Study on ground water pollution at Tiruchirappalli town, Tamil Nadu

M. Mohamed Sihabudeen[1], A. Abbas Ali[2] and A. Zahir Hussain[1]

[1]PG and Research Department of Chemistry, Jamal Mohamed College, Trichy, Tamil Nadu, India
[2]Department of Chemistry, M. I. E. T. Engineering College, Gundur, Trichy, Tamil Nadu, India
_____

ABSTRACT

The ground water quality in and around Trichy town was studied. Ten ground water samples were taken in and around Trichy District. The samples were subjected to Physico–chemical analysis. High concentrations of Electrical conductivity, Alkalinity, Total dissolved solids and Chloride were observed in most of the ground water samples.

Keywords: Ground water, Trichy, Physico–chemical, Water quality
_____

INTRODUCTION

Tiruchirappalli is one of the most important industrial cities in Tamilnadu and which is situated on the bank of river Cauvery. Ground water is the principle source of drinking water in rural areas of India and it is indispensable source of life. The problems of ground water quality are more acute in the areas which are densely populated and thickly industrialized.

Once the ground water is polluted, its purification is too difficult. In order to maintain equilibrium in bio-chemical reaction taking place in living organism, certain chemical methods are needed for maintaining physiology of human beings or living organisms. The presence of too much of chemical elements is also harmful. Therefore an attempt has been made to assess the quality of ground water in and around Trichy district.

MATERIALS AND METHODS

Ground water samples were collected from 10 bore wells in and around Trichy town. The sampling stations are represented as S_1 to S_{10}. The water samples were collected in one litre polythene bottles. The samples were subjected to physico–chemical analysis.

The pH was determined by pH meter. The electrical conductivity of the water was determined by conductivity meter. Carbonate, bicarbonate, total hardness and chloride were estimated by titrimetric method. Nitrate, phosphate, and sulphate were estimated by colorimetric method using standard procedure [1]. Sodium and potassium were measured by using flame photometer. Calcium and magnesium were determined by the instrument that Met Flame Meter. Fluoride was determined from Fluorimeter using standard procedure.

RESULTS AND DISCUSSION

The physico–chemical characteristics were determined. The obtained results are presented in Table 1 and the results are discussed.

1

_____

pH
The pH value is an important factor in maintaining the carbonate and bicarbonate levels in water. The pH values are found to be within the permissible limit of WHO (6.5–8.5) in all the sampling stations for ground water samples. There are no abnormal changes in ground water samples.

The slight alkalinity may be due to the presence of bicarbonate ions, which are produced by the free combination of CO_2 with water from carbonic acid, which affects the pH of the water [2]. The Carbonic acid dissociates partly to produce H^+ and bicarbonate ions [3].

The pH values increased slightly for ground water samples in all the sampling stations. The mild alkalinity indicates the presence of weak basic salts in the soil [4]. The low pH does not cause any harmful effect.

Electrical Conductivity
Electrical conductivity is the ability of water to carry an electrical current. The importance of electrical conductivity is its measure of salinity, which greatly affect the taste and has a significant impact of the user acceptance of the water as potable [5].

The higher the ionisable salts, the greater will be the electrical conductivity. High electrical conductivity affected the germination of crops and it may result in much reduced yield [6]. The WHO permissible limit for electrical conductivity in water is 600 micro mho cm^{-1}.

In the present study the electrical conductivity values are observed in the range from 1285 – 10950 micro mho cm^{-1}. It indicates that the presence of high amount of dissolved inorganic substances, ionic constituents and dissolved minerals in the water samples [7].

Total dissolved solids
The value of total dissolved solids for all the ground water samples is ranged from 900 – 7665 ppm. Total dissolved solids denote various types of minerals present in water in the dissolved form. Most of the ground water samples show higher values of total dissolved solids and are well above the permissible limit of WHO (500 ppm). It may be due to percolation of sewage and industrial effluents [8]. The accumulation of organic and inorganic solids also contributes to high total dissolved solids [9].

Total Hardness
Total hardness results from the presence of divalent metallic cations, of which calcium and magnesium are the most abundant in ground water. The hardness in water is delivered from solution of CO_2, release by bacterial action in the soil, in percolating rainwater [10].

In the present study, the total hardness values were observed in the range of 300–688 ppm for ground water samples. Total hardness value exceeded the desirable limit of WHO (300 ppm) in all the stations for ground water samples.

This may be due to the presence of bicarbonates, chlorides and sulphates of calcium and magnesium present in the water. The high concentration of hardness causes heart disease and kidney problem [11].

Carbonate
The carbonate values are not detectable for the ground water samples. Since the observed pH is below 8.6, the carbonate values are not detectable [12].

Bicarbonate
The value of bicarbonate for all the ground water samples is ranged from 313 – 3131 ppm The bicarbonate values of ground water samples are found to be within the permissible limit of WHO (600 ppm) except at stations S_4, S_7 and S_8. This may be due to ground water samples which are collected from nearer to the sewage logging place [13].

High amount of alkalinity in water is harmful for irrigation which leads to soil damage and reduce crop yields [14].

_____

Chloride

The value of chloride for all the ground water samples is ranged from 195–3650 ppm. Excess chloride of greater than 250 ppm imparts a salty taste to water. Excessive chloride in potable water is particularly not harmful but the criteria set for chloride value is based on its potentially high corrosiveness. Soil porosity and permeability also plays an important role in building up the chloride value [15].

Increase of chloride level in water is injurious to people who are suffering due to heart and kidney diseases. High concentration of chloride is considered to be an indicator of pollution by organic waste of animals and industrial origin [5].

Calcium

The value of calcium for all the ground water samples is ranged from 81 – 760 ppm Calcium may dissolve readily from calamite rocks and limestone or to be leached from soils. But calcium is an essential nutritional element for human being and aids in maintaining the structure of plant cells and soils.

In the present study, the calcium values are found within the maximum permissible limit (200 ppm) except at stations S_4, S_7 and S_8. It may be due to the cationic ion exchanges with sodium [16].

Magnesium

The magnesium values are found to be in the range of 27–296 ppm. The magnesium values exceed the permissible limit of WHO (150 ppm) in most of the ground water samples. This may be due to the logging of the sewage and dissolution and rock weathering of soil in monsoon seasons [17]. It indicates that the water is unsuitable for domestic uses.

Nitrate

The nitrate values are found to be in the range of 8–140 ppm. Most of the ground water samples are polluted except at station S_1, S_6 and S_9. The nitrate in water is responsible for the growth of blue green algae [4].

Potassium

The potassium values are in the range of 2–856 ppm for the ground water samples. High concentration of potassium may be attributed to the contamination by sewage [18].

Sulphate

The sulphate values are recorded within the range of 10–115 ppm. All the ground water samples are found to be within the permissible limit of WHO (250 ppm).

Sodium

The sodium values are found to be in the range of 34–980 ppm for the ground water samples. The sample stations at S_4, S_7 and S_8 are observed at very high values. The Higher concentration of sodium may be due to the logging of effluents [19] and percolation of brine water of irrigational and industrial use [20].

Phosphate

The value of phosphate in the ground water sample lies between 0.04–0.21 ppm. The Highest value is recorded at station S_7. In the present study, the phosphate values are found above the permissible limit of (0.1 ppm) of WHO [16].

Normally ground water contains only a minimum phosphorous level because of the low solubility of native phosphate minerals and the ability of soils to retain phosphate [21]. The phosphate values of all the ground water samples do not pose any water quality problem [22].

Fluoride

The value of fluoride for the ground water samples is recorded between 0.2–0.4 ppm. The maximum allowed limit of fluoride according to WHO is 1.0 ppm. The fluoride values for all the ground water samples are within the permissible limit. The high concentration of fluoride in ground water may be due to break down of rocks and soils or infiltration of chemical fertilizers from agricultural land. Skeletal fluorosis is an important disease due to the presence of high fluoride content in ground water [23].

_____

Table-1

Station	pH	EC	TDS	TH	CO₃²⁻	HCO₃⁻	Cl⁻	Ca²⁺	Mg²⁺	NO₃⁻	NO₂⁻	K⁺	SO₄²⁻	Na⁺	PO₄³⁻	F⁻	NH₃	O₂
S_1	7.6	1665	1166	320	0	313	305	81	27	8	1.12	12	71	216	0	0.2	0	0.48
S_2	7.5	1477	1034	380	0	394	205	97	36	50	0.93	12	26	140	0	0.2	0	0.48
S_3	7.7	1285	900	300	0	525	195	129	48	50	0.89	2	10	34	0	0.2	0	0.48
S_4	7.6	6420	4494	688	0	2121	1660	517	199	140	0.92	45	77	420	0	0.4	0	0.8
S_5	7.5	1460	1022	312	0	384	260	94	36	48	0.94	12	10	140	0	0.2	0	0.8
S_6	7.4	1473	1031	384	0	566	205	137	53	24	1.06	4	26	56	0	0.2	0	0.8
S_7	6.8	10950	7665	316	0	3131	3650	760	296	120	10.8	85	15	980	0.21	0.2	0.09	1.2
S_8	7.2	4600	3220	584	0	1353	975	331	126	140	3.94	46	115	320	0.04	0.2	0	1.08
S_9	7.3	1806	1264	392	0	556	330	137	51	10	0.91	12	45	140	0	0.2	0	0.4
S_{10}	7.8	1405	984	300	0	384	280	94	36	60	0.97	12	15	134	0.04	0.4	0	0.4
Perm-issible Limit	6.5 - 8.5	300	500	300	0	600	250	75	30	45	-	30	250	200	-	1	0.5	-

EC in micro mho cm⁻¹ – All parameters are expressed in mg / lit

S_1 – Harihar S_6 – Senthaneerpuram
S_2 – Anna nagar S_7 – Kattur
S_3 – Gundur S_8 – Ariyamangalam
S_4 – Sembattu S_9 – Tiruverumbur
S_5 – Kottapattu S_{10} – Thuvakudi

CONCLUSION

The results reveal that the ground water in most of the area does not meet the drinking water standards and is unfit for drinking and domestic purposes. This problem should be attended and controlled at the earliest for the sake of people health, environmental safety, soil and water quality because once the ground water and soil are polluted, it is difficult to restore it to its initial quality.

REFERENCES

[1] APHA, *Standard methods for examination of water and wastewater,* 19th edn. Washington, D.C. **1995.**

[2] Azeez PA, Nadarajan NR, Mittal DD, *Pollution Research,* **2000,** 19(2), 249–255.

[3] Jha AN, Verma PK, *Pollution Research,* **2000,** 19(2), 75–85.

[4] Abdul Jameel A, *Indian Journal of Environmental Health,* **2002,** 44(2), 108-112.

[5] Yadav SS, Kumar Rajesh, *Advances in Applied Science Research,* **2011,** 2(2): 197-201.

[6] Srinivas CH, Ravishankar P, Venkatesan R, Sathya Narayan Rao MS, Ravinder Reddy R, *Pollution Research,* **2000,** 19, 285–289.

[7] Murugesan A, Ramu A, Kannan N, *Indian Jounal of Environmental Protection,* **2005,** 25(10), 885–892.

[8] Someswara Rao N, Venkateswara Rao TNV, Jaganandha Rao D, Narasimha Murthy B, Sastry DS, *Asian Environment,* **1992,** 14(2), 47–60.

[9] Indrajit Sen, Shandil, Shrivastava VS, *Advances in Applied Science Research,* **2011,** 2(2), 161-166.

[10] Ponniah Raju A, Chandrasekar N, Saravanan S, *International Journal of water Research,* **2013,** 1(1), 1–6.

[11] Jain CK, Shamia MK, Omkar, *Indian Journal of Environmental Protection,* **1997,** 17(6), 401–405.

[12] Mohamed Sheriff KM, Zahir Hussain A, *Advances in Applied Science Research,* **2012,** 3(6), 3587–3592.

[13] Rakh MS, Bhosle AB, *Advances in Applied Science Research,* **2011,** 2(5), 104–109.

[14] Lenin Sundar M, Saseetharan MK, *Journal of Environmental Science and Engineering,* **2008,** 50(3), 187–190.

[15] Jain CK, Bhatio KK, Kumar SR, *International Journal of Environmental Protection,* **2000,** 23(3), 321–329.

[16] Mohamed Hanipha M, Zahir Hussain A, *International Research Journal of Environment Science,* **2013,** 2(1), 68–73.

[17] Elinge CM, Itodo AU, Peni IJ, Brinin–Yauri UA, Mbongo AN, *Advances in Applied Science Research,* **2011,** 2(4), 279-282.

[18] Abdulrafiu Majolagbe O, Adeleke Kasali A, Lateef Ghaniyu O, *Advances in Applied Science Research,* **2011,** 2(1), 289–298.

[19] Sulochana N, Selvarani K, Stephen Inbaraj B, *Indian Journal of Environmental Protection,* **1997,** 17(6), 421–425.

[20] Sadhana C, *Indian Journal of Environmental Protection,* **1994,** 14(10), 758–765.

_____

[21] Rajmohan N, Elango L, *Environmental Geology,* **2005,** 47, 820–830.
[22] Abdul Jameel A, Zahir Hussain A, *Environ Monit Assess,* **2011,** 183: 103 – 111.
[23] Mangale Sapana M, Chonde Sonal G, Raut PD, *Res. J. Recent Sci,* **2012,** 1(3), 31–40.