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Analysis of water quality parameters of groundwater near Ambattur industrial area, Tamil Nadu, India

K. Saravanakumar[1] and R. Ranjith Kumar[2]
[1]*Department of Chemical Engineering, St.Peter's Engineering College, Avadi, Chennai-600 054, India.*
[2]*Department of Civil Engineering, A.M.S. College of Engineering, I.A.F. Avadi, Chennai-600055, India*
saroo_1978@yahoo.co.in; ranjith_attitude@yahoo.co.in

Abstract
This paper presents groundwater quality of Ambattur industrial area in Chennai City. Ten different locations were selected for the study and compared. The parameters studied were pH, total alkalinity, total hardness, turbidity, chloride, sulphate, fluoride, total dissolved solids and conductivity. From overall analysis, it was observed that there was a slight fluctuation in the physico-chemical parameters among the water samples studied. Comparison of the physico-chemical parameters of the water sample with WHO and ICMR limits showed that the groundwater is highly contaminated and account for health hazards for human use.

Keywords: Groundwater, Ambattur, Chennai, India

Introduction
Water is an indispensable natural resource on earth. Safe drinking water is the primary need of every human being. Fresh water has become a scarce commodity due to over exploitation and pollution of water. Groundwater is the major source of drinking water in both urban and rural areas (Gupta *et al.*, 2009). Groundwater is the most important source of water supply for drinking, irrigation and industrial purposes. Increasing population and its necessities have lead to the deterioration of surface and sub surface water (Dhiviyaa Pranavam, 2011). Water is polluted on all the surfaces of earth and Ambattur is no exception to this phenomenon. All metabolic and physiological activities and life processes of aquatic organisms are generally influenced by such polluted waste and hence, it is essential to study physico-chemical characteristics of water.

Materials and Methods
Study Area
Ambattur industrial area is part of Chennai situated at 13°4' N and 80°5' latitude with the industrial areas lying on the north. Underground water is the only source of water for the industrial areas of Ambattur. The groundwater quality of Ambattur is continuously degrading due to industrial activities and the soils of the nearby fields are also being affected. Therefore, we have decided to analyze its groundwater so that some remedies for the improvement could be possible. Fig.1 shows the study area and sampling locations.

Methods
Groundwater samples were collected from ten different locations of Ambattur town during the post-rainy season (November 2010). Borosilicate glassware, distilled water and E-Merk reagents were used throughout the testing. Samples were collected in sterilized screw-capped polyethylene bottles of one litre capacity and analyzed in laboratory for their physico-chemical parameters. Samples collected from study sites were properly labeled and a record was prepared (Table 1). The various physio-chemical parameters were analyzed (Table 2) and health effects of chemical parameters are reported (Table 3). Total alkalinities of the water samples were determined by titrating with N/50 H_2SO_4 using phenolphthalein and methyl orange as indicators. The chloride ions were generally determined by titrating the water samples against a standard solution of $AgNo_3$ using potassium chromate as an indicator. The conductivity of the water sample was measured using the conductometry method. The total hardness of the water samples was determined by complexometric titration with EDTA using Erichrome balck-T as an indicator. Sulphate and fluoride of the water

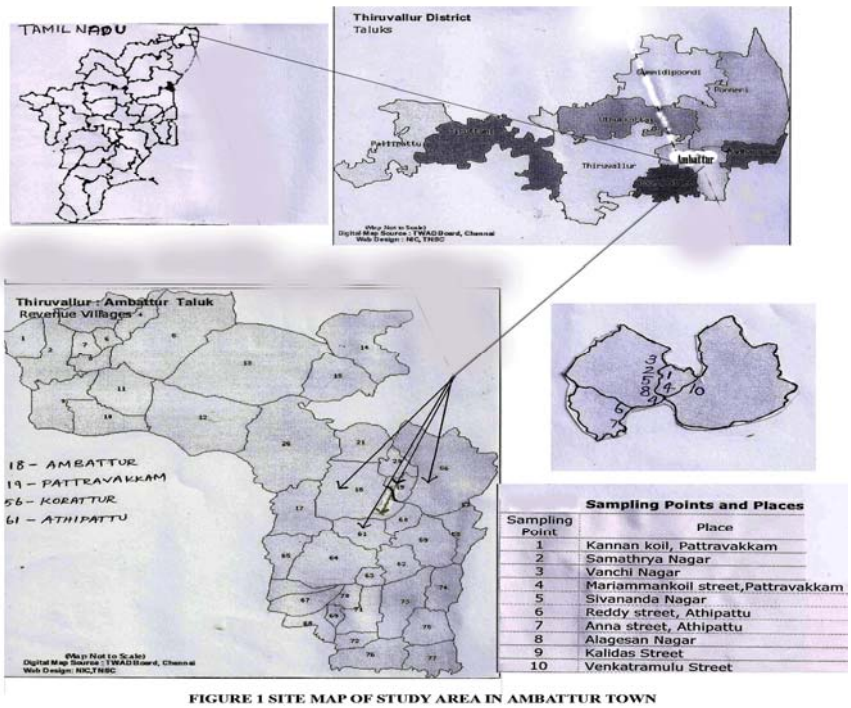

FIGURE 1 SITE MAP OF STUDY AREA IN AMBATTUR TOWN

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Table 1. Sampling points

Sampling place	Sampling point number
Kannan koil, Pattravakkam	1
Samathrya Nagar,	2
Vanchi Nagar	3
Mariammankoil Street,Pattravakkam	4
Sivanandanagar	5
Reddy Street, Athipattu	6
Anna Street, Athipattu	7
Alagesan Nagar	8
Kalidas Street	9
Venkatramulu Street	10

samples were estimated by UV-visible spectrophotometer. TDS of water sample were measured using gravimetric method.

Table 2. Methods used for estimation of various physico-chemical parameters

Parameters	Method
Temperature	Thermometer
pH	p^H metry
Total Alkalinity	Conductometry
Total Hardness	EDTA Titration
Turbidity	Turbidity Meter
Chloride	Silver nitrate Method
Sulphate	Turbidometric Method
Fluoride	Ion Selective Electrode
Total Dissolved Solids	Conductivity Meter
Conductivity	Conductometry

Results and Discussion

The sample collected from Ambattur industrial area was analyzed. The analysis (Table 3) of ground water samples includes the determination of concentration of inorganic constituents. The physico- chemical parameters, which were analyzed in post monsoon season, November 2010, have been shown in Table 4.

The desirable pH range necessary for drinking water is from 7.0 to 8.5. The pH value of water sample in the study area ranged from 7.2 to 8.5. On an average, pH of all samples was in desirable limit as prescribed for drinking water standard. This shows that pH of water sample was slightly alkaline.

Total alkalinity of water in terms of $CaCO_3$ varied from 270-320mg/l. The values of total alkalinity were comparatively moderate. The water for domestic use having alkalinity less than 100mg/l is safe. The high content of alkalinity is shown in the Table 4.

Total hardness was found in the sample water ranges from 220-310mg/l, which shows that water is safe for drinking purpose. Hardness has no known adverse effects on health. However, maximum permissible level prescribed by WHO for drinking water is 500 mg/l as set. According to some classifications, water having hardness up to 75mg/l is classified as soft, 76-150 mg/l is moderately soft, 151-300 mg/l as hard (Dufor & Becker,1964) and more than 300 mg/l as very hard. On this basis, the results show that all the samples were moderately soft except sample B4 (Ravisankar & Poogothai , 2008).

Chloride content of the water samples was low in rainy season. According to WHO, maximum permissible limit for chloride is 500mg/l. The value observed in present study is in the range of permissible limit (Ravisankar & Poogothai, 2008) (Fig.3).

The sulphate content varies between150 to 230 mg/l and the fluoride content varies between 0.8 to 1.4 mg/l. The sulphate and fluoride values were also found to be within the prescribed limits.

Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro granular suspended form. The permissible limit of TDS of drinking water is 500 mg/l (WHO, 2004). The observation shows that the TDS is within the permissible range as prescribed by WHO (2004).

The specific conductivity of water samples under study varies between 750 to 900 µ mho/cm. The maximum permissible limit of this parameter for drinking water is 300µ mho/cm. However, the average specific conductivity exceeds this limit because of its high values during rainy season .In rainy season due to floods and rains, water level in the well increases, which contains more electrolytes.

Table 3. Health effects of chemical parameters

Parameters of water analysis	BIS Guideline values (Max. allowable)	Potential health effects	Reference
Temperature	-	-	
pH	6.5-8.5	Affects mucous membrane; bitter taste; corrosion	Ref.4,5 and 8
Total Alkalinity	600mg/l	Boiled rice turns yellowish	Ref.4,5 and 8
Total Hardness	600mg/l	Poor lathering with soap; deterioration of the quality of clothes; scale forming	Ref.4,5 and 8
Chloride	1000mg/l	Taste affected; corrosion	Ref.4,5 and 8
Sulphate	400mg/l	Taste affected; gastro-intestinal irritation	Ref.4,5 and 8
Fluoride	1.5mg/l	Dental and skeletal fluorosis; non-skeletal manifestations	Ref.4,5 and 8
Total Dissolved Solids	200mg/l	Undesirable taste; gastro-intestinal irritation; corrosion or incrustation	Ref.4,5 and 8

Conclusion

The results of water investigation show that the waters of the study area are highly contaminated with total dissolved solids. As a result of high concentration of TDS, water loses its potability and reduces the solubility of oxygen in water. Water of almost all study points is hard

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and contaminated because of this, people of Ambattur area are prone for the immediate health problems such as stomach diseases, gastric troubles etc.

Table 4. Physio-chemical parameters of sampled waters (values in parentheses are Standard Deviations)

Parameters	Sampling point									
	1	2	3	4	5	6	7	8	9	10
Temperature (^{0}C)	29 (1.41)	30 (0.89)	29 (0.89)	30 (0.89)	29 (0.70)	28 (0.70)	29 (0.89)	30 (0.89)	31 (0.70)	29 (0.89)
pH	7.2 (0.13)	7.6 (0.13)	8.5 (0.22)	8.3 (0.13)	7.8 (0.11)	7.3 (0.14)	7.4 (0.21)	7.6 (0.28)	7.2 (0.15)	7.9 (0.13)
Total Alkalinity (mg/l)	280 (4.21)	320 (4.52)	300 (4.56)	310 (3.36)	280 (3.46)	310 (3.27)	300 (3.89)	285 (6.37)	270 (2.28)	310 (4.86)
Total Hardness (mg/l)	240 (2.96)	280 (4.94)	230 (3.57)	310 (4.56)	220 (4.61)	240 (3.56)	260 (3.13)	270 (5.81)	250 (2.77)	260 (2.68)
Turbidity (mg/l)	268 (4.33)	237 (4.21)	210 (3.78)	150 (5.36)	187 (7.66)	154 (3.78)	135 (2.94)	187 (3.83)	165 (2.96)	175 (4.60)
Chloride (mg/l)	380 (4.43)	370 (3.34)	345 (4.39)	345 (3.49)	360 (2.79)	370 (4.52)	330 (3.08)	325 (3.46)	355 (4.15)	360 (6.57)
Sulphate (mg/l)	180 (4.41)	190 (5.11)	190 (5.63)	150 (6.87)	165 (5.84)	210 (7.19)	185 (4.27)	220 (7.03)	230 (9.65)	190 (5.63)
Fluoride (mg/l)	1.0 (0.12)	1.2 (0.15)	0.9 (0.14)	0.8 (0.18)	1.1 (0.12)	0.9 0.12 ()	0.9 (0.20)	1.3 (0.19)	1.1 (0.15)	1.4 (0.24)
Total Dissolved Solids (mg/l)	650 (11.9)	550 (8.96)	870 (4.24)	880 (6.27)	890 (5.85)	450 (5.19)	760 (9.60)	680 (4.93)	720 (2.87)	740 (7.66)
Conductivity (µ mho/cm)	900 (8.44)	750 (6.75)	780 (4.35)	810 (4.93)	760 (7.08)	840 (4.24)	780 (5.37)	770 (14.33)	780 (11.31)	780 (5.03)

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