, 5 and 9. This may be due to corrosion of pipelines. The excess of iron causes corrosion to plumbing works, provides metallic taste, odour to drinking water, produces stain in clothes during washing and causes troubles in manufacturing process.

Treatment of water

The water samples 5, 6, 9 and 11 contain relatively high value for total hardness, calcium hardness and magnesium hardness. In general hardness can be removed by treatment method, such as lime soda, geolite or ion exchange. The total solids, total suspended solids and total dissolved solids are also high for these samples. This can be minimized by preventing the dumping of waste materials. The samples 1 and 2 have high phosphate content requires special treatment. The traces of iron can be removed by chlorination, water softner or distillation. The nitrite content for samples 11, 7 aed 8 varies marginally. Even small amount of nitrite show organic pollution causes 'blue baby syndrome' and can be reduced by desalination. In general the water may be boiled, cooled, filtered and used for drinking purposes.

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