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STATUS OF THE GROUNDWATER QUALITY IN KUNIAMUTHUR AND MADUKKARAI AREAS OF COIMBATORE, TAMIL NADU

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ABSTRACT

The paper deals with study of physico-chemical parameters such as pH, electrical conductivity, total dissolved solids, total hardness, total alkalinity, calcium, magnesium, manganese, ammonia, chloride, sulphate and fluoride of ground waters from seven sampling stations in Kuniamuthur and Madukkarai areas of Coimbatore. The analysed data were compared with standard values recommended by WHO, USPH, BIS and ICMR, and the variations were notable for the parameters like total hardness and electrical conductivity for few samples.

INTRODUCTION

The chemistry of waters is influenced by the inputs of material containing minerals and the chemical equilibrium prevailing the aqueous solution. Groundwater is a replenishable resource and is considered to be least polluted as compared to other inland water resources (Garg 2000). Groundwater is the cheapest and most practical means of providing water to small communities. It is likely to be free of pathogenic agents. It is subjected to less contamination and has high mineral content. Groundwater is becoming increasingly contaminated due to constant addition of industrial wastes, use of fertilizers and pesticides, manures, lime and septic tank etc. Extent of pollution depends on rainfall pattern, depth of water table, distance from the source of contamination and soil properties (Chatterjee 1994). Water quality also depends on physical, chemical and bacterial constituents (Honda 1986). Groundwater is generally used for drinking, domestic and agricultural purposes. The present study attempts to evaluate the quality of groundwater in Kuniamuthur and Madukkarai areas of Coimbatore, Tamil Nadu.

MATERIAL AND METHODS

Seven samples of borewell waters were collected to analyse the drinking water in outskirts of Kuniamuthur and Madukkarai area of Coimbatore. The samples were collected from the public borewells with a lateral distance of more than 4 km. The details of the samples are given in Table 1.

The samples were collected in 2-L clean well-dried brown glass bottles with necessary precautions (APHA 1995), and labelled for collecting points, date and time. The samples were stored in an icebox and brought to the laboratory for physical and chemical analysis. Double distilled water was used for the preparation of all the reagents and solutions. Glassware was cleaned with commercial HCl followed by distilled water.

The physico-chemical analysis of waters was carried out according to standard methods (APHA 1995, Manivasagam 1984). The pH and electrical conductivity were measured by using digital pH meter with accuracy of ± 0.01 and digital conductivity meter respectively. TDS were measured by

using evaporating method at 185°C. Total hardness, calcium and magnesium were determined by EDTA titration method. Total alkalinity was measured by titration method. Chloride was measured volumetrically by silver nitrate method using potassium chromate as indicator. Fluoride was measured by ion-selective electrode method. Sulphate was determined by gravimetric method using barium chloride.

Table 1: Details of the sampling locations.

Sample No	Sampling Location
S_1	Government official colony, Kuniamuthur
S_2	Near Government High School, Kuniamuthur
S_3	Thiruvalluvar Nagar, Kuniamuthur
S_4	Madukkarai Market
S_5	Chettipalayam
S_6	Ashokapuram
S_7	Mangarai of Veerapandi

RESULTS AND DISCUSSION

The physico-chemical characteristics of the water samples are presented in Table 2. All the values are compared with the standards given by WHO, USPH, BIS and ICMR (Table 3).

The temperature ranged from 28°C to 35°C**.** All groundwater samples should be colourless and odourless. The pH of the samples ranged from 6.9-8.2. The pH reveals that the water samples were almost neutral except S_6 and S_7, which have slightly higher pH values. The recommended value of pH for drinking purposes is between 6.5 and 9.2 (BIS 1998). However, higher values of pH hasten the scale formation in water heaters and reduce the germicidal potential of chlorine (Mohapathra & Purohit 2000).

Electrical conductivity in water is due to ionization of dissolved inorganic solids and becomes a measure of total dissolved solids. It is used as a basic index to select the suitability of water for domestic and agricultural purposes. In present study, minimum value was recorded as 820 µmho/cm at Veerapandi area (S_7), while higher values were found in all other samples. The high values of electrical conductivity are due to concentration of ionic constituents present in the groundwaters and reflect the contribution from salinity intrusion as well as pollution by industrial and domestic wastes.

Total dissolved solids of the water samples were in the range of 574-3640 mg/L. For TDS values only one sample (S_7) had desirable limit, while other six samples crossed the permissible limits. The high level of TDS in waters is a measure of groundwater pollution caused by big and small industries located near it. The higher values of TDS could be due to low water levels within the aquifers and sediment effect. The TDS above the allowable limit may cause gastrointestinal irritation and constipation effects. The total alkalinity levels varied from 218 mg/L to 460 mg/L. The alkalinity data show that all the water samples in the study area are well within permissible limit.

The total hardness (TH) of water sample was in the range of 280-2100 mg/L. The universal acceptable limit for total hardness is 500 mg/L. The present study revealed only three samples (S_2, S_4 and S_6) crossing the acceptable limit of hardness stated by USPH drinking water standards. The drinking water source of the area Madukkarai market (S_4), having highest value of TH among all other samples, can be expected to have harmful effects. The adverse effects of total hardness are formation of kidney stone and heart diseases (Freeda Gnana Rani 2001, Sastry & Rathee 1998). The people of the area were surveyed for these diseases and were found to be of rare occurrence. Presence of higher amount of total hardness in these sampling stations may be due to the ground water receiving calcium and magnesium rich minerals leached from the rocks and other deposits like limestone, dolomites, calcite and gypsum.

The calcium content of water samples fluctuated in the range of 72-500 mg/L. Maximum permissible limit of calcium in drinking water is 100 mg/L. All the samples are in permissible limit

Table 2: Water quality data of physico-chemical parameters of the study area (Sites S1-S7) during January 2007.

S.No	Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7
1	Appearance	Clear	Clear	Clear	Clear	Clear	Clear	Clear
2	Colour	Colour less	Colour less	Colour less	Colour less	Colour less	Colour less	Colour less
3	Odour	None	None	None	None	None	None	None
4	TDS	1082	1850	1116	3650	743	1188	572
5	EC	1554	2680	1589	5220	1083	2565	843
6	pH	7.6	7.1	7.3	7.8	8.2	8.4	7.4
7	TH	480	790	420	2150	320	610	290
8	Ca^{2+}	123	210	121	510	90	170	75
9	Mg^{2+}	40	65	39	160	22	50	24
10	Cl^-	275	420	364	1051	85	490	30
11	Alk	280	350	265	220	272	480	383
12	SO_4^{2-}	40	121	27	633	173	110	24
13	NH_3	-	-	-	-	-	-	-
14	Mn^{2+}	-	-	-	-	-	-	-
15	F^-	0.4	1.5	0.3	0.6	0.6	0.4	0.2

TDS - Total dissolved solids, EC - Electrical Conductivity (µmho/cm); TH - Total Hardness; Alk - Total Alkalinity
All the values are in mg/L except EC, pH, colour, odour and appearance.

Table 3: Comparison of groundwater quality data with drinking water quality standards.

S.No	Parameters	USPH	WHO	BIS	ICMR	Range in the study
1	pH	6.0-8.5	6.5-9.2	6.5-9.2	6.5-8.5	7.1-8.4
2	EC	300	300	-	-	843-5220
3	TDS	500	500	500-1000	500-1500	572-3650
4	TH	500	-	300-600	300	290-2150
5	Alk.	-	-	200-600	-	220-480
6	Ca^{2+}	100	75	100	75	75-510
7	Mg^{2+}	30	50	30-100	50	24-160
8	SO_4^{2-}	250	200	200-400	200	24-633
9	Cl^-	250	200	250-1000	250	30-105
10	F^-	1.5	1.0-1.5	0.6-1.5	1.0	0.2-1.5

USPH - United State Public Health; WHO - World Health Organization; BIS - Bureau of Indian Standards;
ICMR - Indian Council of Medical Research

except S_5 and S_6. Calcium content above the permissible limit in human body causes hypercalcaemia, coma and death. The magnesium content of water samples was in the range of 24-168 mg/L. Maximum permissible limit of magnesium in drinking water is 30-50 mg/L (WHO 1994). All the samples are in permissible limit except S_2, S_4 and S_6. Magnesium content above the acceptable limits causes nausea, muscular weakness and paralysis (Purandara 2003). The sulphate content of water sample varied in the range of 22-642 mg/L. Maximum permissible limit of sulphate in drinking water is 250 mg/L. All the samples were in permissible limit except S_5. Sulphate content above the permissible limit may cause diarrhoea.

The chloride content of water sample lies in the range between 32 mg/L and 1015 mg/L. Maximum permissible limit of chloride in drinking water is 250 mg/L. All the samples were above the permissible limit except S_5 and S_7. Fluoride is important in human nutrition for the normal development of bones. Fluoride content of water samples was in the range of 0.2-1.4 mg/L. In general, it should not exceed 1.5 mg/L. If it is in excess of 3.0 mg/L, it will causes skeletal fluorosis

and non-skeletal fluorosis (Park 1997). The fluoride data show that all the water samples in the study area were well within the permissible limit of BIS (1998).

CONCLUSION

The quality of ground water samples, collected from seven different locations around Kuniamuthur and Madukkarai areas of Coimbatore, was studied and the general observation was that the quality of groundwater in Mangarai of veerapandi (S_7) was superior to the water in Madukkarai and Kuniamuthur. The quality of groundwater in Government official colony (S_1) and Chettipalayam (S_5) was also fairly good. The water samples collected from Madukkarai area (S_4) were of the lowest quality among the locations. The sample S_4 exceeded the prescribed limit due to entry of cement factory effluent and domestic sewage into the ground water. People dependent on this water are often prone to health hazards due to polluted drinking water. Therefore, some effective measures are urgently required to enhance the drinking quality of this area.

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