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Research Article

Physico - Chemical Characteristics of Dye Effluent & Ground Water Samples in Karur District, Tamil Nadu, India

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Abstract: Physico – Chemical Characteristic of the ground water quality at Chinnandankovil in Karur City, Tamil Nadu, India was carried out during September to November 2008. Two water samples from dye effluent industry and Eight Bore well water samples representing study area were collected and almost of all the samples values were within the permissible limit of World Health Organization (WHO) and Bureau of Indian Standards (BIS) prescribed for drinking water standards pH 7.72 to 9.2, total dissolved solids (TDS) – 310 to 6850 mg/L, Electrical conductivity (EC) – 361 to 9800 micro mho/cm, phenolphthalein alkalinity (PA) range 20 to 130 mg/L, Total

alkalinity (TA) 127 to 730 mg/L, Total hardness (TH) 113 to 934 mg/L, chloride 37 to 3375 mg/L, Ca – 27 to 192 mg/L, Mg 11 - 143 mg/L, Na 336 to 846 mg/L, K 18.4 to 30.1 mg /L, Fe 0.11 to 2.28 mg/L, free ammonia 0.47 – 0.57 mg/L, Nitrite 0.01 – 0.54 mg /L, Nitrate 1 – 14 mg /L, Sulphate 10- 247 mg /L, Fluoride 0.0 - 2.2 mg/L, Phosphate 0.02 to 0.28 mg /L, Tidy's test (as O mg/L) 0.4 – 78 mg /L, dissolved oxygen (DO) – 2.8 to 4.1 mg/L, biological oxygen demand (BOD) 81 to 234 mg/L, chemical oxygen demand (COD) 216 to 700 mg/L. However further it will need proper monitoring of the ground water quality in the study area.

INTRODUCTION

Water is a gift to mankind by nature. But man's activity have made as a source of potential danger to Health and very existence. Due to industrial and agricultural activities of the surface and ground water are, of late, subjected to frequent pollution. In recent years, the wide range of fertilizers used have also contributed to high levels of nitrate in same water systems many toxic materials have also find their way to various water sources. Apart from this, most of hundreds and thousands of manmade chemicals which are otherwise find to very useful they also accumulate over a period of time and cause unknown hazards to the animal and plant kingdom. It is noted that more than 2000 chemical contaminants of all kinds have been found in water, about 750 which have been identified in drinking water. The indiscriminate disposal of industrial wastes on the earth slowly makes the ground water susceptible to pollution. So, it is essential to examine carefully such factors that adversely affect the water quality for the use of drinking purposes from a particular source. A critical perusal of revealed that no scientific investigation was carried out with respect to ground water quality in the study area of Chinnandankovil in Karur District, Tamil Nadu, India. Hence, an attempt has been made to investigate the quality of ground water in this area¹⁻⁴.

EXPERIMENTAL

Chinnandankovil is situated within Karur district in Tamil Nadu, India. The sampling of ground water from the 8 bore wells and 2 samples from dyeing effluent industry were collected after running them for 10 minutes was done during the month of September to November – 2008. The water samples were analyzed in Tamil Nadu water testing laboratory at Karur. Before collecting water samples, the plastic water bottles were rinsed with concentrated hydrochloric acid and then with ground water to be analyzed totally about 26 water parameters were analyzed. Turbidity was measured by turbidity meter and TDS was measured by gravimetric method. Electrical conductivity was measured by electrical conductometer. pH was measured by using pH meter. The phenolphthalein alkalinity (PA), total alkalinity (TA), hardness, chloride, chemical oxygen demand (COD) , biological oxygen demand (BOD), dissolved oxygen (DO) and Tidy's test were measured by using titration methods. The amount of Na, K, Fe, Mn, free ammonia, nitrite, nitrate, sulphate and phosphate were measured by using spectrophotometer method. Fluoride was measured by visual comparison method.

RESULTS AND DISCUSSION

The data revealed that there were considerable variations in the samples with respect to chemical characteristics (**Table 1** and **2**). A comparison of physico-chemical characteristics of ground water samples and dye effluent samples has also be made with WHO (1984) and BIS 1998 standards. The water has alkaline nature with pH, ranging from 7.72 to 9.2; this indicates that it has no direct effect on human health. Since recommended value for drinking purpose by WHO is 6.5 to 8.0 and BIS standard is 6.5 to 9.2 ground water chemistry charges as the water flows through the sub surface geological

environment increasing in dissolved solids and major ion. The TDS values varied from 310 to 6850 mg/L. The sample no. 1 (S_1) had a high TDS value which was collected from dye effluent industry (Inlet). Among the 10 samples, S_1 , S_2 , S_3 , S_4 , S_5 , S_6 , S_7 and S_9 had high TDS and beyond the acceptable limit and 8 & 10 had permissible limit of BIS and WHO standard for portable purpose ⁵.

Table-1: Physicochemical Parameters of Dye effluent and Ground Water Samples

Sample	Appearance	Odour	Turbidity	TDS	EC	pH	Alkalinity Ph(CaCO ₃)	Alkalinity Total (As Ca CO ₃) Mg/l	Total Hardness (as Ca CO ₃) mg/l	Sodium (as Na) mg/l	Potassium (as K) mg/L	Calcium (as Ca) mg/l	Magnesium (as Mg) mg/L	Iron (as Fe) Mg/L
S1	Blockish & Turbidity	OB J	200	6850	9800	9.2	130	730	600	846	30.1	192	29	2.28
S2	Slightly Brownish	OB J	12	2030	2900	8.5	50	320	260	336	18.4	72	19	1.12
S3	Clear & Colourless	-	2	1230	1763	7.7	Nil	388	374	-	-	94	33	Nil
S4	Clear & Colourless	-	2	2440	3506	8.1	Nil	388	677	-	-	110	96	Nil
S5	Clear & Colourless	-	1	3420	4908	7.9	Nil	475	934	-	-	137	143	Nil
S6	Clear & Colourless	-	1	2180	3141	7.8	Nil	380	667	-	-	136	79	Nil
S7	Clear & Colourless	-	2	2040	2924	7.8	Nil	416	667	-	-	137	78	Nil
S8	Clear & Colourless	-	1	310	457	7.7	Nil	131	113	-	-	27	11	Nil
S9	Slightly Brownish	OB J	7	1980	2865	8.1	Nil	388	687	-	-	199	46	0.11
S10	Clear & Colourless	-	1	250	361	8.4	20	127	141	-	-	30	16	Nil

OBJ: Objectionable

The EC values varied from 361 to 9800 micro mho/cm. The S_1 had high EC due to inlet from dye effluent and S_{10} had low EC value. The constituents of alkalinity in natural system mainly include carbonate, bicarbonate and hydroxide. These constituents result from dissolution of mineral substances in the soil and atmosphere. The WHO acceptable limit of 200 to 600 mg/L. S_1 , S_2 and S_{10} had PA range 20 to 130 mg/L and remaining samples had no PA. The TA range varied from 127 to 730 mg/L, S_1 had

high alkalinity total value which above permissible limit of BIS and WHO standard 200 to 600 mg/L showing that all parameters except S_1 were well within prescribed drinking water standard ⁶.

Hardness in water is caused by metallic ions dissolved in water due to the presence of Ca^{2+} and Mg^{2+} ions; also the heavy metals such as Fe and Mn contribute to hardness. The amount of TH in potable water ranges from 200 to 600 mg/L for BIS standard and 100 to 500 mg/L for WHO standard where as in this investigation total hardness ranged from 113 to 934 mg/L. The S_1 , S_4 , S_5 , S_6 , S_7 and S_9 had high TH values which were beyond the permissible limit ⁷.

Table -2: Physicochemical Parameters of Dye effluent and Ground Water Samples

Sample	Manganese (as Mn)mg/L	Free Ammonia(asNH ₃)mg/L	Nitrite (asNO ₂) mg/L	Nitrate (asNO ₃) mg/L	Chloride (asCl)mg/L	Flouride (as F) mg/L)	Sulphate (as SO ₄) mg/L	Phosphate (as PO ₄) mg/L	Tidy's test (as O) mg/L	BOD mg/L	COD mg/L	D.O mg/L
S1	NIL	0.52	0.54	--	3375	--	180	0.24	78	234	700	2.8
S2	Nil	0.47	0.25	-	750	-	77	0.28	24	81	216	4.1
S3	Nil	Nil	0.08	5	333	0.6	47	0.08	0.52	-	-	-
S4	Nil	Nil	0.05	5	1005	0.8	44	0.05	0.52	-	-	-
S5	Nil	Nil	0.04	6	1518	1.2	134	0.04	0.44	-	-	-
S6	Nil	Nil	Nil	13	728	1.5	179	0.02	0.52	-	-	-
S7	Nil	Nil	0.03	14	616	2	247	Nil	0.4	-	-	-
S8	Nil	Nil	Nil	2	41	0.2	15	Nil	0.36	-	-	-
S9	Nil	Nil	0.03	3	728	0.8	115	0.05	24.4	-	-	-
S10	Nil	Nil	0.01	1	37	0.2	10	0.03	0.44	-	-	-

A chloride in excess imparts the salty taste to water and people who are not accustomed to high chlorides are subjected laxative effect. The WHO limit for chloride in drinking water 200 to 600 mg/L and BIS standard is 200 to 1000 mg/L, but chloride content ranged from 37 to 3375 mg/L. The S_1 had high chloride content. The S_1 , S_2 , S_4 , S_5 , S_6 , S_7 and S_9 had no drinking water quality. The Ca content of sample ranged from 27 to 192 mg/L. Almost all the samples were with in permissible limit of BIS and WHO standard is 75 to 200 mg/L. The Mg range of samples varied from 11 to 143 mg/L and within permissible limit of 30 to 150 mg/L. The Na range of permissible limit of WHO standard is 200 mg/L, but S_1 and S_2 have sodium content 336 to 846 mg/L due to direct dye effluent samples which were beyond the permissible limit. The K content of S_1 and S_2 were 18.4 to 30.1 mg/L. The Fe content of samples varied from 0.11 to 2.28 mg/L. The S_3 , S_4 , S_5 , S_6 , S_7 , S_8 , S_{10} had no Fe content but permissible limit of BIS of Fe is 0.1 to 1.0 mg/L and WHO standard is 0.3. The S_1 and S_2 had high Fe content which is beyond the permissible limit ⁸.

The BIS and WHO acceptable limit for Mn is 0.3 to 0.1 mg/L. But all the samples had no Mn content. The free ammonia ranges of the samples were 0.47 to 0.57 mg/L. But samples 3 to 10 had no free ammonia. The permissible limit for nitrite as per WHO norms is 0.1 mg/L. The nitrite content of

samples varied from 0.01 to 5 mg/L and S₅ and S₈ no nitrite content. The nitrate content of samples varied from 1 to 14 mg/L, but permissible limit of BIS is 45 to 100 mg/L. and WHO permissible limit is 45 mg/L. The S₁ and S₂ had no nitrate content and remaining samples S₃ to S₁₀ were within permissible limit of nitrate content. The WHO permissible limit of fluoride is 1.5 mg/L and BIS standard 1.0 to 1.5 mg/L, but fluoride content of samples varied from 0.2 to 2.0 mg/L which were within permissible limit except S₇ which has high Fluoride ion concentration. The sulphate in ground water takes place from break down of organic substances in the soil, leachable sulphates present in fertilizers and other human influences. Hence the recommended content of sulphate in drinking water is 150 to 400 mg/L. It is proved from present studies findings sulphates values varied from 10 to 247 mg/L. However, these values were below the recommended limit⁹. Phosphorus is an essential element for sustained primary productivity in the ecosystem. The form of phosphorus is ortho phosphate which is in natural water in the range of 0.001 to 0.24 mg /L, but in our study area phosphate concentration varied from 0.02 to 0.28 mg/L, it is within permissible limit of both WHO and BIS Standard. Tidy's test (as O) mg/L varied from 0.4 to 78 but S₁, S₂ and S₉ has high tidy's test value, it shows that ground water gets polluted due to dye effluents from industries. The DO values varied from 2.8 to 4.1 mg/L which lies in permissible limit of WHO¹⁰.

The BOD values varied from 81 to 234 mg/L. The S₁ was taken from inlet of dye effluent so it had high BOD value and S₂ had low BOD value due to various physical and chemical treatments in dye effluent industry which is within permissible limit of BIS. The COD value varied from 216 to 700 mg/L. The S₁ had high COD value due to raw effluent and S₂ had low COD value due to various treatments with in dye effluent industry. But COD of S₁ is beyond the permissible limit of BIS¹¹.

CONCLUSIONS

Most of the physico-chemical parameters of water of Chinnandankovil in Karur District, Tamil Nadu, India were within the permissible limits prescribed for WHO and BIS drinking water standards ground water is extremely important to the future economy and growth of country. If the resource is to be available as high quality water for future generation, it is important to protect them from possible contamination. However monitoring is a vital device to detect ground water contamination and to provide an advanced warning of approaching contaminated ground water to important source of water supply. So, we have to secure a safe drinking water supply for present and future generation.

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