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Assessment of Physico-Chemical quality of Ground Water samples in and around Trichy Town, Tamilnadu, India

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ABSTRACT

The Ground Water quality of in and around Trichy Town was studied. Trichy is the fourth largest city in Tamilnadu and 53rd largest city in India. Trichy is surrounded by 141.7m2 area with an approximate population of ten lakhs. It sits almost at geographic centre of the state. The study was carried out in the monsoon period. The samples were subjected to Physico-chemical analysis. A comparison of Ground Water quality in relation to drinking water quality standard proves that most of the samples exceeded the permissible limit for drinking.

Keywords: Ground water, Physico-chemical Analysis, Total Hardness, WHO.

INTRODUCTION

Water is one of the most indispensable resources and it is the elixir of life. It constitutes about 70% of the body weight of almost of all living organisms. Life is not possible on this planet without water. Of the total water resources 97.3% is in the sea and remaining 2.7% is present as fresh water. Major portion of fresh water is locked up in the form of polar ice or in greater depth of meter which cannot reach of common man for his purpose. Only a tiny fraction of about 0.03% of the water resources is used by human beings. Ground water is used for drinking purpose by majority of the people. It is a very important source of fresh water resources Ground water in ultimate most suitable fresh water resources with nearly balanced concentration of the salts for human consumption.[1] In India Ground Water is intensively used in irrigation and industrial purposes, a variety of land and water based human activities are causing pollution to the ground water. Soil and geological formation containing high levels of heavy metals can lead those metals into ground water. This can be aggravated by over-pumping wells, particularly for agriculture. Pollution caused by fertilizers and pesticides used in Agriculture are often dispersed over large areas. It is a great threat to the fresh water ecosystems. Pollution from ground water often causes diarrhea and stomach irritation which can lead to more severe health hazards. Accumulation of heavy metals and some organic pollutants can lead to cancer, reproductive abnormalities and many more severe health problems. The knowledge of the extent of pollution and the status of water becomes essential in order to preserve the valuable sources of water for the future generation. Hence the present study has been undertaken to investigate the Physico-chemical analysis in and around Trichy Town, Tamil Nadu.

MATERIALS AND METHODS

For the present studies, Ten ground water samples were collected from the bore well in and around Trichy town. The ground water samples were collected in polyethylene bottles and a small amount of Nitric acid was added to acidify the samples and also to prevent the loss of metals. The water was pumped out from the bore wells a few minutes before the sample collection. The P^H was determined by Elicometer, the electrical conductivity of the water sample was determined by conductivity meter. Carbonate, Bicarbonate, Total Hardness, Alkalinity, Dissolved oxygen, B.O.D, C.O.D, Chloride, Calcium & magnesium were estimated by the standard procedure.[2] Sodium and

Potassium were measured by using Flame Photometer. Fluoride was determined from Fluori meter using standard procedure.

RESULTS AND DISCUSSION

pH

It indicates the intensity of acidity and alkalinity and measures the Hydrogen ion concentration in water. It is one of the important parameter of water body since most of the aquatic organisms are adapted to an average pH and do not with stand abrupt changes. In the present study, the pH values are found to be in the range from 7.2 – 8.5.All the ground water samples are within the permissible limit (6.5 – 8.5).

Electrical Conductivity

Electrical conductivity is a measure of water capacity to convey electric current.[3] In the present study, the EC values are found to be in the range from 1780 – 8460 micro mhocm^{-1}.Highest value of electrical conductivity is found at Station 7, which indicates that the presence of high amount of dissolved inorganic substances, ionic constituents and dissolved minerals in the water samples. All the Station values are above the permissible limit of 600 micromhocm^{-1}.

Total Dissolved Solids

It is a measure for salinity which effects utility of water for drinking, irrigation and industrial purposes. In the present study, the TDS values are found to be in the range from 925 – 3821ppm.High value of TDS is found at Station 7. It may be due to percolation of sewage and industrial waste. The accumulation of organic and inorganic solids also contributes to high dissolved solids.[4] All the Stations values are found to be above the permissible limit (500 ppm).

Total Hardness

Hardness is the characteristic property of water. Hardness is of two types namely Temporary Hardness and Permanent hardness. The temporary hardness of water is due to the presence of bicarbonates of calcium and magnesium in water where as the permanent hardness is due to the presence of chlorides and Sulphates of Calcium and Magnesium. In the present study, the total hardness are found to be in the range from 187 – 412 ppm. High value of hardness is found at Station 1, 4&7. The High concentration of hardness causes heart disease and kidney stone formation.[5]

Carbonate

The ability of the water to neutralize acid is called Total Alkalinity. Alkalinity is natural system includes mainly carbonate, bicarbonate and Hydroxide etc. In the present study, the carbonate values are not detectable and it is detectable only above pH 8.6.[6].

Bicarbonate

In the present study, the bicarbonate values are found to be in the range from 65 – 463 ppm. Alkalinity itself is not harmful to human beings.[7] High value of Bicarbonate is found at Station4.All the values are within the permissible limit of 600 ppm. High CO_2 percolation along with rain water during monsoon season increases the bicarbonate alkalinity.

Chloride

Chloride imparts salty taste to water depending on the presence of Cation constituents. In the present study , the values of chloride are found to be in the range from 78-1868 ppm. High value of chloride is found at Station 7. Higher chloride concentration is samples from sites may be due to discharge of sewage near the sample sites. [8] Excessive chlorides in potable water are not particularly harmful and the criteria set for this anion are based primarily on palatability and its potentially high corrosiveness.[9]

Sodium

In our present study, the values of sodium ranged from 79 – 285 ppm. High value of sodium is found at Station 7.Sodium content around 200 ppm may be harmful to persons having cardiac and renal diseases and in women's with toxemia associated with pregnancy.[10]

Potassium

In the present study, the Potassium values are found to be in the range from 21-85 ppm. All the Station values are above the permissible limit of 12 ppm. High concentration of Potassium may be attributed to the contamination by sewage.[11]

Calcium
In the present study, the Calcium values are found to be in the range from 36-221 ppm. High value is found at Station 4. Hardness below 300 ppm is considered as potable, but beyond this limit causes gastro intestinal irritation.

Magnesium
In the present study, Magnesium values are found to be in the range from 25-115 ppm. High value is found at Station 4. It may due to the sewage and dissolution and rock weathering of soil in monsoon season.

Nitrate
Nitrates reach both surface water and ground water as a consequence of agricultural activity. The high nitrogen content is an indicator of Organic Pollution. In the present study, the nitrate values are found to be in the range from 9-126 ppm. High value is found at Station 4.

Fluoride
Fluoride in small amount is necessary for good health but higher concentration of fluoride causes dental fluoride and skeletal fluorosis. In the present study, the fluoride values are ranged from 0.1-0.5 ppm. All the sample values are within the permissible limit of WHO (1-1.5 ppm).[3]

Sulphate
The value of Sulphate are found to be in the range of 32-339 ppm for ground water samples. High value of Sulphate is found at Station 7. Higher concentration of Sulphate is due to the accumulation of soluble salts in soil, anthropogenic activity, and addition of excessive of Sulphate fertilizer.[12]

Phosphate
The value of Phosphate is found to be in the range of 0.06-0.52 ppm. High value is found at Station 4. The major cause for phosphate concentration in ground water may due to the agricultural runoff from the irrigated lands containing phosphate fertilizers.

Biological Oxygen Demand
It is the amount of oxygen required for microbial metabolism of organic compounds in water. Its demand occurs some variable period of time depending on temperature, nutrient concentration and the enzyme available to indigenous microbial population. The amount of oxygen required to completely oxidize the organic compounds to CO_2 and H_2O through generations of microbial growth, death, decay and cannibalism is total BOD. In the present study, the BOD values are ranged from 7.3-15.5 ppm. High value may be attributed to the maximum biological activity at elevated temperature where as the lowest BOD may indicate lower biological activity. There is an inverse relationship between DO & BOD.[13,14] High values of total dissolved solids are responsible for higher BOD.[15]

Physico Chemical parameters of groundwater samples collected in the month of November-2015

Sample / Station	pH	EC	TDS	TH	CO_3	HCO_3	Cl	Na	K	Ca	Mg	NO_3	F	SO_4	PO_4	BOD	COD	DO
1	7.7	1780	925	386	0	65	78	239	21	36	25	11	0.5	32	0.06	7.3	16.5	5.8
2	7.8	2150	1276	187	0	98	487	185	35	73	59	39	0.5	83	0.1	8.4	13.2	7.4
3	7.8	3600	1973	304	0	205	746	162	60	136	82	48	0.4	195	0.21	9.4	16.6	6.7
4	7.2	8200	3588	412	0	463	1585	242	85	221	115	126	0.4	291	0.52	15.5	22.6	8.3
5	7.3	2650	1596	216	0	171	675	103	43	95	69	47	0.4	147	0.12	8.7	13	6.1
6	7.2	2080	1214	201	0	105	479	81	33	87	55	21	0.3	123	0.08	9.4	11.4	5.8
7	8.2	8460	3821	398	0	429	1868	285	79	202	107	65	0.3	339	0.46	14.2	24.6	8.2
8	8.3	4600	2239	310	0	261	862	156	59	155	89	96	0.2	215	0.22	10.8	15.6	5.1
9	8.5	2800	1576	268	0	169	615	115	41	95	79	9	0.2	151	0.11	9.4	15.4	7.3
10	8.2	2520	1359	198	0	185	493	79	37	90	50	61	0.1	127	0.09	11.8	18.5	6.8

EC in micro mho cm^{-1} – All parameters are expressed in mg / lit; S_1 – Sooriyur S_6 – Senthaneerpuram; S_2 – Anna nagar S_7 – Ariyamangalam; S_3 – Gundur S_8 – Kattur; S_4 – Sembattu S_9 – Tiruverumbur; S_5 – Kottapattu S_{10} – Thuvakudi

Chemical Oxygen Demand

It is used to measure the load of organic pollutant in the waste water. It is useful in specifying toxic condition and presence of biologically resistant substances. In the present study, the COD values are revenged from 11.4-24.6 ppm. High value is found at Station 7. High COD may be due to the presence of high quantity of non-biodegradable organic waste and less amount of bio-degradable organic waste. Heavy pollution load with the dumping of garbage and other wastes increases the COD values.[7]

Dissolved Oxygen

It is an important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. In the present study, the DO values are ranged from 5.1-8.3 ppm. The DO values of all the water samples are above the permissible limit of WHO (5 ppm).The general trends of changes in DO concentration in different Station are directly or indirectly governed by fluctuations of temperature and BOD. DO content of water is enhanced by the decomposition of organic matter by the micro organisms.[14]

CONCLUSION

The ground water quality assessment guides in a better way to get the information about the sources of Pollution and to identify the main parameters of knowing the relevant information. It is obviously clear from the obtained results that the ground water source is polluted totally. The thinly populated inhabitants use water for drinking and all other purposes which lead to the heavy pollution load, domestic sewage and other hazardous wastes. To avoid the effect of the pollution, various precautionary and remedial measures must be done immediately.

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