Study on ground water pollution at Tiruchirappalli town, Tamil Nadu

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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 S₁ to S₁₀. 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.
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

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
<th>EC</th>
<th>TDS</th>
<th>TH</th>
<th>CO₂</th>
<th>HCO₃⁻</th>
<th>Cl⁻</th>
<th>Ca²⁺</th>
<th>Mg²⁺</th>
<th>NO₃⁻</th>
<th>NO₂⁻</th>
<th>K⁺</th>
<th>SO₄²⁻</th>
<th>Na⁺</th>
<th>PO₄³⁻</th>
<th>F⁻</th>
<th>NH₄⁺</th>
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<tr>
<td>S₁</td>
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<td>1166</td>
<td>320</td>
<td>0</td>
<td>313</td>
<td>305</td>
<td>8</td>
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<td>31</td>
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<tr>
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<td>1034</td>
<td>312</td>
<td>0</td>
<td>394</td>
<td>205</td>
<td>9.7</td>
<td>36</td>
<td>50</td>
<td>1.93</td>
<td>12</td>
<td>26</td>
<td>140</td>
<td>0</td>
<td>0.2</td>
<td>0.48</td>
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<tr>
<td>S₃</td>
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<td>1285</td>
<td>900</td>
<td>300</td>
<td>0</td>
<td>525</td>
<td>195</td>
<td>129</td>
<td>48</td>
<td>50</td>
<td>0.89</td>
<td>2</td>
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<tr>
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<td>205</td>
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<td>50</td>
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<td>S₅</td>
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<td>384</td>
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<td>36</td>
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<td>0.94</td>
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<tr>
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<td>140</td>
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</table>

**Perm issible Limit**

<table>
<thead>
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<th></th>
<th>EC in micro mho cm⁻¹</th>
<th>All parameters are expressed in mg / lit</th>
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<td>S₁</td>
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</tr>
<tr>
<td>S₂</td>
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<td>500</td>
</tr>
<tr>
<td>S₃</td>
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<td>300</td>
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**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.

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**REFERENCES**