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STUDY OF GROUNDWATER QUALITY NEAR SIPCOT INDUSTRIAL ESTATE OF PERUNDURAI OF ERODE DISTRICT, TAMILNADU

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ABSTRACT

Assessment of physico-chemical parameters of groundwater were carried out in a radius of three km from the SIPCOT industrial area of Perundurai. Water samples were collected from different villages and analysed for various water quality parameters like pH, turbidity, colour, odour, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, sodium, potassium, iron, nitrate, chloride, fluoride and sulphate. The study indicates that groundwaters near the SIPCOT region are not fit for human consumption with regard to many parameters.

INTRODUCTION

Groundwater is a precious natural resource, which has been exploited by man since centuries. Groundwater and surface water have always been useful and unique source of freshwater for domestic, industrial and agricultural purposes. Industrialization boost the economy of the country on one hand and on the other act as a threat to environment. The overexploitation of groundwater and improper waste management has led to contamination of groundwaters in industrial areas. With the increasing pace of industrialization in Tamilnadu, the need for continuous monitoring of pollution has become significant (Gawas et al. 2006). Rajkumar & Gowri (2005) studied physico-chemical and microbiological properties of drinking water in schools of Erode district, Tamilnadu. Pandit & Foram B. Oza (2005) have studied physico-chemical and bacteriological analysis of groundwaters in Bhavnagar, Gujarat. Madhvi Sharma et al. (2005) reported water pollution in industrial area. Ramanaiah et al. (2005) suggested to assess the source of groundwater pollution through the study of coefficient of variation of parametric ratios among the influencing parameters of groundwater samples. Krishna et al. (2006) reported nitrate pollution in the groundwater of Jidimetla industrial area. Murugesan et al. (2006) studied water quality in Uthamapalayam Municipality in Theni district, Tamilnadu. Freeda Grana Rani et al. (2006) reported water quality of different villages.

As there are no data on physico-chemical quality of groundwater in SIPCOT industrial area of Perundurai region, therefore, an attempt was made to analyse physico-chemical quality of groundwater at nearby villages of this area.

THE STUDY AREA

State Industries Promotion Corporation of Tamilnadu (SIPCOT) Ltd., Perundurai is one of the major industrial complexes covering an area of 2600 acres. The exact location of the study area lies between latitude 11°13’14” N and longitude 77°33’22” E. The site is about 19 km from Erode and is near to the national highway (NH-47), which connects Perundurai with Erode and Coimbatore. The SIPCOT industrial complex, Perundurai is developing with 101 industries (textile industries 47, tanneries 18, chemical industries 12 and other general type industries 24).

Table 1: Water sampling locations.

Code	Location (Name of the village)	Distance from the site (km)	Direction w.r. to site
S_1	Elitingal Patti	0.5	N
S_2	Kuttam Palayam	1.5	SW
S_3	Kasilingam Palayam	1	NW
S_4	Kadappamadi	2.5	N
S_5	Velliyam Palayam	3	SE
S_6	Ingur	3	E
S_7	Kambaliyam Patti	3	W
S_8	Periyavettu Palayam	3	NE
S_9	Sarali	3	NW
S_{10}	Palap Palayam	3	S
S_{11}	Varap Palayam	2.5	SW

The SIPCOT Industrial area is located among the villages of Perundurai like Elithingal Patti, Kuttam Palayam, Kasilingam Palayam, Kadappamadi, Velliyam Palayam, Ingur, Kambaliyam Patti, Periyavettu Palayam, Sarali, Palap Palayam and Varap Palayam, etc. Therefore, the environmental monitoring study is needed to the surroundings of SIPCOT, Perundurai.

MATERIALS AND METHODS

Totally 11 groundwater samples were collected from 11 different villages in and around the SIPCOT industrial area within a radius of 3 km. The location of sampling stations is presented in Table 1. The samples were collected in clean two-litre polythene bottles. Analysis was carried out for pH, turbidity, colour, odour, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, sodium, potassium, iron, nitrate, chloride, fluoride and sulphate as per APHA (1995) and Trivedy & Goel (1986).

RESULTS AND DISCUSSION

The results of water analysis are given in Table 2. The results were compared with standards for drinking water as per IS: 10500-1983 specifications for drinking water for groundwater and WHO. The pH value of waters ranged from 7.54 to 7.82. Almost all the site show that pH is slightly alkaline which is within the permissible limits. If pH values are higher than the permissible limits, this will affect adversely alkalinity of soils, microbial life and corrosion rate. The turbidity ranged from 3 to 8 NTU and these values were found to be within the limits except samples S_3 (7), S_4(8), S_5 (6) and S_8 (6).

Electrical conductivity values were found to vary from 1380 to 4020 µmhos/cm, which are quite higher than the limits of the prescribed standard (1500 µmhos/cm) as recommended by WHO except at S_8. The higher EC and TDS values reflect greater salinity of water and it is not suitable for drinking and irrigation under ordinary conditions, but may be used occasionally under special circumstances. By using only EC values (Table 3) Wilcox (1995) has classified the limits of EC for irrigational water. According to Wilcox classification more than 40% of samples of the study area were found to be doubtful and unsuitable classes.

Total dissolved solids were observed in the range of 966 to 2814 mg/L and these values exceed the limits as prescribed by IS: 10500-1983. The samples which have high values of TDS are unsuitable for drinking and irrigation. These samples may affect the soil porosity. Total hardness of the

Table 2: Physico-chemical analysis of groundwaters of the selected villages.

Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}
pH	7.73	7.68	7.54	7.82	7.59	7.69	7.72	7.68	7.8	7.73	7.6
Turbidity	5	3	7	8	6	4	5	6	4	3	5
Colour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Odour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
EC	1560	2370	2940	4020	2870	1880	3480	1380	1560	1620	1740
TDS	1092	1659	2058	2814	2009	1316	2436	966	1092	1134	1218
TH	512	556	872	1120	840	416	880	472	480	500	496
Ca	104	112	176	240	176	93	182	96	97	105	100
Mg	60	66	103	124	96	54	101	55	56	56	58
Na	110	150	210	520	220	120	320	76	120	120	150
K	32	43	45	140	58	42	85	24	30	30	40
Fe	0	0	0	0.14	0.1	0	0	0.1	0	0	0.12
NO_3	62	62	72	110	63	40	58	32	46	40	50
Cl	164	540	512	880	528	288	720	172	172	180	224
F	0.2	0.8	1.4	0.4	0.4	0.2	1.2	0.4	0.4	1	1
SO_4	72	97	70	26	185	70	252	56	64	84	134

All the values are in mg/L, except pH, turbidity (NTU) and electrical conductivity (µmhos/cm).

Table 3: Classification of waters on the basis of EC values (Wilcox 1995).

EC (µmhos/cm)	Class	No. of samples
< 250	Excellent	Nil
250-750	Good	Nil
750-2000	Permissible	6
2000-3000	Doubtful	3
>3000	Unsuitable	2

samples ranged from 416 to 1120 mg/L. On the basis of total hardness, water samples analysed can be classified either soft (0 to 70 mg/L), moderately hard (75 to 150 mg/L), hard (150 to 300 mg/L) and very hard (above 300 mg/L) (Gawas et al. 2006). Hence, it was observed that the samples were very hard. Calcium ranged from 93 to 240 mg/L and these values were above the desirable limit of 75 mg/L. Magnesium values ranged from 54 to 124 mg/L in all the samples. Magnesium values are higher than the prescribed standard value of 30 mg/L.

Sodium values varied from 76 to 520 mg/L. The samples S_3, S_4, S_5 and S_7 are with higher Na value than the standard value (200 mg/L) as recommended by WHO. Potassium ranged from 24 to 140 mg/L. These minerals, however, are insoluble so that potassium levels in groundwaters normally are much lower than sodium concentration. The concentration of iron ranged from 0.1 to 0.14 mg/L and the values are within the limits except samples S_4 and S_{11} as prescribed by IS: 10500-1983. Presence of iron leads to the growth of some microorganisms. Excess iron cause indigestion and constipation in human beings.

Nitrate of the samples ranged from 32 to 110 mg/L. Much of the nitrate to the groundwater reaches with the percolating water through the soil. Nitrates very loosely bound with the soil particles and easily leach out. Eight samples in the present study (S_1, S_2, S_3, S_4, S_5, S_7, S_9 and S_{11}) have

abnormal high value of nitrate exceeding 45 mg/L. The high concentration of nitrate in drinking water is toxic and causes blue body disease/methaemoglobinaemia in children and gastric carcinomas.

Chloride values vary from 164 to 880 mg/L. Among the 11 water samples, six water samples (S_2, S_3, S_4, S_5, S_6 and S_7) have high concentration of chloride which exceeds the permissible limit of 250 mg/L. Chlorides in drinking water do not cause harmful effects on public health, but high concentration can cause salty taste that most people find objectionable, and it may increase the corrosivity of water.

In this study, the fluoride concentration was found between 0.2 and 1.4 mg/L. It has a dual effect on the physiology. Concentration less than 0.7 mg/L and more than 1.5 mg/L are injurious. Approximately 1mg/L of fluoride ion is desirable in public waters for optimal dental health. Sulphate was ranging from 26 to 252 mg/L and these values are within the limits except sample S_7. Higher concentrations of sulphate in drinking water may produce objectionable taste or unwanted laxative effects, but there is no significant danger to public health from sulphate.

CONCLUSION

On the basis of physico-chemical studies, it may be concluded that the quality of groundwater near the SIPCOT region is affected and the groundwater from these sites are not fit for human consumption. The groundwater sources, once get polluted, the effects of pollutants may persist for longer duration. Therefore, proper disposal of industrial effluents with periodical monitoring of groundwater in the industrial area is necessary otherwise alarming position will arise soon.

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