Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

Vol. 7	No. 4	pp. 635-638	2008

Original Research Paper

Study of Water Quality in and Around Vriddhachalam in Cuddalore District, Tamil Nadu

V. Karunakaran, A. Ramalingam and R. Ramanathan*
Department of Physics, Government Arts college, Ariyalur-621 713, Tamil Nadu, India
***Department of Physics, V.S.S. Government Arts College, Pulankurichi-630 413, District Sivagangai, Tamil Nadu, India

Key Words:
Drinking water standards
Groundwaters
Water quality
Vriddhachalam
Fluorosis

ABSTRACT

Physico-chemical quality of the groundwater samples of bore wells in and around Vriddhachalam of Cuddalore district is studied. Three samples, one from Vriddhachalam town, one from Erumanur village and the third one from M. Patti village were collected for the study. The parameters observed were pH, electrical conductivity, total dissolved solids, total alkalinity, total hardness, calcium, magnesium, nitrate, chloride, sulphate, sodium, potassium and fluoride. The results reveal that most of the physico-chemical parameters for the second and third samples have the values above the permissible limit, but below the excessive limit. Hence, they can be used for drinking purposes. The values of these parameters except TDS are above permissible limits and below excessive limit for the first sample. The TDS exceeds the excessive limit, hence, it has to be pretreated by reverse osmosis before drinking.

INTRODUCTION

Vriddhachalam is an important pilgrim town located at the centre of Cuddalore district in Tamil Nadu. Palar is the river which flows through this town. This river dries up during summer season and water flows only for about four months in an year. Hence, people use bore well water for drinking, agriculture and industries. So, bore well water is selected for analysis in the present study.

The study was carried out in Vriddhachalam town. Sample 1 (S1), Erumanur village, Sample 2 (S2), which is 4 km from Vriddhachalam town and at M. Patti village and Sample 3 (S3) which is 5 km from Vriddhachalam town were collected. There is no available physico-chemical analysis in the area of study. There is rapid industrial progression and also ceramic industries thrive in this area for many years as the soil is used as a raw material for ceramic industries. Hence, due to the clay soil found on the upper surface, this study is conducted to see whether any physico-chemical changes have occurred in the water which is used for drinking.

MATERIALS AND METHODS

Sampling techniques: Samples of bore well water were collected in high grade plastic bottles of one-litre capacity rinsed with distilled water, and before collection of samples they were rinsed thrice with the sample water.

Analysis techniques: Samples were brought to the laboratory and the parameters like pH, electrical conductivity and total dissolved solids were measured immediately. Other physico-chemical parameters were analysed within 36 hours. Standard methods were adopted for the analysis of water samples (APHA, AWWA, WPCF 1989).

RESULTS AND DISCUSSION

The physico-chemical characteristics of the collected water samples like pH, electrical conductivity, total dissolved solids, alkalinity, total hardness, calcium, magnesium, nitrate, chloride, sulphate, sodium, potassium and fluoride along with the standards are given in Table 1.

All the three samples were clear and colourless and odour was also unobjectionable. Hence, these samples, are suitable for drinking purpose, from its appearance and odour.

pH: The hydrogen concentration affects the taste of water. The pH value of natural waters change due to the biological activity, temperature and disposal of industrial wastes as well as due to acid mine drainage. In this study pH value of the various sampling points varied from 7.2 to 7.4, though they are above permissible limits, they do not exceed the excessive limit, which shows the pH value of all the three samples is acceptable for drinking purpose.

Total alkalinity: The values of total alkalinity of the water samples ranged between 396 and 404 mg/L. The maximum permissible limit of total alkalinity is 600 mg/L. Alkalinity in itself is not harmful to the human beings, still the water with less than 200 mg/L are desirable for domestic use. However, in large quantities alkalinity imparts bitter taste to water. Though, it has exceeded the permissible limit, but not exceeded the excessive limit, hence, from total alkalinity point of view the water is fit for drinking.

Total hardness: The hardness of water, caused by multivalent metallic cations varies considerably from place to place. The hardness of water reflects the nature of geological formation with which it has been in contact. In the present case total hardness varied from 170 to 388 mg/L. Total hardness is also above the permissible limit but below the excessive limit.

Calcium: The values of calcium in natural water depend on the type of rocks. Presence of calcium in high quantities in rocks leads to its leaching, which contaminates the water. Calcium was found in the samples ranging from 40 to 93 mg/L. The value of calcium is within the permissible limit for the sample S2 whereas for the other two samples, the values are higher than the permissible limit.

Magnesium: In the present study, magnesium hardness ranged between 17 and 37 mg/L. Magnesium has been considered as non-toxic to humans at the concentration expected in water. The value of magnesium is higher than the permissible limit for samples S1 and S3 as per BIS standards, whereas as per the WHO standards, all the three samples are within the permissible limit.

Sodium and potassium: Sodium and potassium contents were analysed for the samples S1 and S3 only. Increase in levels of sodium in groundwater is due to the percolation of sodium bearing minerals.

Nitrate: Nitrate occurrence in groundwater is very common. It is mainly due to aerobic decomposition of nitrogen from organic matter, which is leached out from soil to the groundwaters. Nitrate from other sources like fertilizers, industrial effluent and septic tanks also contributes to groundwaters in the form of pollutants. Generally, nitrate concentration in groundwater range from few milligrammes to several hundred mg/L. The present study shows that nitrate levels are within the desirable range of 45 mg/L. Hence, the water is unpolluted with regard to nitrate.

Chloride: The higher concentration of chloride above 250 mg/L makes the water salty in taste. Chloride values varied from 72 to 204 mg/L, which are well within the prescribed limit.

Sulphate: Sulphate does not affect the taste of water. The sulphate in water samples of the study area ranged between 51 to 160 mg/L.

Table 1: The physico-chemical parameters of water samples at three selected places in and around Vriddhachalam with drinking water standards of BIS and WHO.

S.No.	Parameters	BIS (1998)		WHO (1993)		S1	S2	S3
		P	E	P	E			
1.	pH	6.5	9.2	6.5	8.5	7.2	7.4	7.3
2.	E.C.	-	-	-	-	1806	1154	1146
3.	Calcium	75	200	75	200	93	40	80
4.	Magnesium	30	100	50	150	37	17	36
5.	Sodium	-	-	-	-	188	-	76
6.	Potassium	-	-	-	-	36	-	16
7.	Sulphate	200	400	200	400	160	56	51
8.	Chloride	250	1000	200	600	204	72	75
9.	Phosphate	-	-	-	-	2.6	3.08	3.9
10.	Nitrate	45	45	-	45	10	6	6
11.	TDS	500	1000	300	600	1218	776	768
12.	Total hardness	300	600	-	-	388	170	351
13.	Total alkalinity	200	600	-	-	404	400	396
14.	Fluoride	1	1.5	-	-	0.2	0.4	0.6

where P-permissible limit, E-Excessive limit. All parameters are expressed in mg/L except pH, colour (Hazen units) and electrical conductivity (μmhos/cm).

Fluoride: The guideline value of fluoride is 1.5 mg/L in drinking water. Fluoride is more commonly found in groundwater than the surface waters through weathering of primary silicates and associated accessory minerals (Thakare et al. 2005). The excessive amount of fluorides causes fluorosis having disfigurement of teeth known as mottled enamel and deformities in bones (Kulshreshtha et al. 2004). However, presence of less than 0.8 mg/L fluoride in water causes dental caries in children. In the study area fluoride varied from 0.2 to 0.6 mg/L. It is interesting to note that the fluoride levels are well within the limits in an area where ceramic industry thrives well.

Electrical conductivity: Conductivity is measure of the current carrying capacity. Thus, as the concentration of dissolved salts increases, conductivity also increases. S1 shows higher value of electrical conductivity, which means that there is high concentration of salts in the water. This is also confirmed by the presence of higher TDS in the sample. Electrical conductivity in the study area ranged between 1146 and 1806 μmhos/cm.

Total dissolved solids (TDS): The maximum permissible limit of TDS is 1000 mg/L as per BIS standards. S1 exceeds this excessive limit. S1 has a value of 1218 mg/L. Gastrointestinal irritation is caused due to higher concentration of TDS. The TDS values varied from 776 to 1218 mg/L in the study area, with the samples S2 and S3 showing values above the permissible limit, but below the excessive limit. From this point of view S1 becomes unfit for drinking, but if the water is treated by reverse osmosis, the values of TDS will become low. Hence, the water in the area S1 under the study has to be properly treated before it is used for drinking purpose.

CONCLUSION

From the study, it can be concluded that the water quality, in general, is good in the areas S2 and S3. In the area S1, the sample has high values of TDS. It is important to note that the sample S1 is from the proper Vridhachalam town. The water samples S2 and S3, in general, have values which are above permissible limit but below excessive limit. This indicates that there is a chance for these

parameters to go higher after some years due to nature of the soil or due to pollution. Hence, it is suggested that the water for drinking is pretreated before consumption, though the samples have values below the excessive limit. Further, from this study it can be seen that in Vridhachalam town, the groundwater is slightly polluted, but in the adjoining areas the groundwaters are less polluted. The study further suggests that the water samples from the areas S2 and S3 are fit for drinking, and from S1 they are fit only after pretreatment.

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