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Original Research Paper

Seasonal Variation in Physicochemical Characteristics of Water Bodies in and Around Cuddalore District, Tamil Nadu

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ABSTRACT

The present investigation has been designed to assess the water quality parameters of surface waters present in and around Cuddalore district, Tamil Nadu for a period of one year. Water samples were collected from five stations (S1-Chidambaram, S2-Veeranam, S3-Vadalur, S4-Vellar and S5-Sipcot) on 15th day of each month. The parameters analysed include pH, EC, TDS, total hardness, alkalinity, chloride, calcium, magnesium, sodium, sulphate and fluorides. The water samples collected from industrial area showed a high value in all the parameters in summer season. This indicate the extent of pollution due to addition of effluents into the water bodies. But in rainy season all the parameters in all the stations remain under permissible limit. This may be due to the dilution of surface waters with rain water.

INTRODUCTION

Water is a universal solvent and one of the most precious commodity required for survival of any form of life and a primary natural resource required for various proposes like agriculture, forestry, urbanization and many other activities which satisfy human needs. The water quality of a system depends on the terrain through which it flows and its quality depends on physical, chemical and bacterial constituents (Honda 1986). Various kinds of natural and man-made activities like industrial, domestic and agriculture create water pollution problems particularly in freshwater systems. According to WHO (1984) 30 to 80% human diseases occur due to impurities of water. The chemistry of water is influenced by the inputs of material containing minerals and the chemical equilibrium prevailing the aqueous solution. Extent of pollution depends on rainfall pattern, depth of water, distance from the source of contamination and soil properties (Chatterjee 1994). Hence, in the present study an attempt has been made to study the seasonal variations of water quality in and around Cuddalore district, Tamil Nadu.

MATERIALS AND METHODS

Water samples were collected from five different stations (S1-Chidambaram, S2-Veeranam, S3-Vadalur, S4-Vellar and S5-Sipcot) of Cuddalore district during the period of July 2007 to June 2008.

The samples were collected in precleaned polythene bottles with necessary precautions (APHA 1995), and labelled for collecting points. The pH and electrical conductivity were measured by using digital pH meter and digital conductivity meter respectively. The physicochemical parameters like EC, TH, TDS, alkalinity, chloride, calcium, magnesium, sodium, sulphate and fluoride were estimated by using standard methods (APHA 1995, Manivasagam 1984). TDS were measured by using evaporating method at 185°C. Total hardness, calcium and magnesium were determined by EDTA titration method. Chloride was measured volumetrically by silver nitrate method using potassium

chromate as an indicator. Fluoride was measured by ion-selective electrode method. Sulphate was determined by gravimetric method using barium chloride.

RESULTS AND DISCUSSION

The physicochemical characteristics of the water samples are presented in Table 1. All the values are compared with the standards given by WHO, USPH, BIS and ICMR (Table 2). The pH value varied from 6.95 to 8.4 in summer, 7.1 to 8.2 in winter and 6.26 to 8.00 in rainy season. The samples show variation of pH in different seasons of the year. The pH was found to be maximum in S5 site in all the seasons, and minimum in S1 site in summer and winter season, and S2 site in rainy season. The observed pH values in all the sampling points are within the prescribed limit of WHO, BIS, USPH and ICMR (6.0 to 9.2).

Electrical conductivity in water is due to ionization of dissolved inorganic solids. EC is an excellent indicator of TDS, which is measure of salinity that affects the taste of potable water (WHO 1984). In the present study EC was maximum in summer season (160 to 1210 µmho/cm) and minimum in rainy season (76 to 160 µmho/cm). The high values of EC are due to concentration of ionic constituents present in the water due to pollution by industrial effluents, domestic wastes and agricultural water mixed in the river. During rainy season, the water level increase in the river that reduce concentration of ionic constituents so the electrical conductivity values also decrease during rainy season.

Total dissolved solids of the water samples were in the range of 120 to 820 mg/L in summer, 48 to 530 mg/L in winter, and 48 to 325 mg/L during rainy season. The maximum permissible limit of total dissolved solids in drinking water is 500 mg/L according to WHO and BIS standards. the TDS value is all the sites are beyond permissible level in all seasons except S5 in summer season. Water containing high TDS concentration may cause laxative or constipation effects (Kumarasamy 1989) beside the taste.

The total hardness (TH) of water sample was in the range 60.8 to 730 mg/L in summer, 20 to 318 mg/L in winter, and 32.8 to 125 mg/L in rainy season. The universal acceptable limit for total hardness is 500 mg/L. The present study revealed only one sample (S5) during summer season alone crossing the acceptable limit, remaining all the samples in all the three seasons were within the permissible limit. The adverse effects of total hardness are formation of kidney stone and heart diseases (Freeda Gnana Rani et al. 2003, Sastry & Rathee 1998). The higher hardness value in summer season is mainly attributed to rising temperature thereby increasing the solubility of calcium and magnesium salts (Garg 2003).

Alkalinity values were recorded in the range of 0 to 240 mg/L in summer season, 15 to 230 mg/L in winter season, and 10 to 28 mg/L in rainy season. The alkalinity was maximum in summer season and minimum in rainy season. According to the WHO and BIS standards, permissible limit of alkalinity is 200 mg/L. The higher value of alkalinity indicate presence of bicarbonate, carbonate and hydroxide in the water bodies (Jain et al. 2000).

The chloride in the study area ranges from 46 to 363mg/L in summer, 65 to 180 mg/L in winter and 9 to 22 mg/L in rainy season. During summer season highest value of 463 mg/L was recorded at S5 site. According to the WHO standards permissible limit of chloride is 250mg/L. The higher values were observed in S4 and S5 sites during summer season. The chloride value is higher than the permissible limit. The excess sodium and chloride in drinking water may induce heart failure (Brooker & Johnson 1984) and hypertension (Hussain & Ikbal 2003).

The calcium content of water samples fluctuated in the range of 12 to 83 mg/L in summer, 24-37mg/L in winter, and 10 to 48 mg/L in rainy season. Maximum permissible limit of calcium in drinking water is 100 mg/L. All the samples are in permissible limit. The excess calcium in the human body causes hypercalcemia, coma and death (Dasgupta & Purohit 2001).

The magnesium content of water samples ranges from 5 to 34 mg/L in summer, 13 to 40 mg/L in winter, and 5 to 12 mg/L in rainy season. The amount of magnesium was maximum in winter season, and minimum in rainy season. The prescribed limit of sodium is 250mg/L as suggested by WHO. The sodium content in all the water samples is within the permissible limit. The sodium value is higher in summer season and lesser in rainy season.

The sulphate content of water samples varied from 9 to 73 mg/L in summer, 0 to 24 mg/L in winter season, and 2 to 25 mg/L in rainy season. Maximum permissible limit of sulphate in drinking water is 200 to 250 mg/L. All the samples were in permissible limit. Sulphate content above the permissible limit may cause diarrhoea.

Table 1: Seasonal variations of water quality parameters in and around Cuddalore district during July 2007 to June 2008.

Parameters	Summer Season					Winter Season					Rainy Season				
	S_1	S_2	S_3	S_4	S_5	S_1	S_2	S_3	S_4	S_5	S_1	S_2	S_3	S_4	S_5
pH	6.95	7.10	7.30	8.1	8.4	7.1	7.25	8.0	7.9	8.2	6.53	6.26	6.97	7.3	8.0
EC	160	185	285	652	1210	85	110	135	220	720	76	80	85	95	160
TDS	120	135	210	322	820	48	85	112	189	530	48	125	220	110	325
T. hardness	60.8	80.5	120	417	730	20	35	80	125	318	32.8	60.8	65.2	73.5	125
Alkalinity	14	17	35	115	240	15	22	210	180	230	10	14	12	20	28
Chloride	46	126	193	267	363	65	70	80	140	180	9	5	12	17	22
Calcium	12	24	31	48	83	24	28	35	32	37	10	8	14	26	48
Magnesium	5	17	24	29	34	13	20	37	35	40	5	2	6	8	12
Sodium	23	30	42	76	104	9	15	49	68	83.2	7	8	9	14	6
Sulphate	9	12	18	29	73	0	9	15	13	24	2	10	17	25	8
Fluorides	0	0	0	12	21	0	0	0	0	0.13	0	0	0	0.12	0.15

The values are in mg/L except pH and EC (micromhos/cm)

Table 2: Drinking water quality standards.

Parameters	USPH	WHO	BIS	ICMR
pH	6.0-8.5	9.5-9.2	6.5-9.2	6.5-8.5
EC	300	300	-	-
TDS	500	500	500-1000	500-1500
T. Hardness	500	-	300-600	300
Alkalinity	-	-	200-600	-
Chloride	250	200	250-1000	250
Calcium	100	75	100	75
Magnesium	30	50	30-100	50
Sodium	-	250	250	-
Sulphate	250	200	200-400	200
Fluorides	1.5	1.0-1.5	0.6-1.5	1.0

USPH-United State Public Health; WHO-World Health Organization; BIS-Bureau of Indian Standards; ICMR-Indian Council of Medical Research; The values are in mg/L except pH and EC (micromhos/cm)

Fluoride is important in human nutrition for the normal development of bones. Fluoride content of water samples was in the range of 0 to 0.21 mg/L in summer, 0 to 0.13 mg/L in winter, and 0 to 0.15 mg/L in rainy season. In general, it should not exceed 1.5 mg/L. If it is in excess of 3.0 mg/L, it will cause skeletal fluorosis and non-skeletal fluorosis (Park 1997). All the water samples in the present study area were within the permissible limit of BIS and WHO.

CONCLUSION

It can be concluded from the study that physicochemical characteristics of water samples were influenced by seasonal variation. The quality of water in S1, S2 and S3 was fairly good. The water samples S4 and S5 were exceeded the prescribed limit due to entry of industry effluents in S5 sample and agriculture and domestic wastes in S4 sample. But in these sites during rainy season the values may be within permissible limits.

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