Assessment of Physico-Chemical Status of Ground Water Samples

S. Suganthi[1]
[1.] Department of Chemistry,
Kongunadu College of Engineering and Technology,
Thottiyam, Trichy - 621215, Tamil Nadu. India.

K. Riaz Ahamed[2]
[2.] Department of Chemistry,
Jamal Mohamed College,
Trichy – 620020,Tamilnadu , India.

***Abstract*: - Ground water samples were collected from different locations at Andakudi area. Water samples from 6 sampling points of Andakudi were analyzed for their physicochemical characteristics. Laboratory analyses on samples were performed for pH, Colour, Odour, Hardness, Chloride, Alkalinity, Total Dissolved Solids (TDS) and others. On comparing the results against drinking water quality standards laid by World Health Organization (WHO), it was found that some of the samples were non-potable for human consumption due to high concentrations of some of the parameters determined. An attempt was made to find whether or not the quality of ground water in the areas of study suitable for human consumption.**

Keywords: Ground water, Physico-chemical analysis, TDS

INTRODUCTION:

Water plays an essential role in human life Although statistics, the WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water [1].Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement [2]. Human and ecological use of ground water depends upon ambient water quality. Human alteration of the landscape has an extensive influence on watershed hydrology [3].Ground water plugs a vital role in human life .The consequences of urbanization and industrialization leads to spoil the water for agricultural purposes ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable. During last decade, this is observed that ground water get polluted drastically because of increased human activities. Consequently number of cases of water borne diseases has been seen which a cause of health hazards. An understanding of water chemistry is the bases of the knowledge of the multi dimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water. The quality of water is of vital concern for the mankind since it is directly linked with human welfare .It is a matter of history that facial pollution of drinking water caused water-borne diseases which wiped out entire population of the studied area [4].The present work is an attempt to measure the water quality of various water sources of Thirumandankudi, Thanjavur District, Tamilnadu.

MATERIALS AND METHODS

WATER SAMPLING:

In present investigation six water samples were collected in polythene bottles which were cleaned with acid water, followed by rinsing twice with distilled water. The water samples are chemically analyzed [5]. The analysis of water was done using procedure of standard methods.

Physico-chemical Analysis

The samples were analyzed for major physical and chemical water quality parameters like temperature, pH, Electrical conductivity (EC), Total Dissolved solids (TDS), total hardness (TH), Ca^{2+}, Mg^{2+}, as per the Assessment of Ground Water Quality method described in "Standard methods for the examination of water and wastewater of American Public Health Association [8]. The parameters present in the water sample calculated by using various methods [9, 10]. The total hardness, total alkalinity, the concentrations of the chloride, nitrite, nitrate, sulphate, phosphate and other chemical parameters were estimated by the standard methods of water and waste water [11, 12] using the Hach DR 2000 direct reading spectrophotometer.

TABLE-I
GROUND WATER STANDARD VALUES

S.NO	PARAMETERS	WHO VALUES
1	pH (µmhos.cm^{-1})	7.5-8.5
2	EC (µmhos.cm^{-1})	600
3	TDS (mg/l)	500
4	DO (mg/l)	6.0
5	BOD (mg/l)	10
6	COD (mg/l)	10
7	Alkalinity (mg/l)	500
8	Carbonate (mg/l)	500
9	Bicarbonate (mg/l)	500
10	Chloride (mg/l)	250
11	Sulphate (mg/l)	250
12	Phosphate (mg/l)	0.10
13	Nitrate (mg/l)	50
14	Fluoride (mg/l)	2.5-3.5
15	Hardness (mg/l)	500
16	Calcium (mg/l)	100
17	Magnesium (mg/l)	150
18	Sodium (mg/l)	200
19	Potassium (mg/l)	12
Heavy metals		
20	Copper	1 (mg/l)
21	Iron	1 (mg/l)
22	Manganese	0.5 (mg/l)
23	Lead	0.05 (mg/l)

RESULTS AND DISCUSSION

1. pH:

pH value is an important factor maintaining the carbonate and bicarbonate levels in water. The pH values are recorded within the range of 7.1-7.7 for the ground water samples (Table-II). The pH values are found within the permissible limit of 7.5-8.5ppm (WHO 1998) in all the sampling stations for ground water sample. However the values reveal to the study areas are slightly alkaline nature of the ground water. The mild alkaline nature suggests that approximately 95% of CO2 in water is present as Bicarbonate.

2. EC:

The important of EC is measure of salinity which greatly affects the taste. The EC values are within the range of 690-940 µmhos.cm^{-1} for the ground water samples. The WHO permissible limit for EC in water is 600 µmhos.cm^{-1}When this exceeds 3000 µmhos.cm^{-1}.thus the germination of almost all the crops would be affected and it may reduce the yield.

3. TDS:

TDS indicates that the salinity behavior of ground water. The TDS values are found within the range of 506-602ppm for the ground water samples. All the ground water samples show that the TDS values are well above permissible limit of 500mg/l (WHO 1998). The maximum TDS values are observed at the station at sample 2 sample 5. Water containing more than 500mg/l of TDS is not considered for drinking water supplies, but in unavoidable cases 1500mg/l is also allowed.

4. DO:

DO is an important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. An ideal DO value (5.0mg/l) is the standard value for drinking water. The DO values have been found in between 7.1-14.2 mg/l in mining and residential areas of Andakudi. All the sampling points show the highest DO values.

5. BOD:

BOD defines as the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions. It is required to assess the pollution of surface and ground water where contamination occurred due to disposal of domestic and industrial effluents. The consequences of high BOD are the same as those for low DO. The values of BOD are between the ranges of 65-85 mg/l for the ground water samples (table II) are exceeds the permissible limit of 10mg/l (WHO 1998).

6. COD:

COD is the measure of pollution in aquatic system. COD determines the oxygen required for chemical oxidation of most organic matter and oxidizable inorganic substances with the help of strong chemical oxidant. The COD values are within the ranges of 36-49 mg/l for ground water samples (Table-II). High COD values may cause oxygen depletion on amount of decomposition by microbes. COD values exceed the permissible limit of 10 mg/l (WHO 1998) in all the sampling stations for ground water, which indicate the pollution by biodegradable and chemically degradable organic matter.

7. Total alkalinity:

(i) Carbonate:

The carbonate values are not detectable for the ground water samples. Since the observed pH value is below 8.5, the carbonate values are not detectable.

(ii) Bicarbonate:

All the Bicarbonate values of ground water samples are found to be within the permissible limit of WHO (500 mg/l). Thus may be due to ground water samples which are collected from the factory logging place. Therefore the Total alkalinity values for all the investigated samples are found to be greater in Sample 2.

8. Chloride:

The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects. In the present analysis, Chloride concentration was found in the range of 96-116 mg/l. Higher Chloride concentration in sample S6 indicates that discharge of sugar factory near the sampling sites.

9. Sulphate:

The values of sulphate are found in the range of 34-58 mg/l for ground water samples (Table-II). The values of sulphate are within the permissible limit of 250mg/l (WHO 1998). High concentration of sulphate is due to the accumulation of soluble salts in soil, anthropogenic activity and addition of excess sulphate fertilizer. The present study indicates that there is no harmful effect by sulphate.

10. Phosphate:

Phosphate may occur in ground water as a result of domestic sewage, detergents and agricultural effluents with fertilizers. The WHO permissible limit for phosphate in water is 5.0 mg/l. The phosphate content in the study area was found in all the samples lie between 0.02-0.06 mg/l.

11. Nitrate:

Ground water contains nitrate due to lacking of nitrate with the percolating water. Ground water can also be contaminated by factory wastes and other wastes rich in nitrates. The nitrate content of study area and residential is well within the permissible limit of WHO (50 mg/l). The low nitrate content may be due to the less usage of nitrogen fertilizers and less disposal of wastes around the study areas. The concentration varies from 0.03-0.18 mg/l.

12. Fluoride:

The percolation of phosphateic fertilizers from the agricultural runoff from the nearby lands and discharge of domestic wastes or the wastes from the surrounding industries increases the fluoride values. This study shows that all the values within the permissible level of WHO is 2.5-3.5 mg/l whereas in our study areas, its concentration varies with the values from 2.87-3.12 mg/l.

13. Total hardness:

Hardness is the property of water which prevents the lather formation with the soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of Calcium or magnesium salts or both. The hardness values are in the range from 134-148 mg/l. The high value of total hardness is sample 4 sample 5.

14. Calcium:

Calcium is the directly related to hardness. The permissible limit for calcium in ground water is 100 mg/l. The calcium value shows the range from 91-98 mg/l. All the values are within the permissible value. The maximum calcium value was observed at 98 mg/l and minimum was 91 mg/l at the study area.

15. Magnesium:

Magnesium is directly related to hardness. The WHO permissible limit for magnesium in ground water is 150 mg/l. The magnesium value shows the range from 39-56 mg/l. All the values are within the permissible value. The maximum calcium value was observed at 56 mg/l and minimum was 39 mg/l at the study area.

16. Sodium:

The values of sodium are in the range of 19-26 mg/l for ground water samples. The sodium value decreases the desirable limit of 200 mg/l (WHO 1998) in the sample. The sample 6 which has the maximum sodium values. Percolation of river water containing high ionisable salts and the intrusion of domestic sewage probably enhances the sodium concentration. Sodium is found in association with high concentration of chloride resulting in salinity.

17. Potassium:

Feldspars, micas, clay materials etc., are responsible for the availability of potassium in ground water by weathering. The values of potassium in ground water samples mg/l whereas in our study areas, its concentration varies with the values from 2.87-3.12 mg/l.

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17. Potassium:

Feldspars, micas, clay materials etc., are responsible for the availability of potassium in ground water by weathering. The values of potassium in ground water samples vary the station wise. The values of potassium are recorded between 0.16-0.23 mg/l for ground water samples (Table II). The values of potassium decrease the permissible limit in all the ground water samples.

Heavy metals

1. Copper:

Copper is an essential element and good for health in very small quantities but quantities by excessive dose is toxic. In the present study the values of copper are recorded in 0.01 mg/l for all the ground water samples (Table-III). The values are within the permissible limit of 1ppm (WHO 1998). The sources of copper are the industrial and domestic wastes. Corrosion of brass and copper pipes and addition of salts during water treatment for algae control also contributes to copper level in water.

2. Iron:

The values of iron in the range of 0.03-0.05mg/l for the ground water samples (Table-III). All the values are within the permissible limit of 1mg/l.

3. Manganese:

The values of manganese are recorded between the ranges of 0.01-0.03 mg/l (Table-III). All the values are below the permissible limit of 0.5 ppm (WHO 1998). But according to ISI for drinking water, permissible limit for manganese is 0.3 mg/l. In this study, the ground water is not much polluted by manganese. However, the slight rise in its level may be accounted for the influence of domestic waste, natural geological rocks.

4. Lead:

Lead is very toxic element, which accumulates in skeletal structure of man and animals. The values of lead are recorded for the ground water samples (Table-III). The maximum permissible concentration of lead in drinking water is 0.05mg/l (WHO 1998).

TABLE-II

Physico-chemical parameters of ground water samples collected from Andakudi village in the month of April-2013.

S.NO	Parameters	S_1	S_2	S_3	S_4	S_5	S_6
1	Colour	<1 hue	<1 hue	<1 hue	<1 hue	>1 hue	>1 hue
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Turbidity	15NTU	20NTU	15NTU	10NTU	25NTU	15NTU
4	pH	7.3	7.6	7.4	7.3	7.5	7.1
5	EC	820	940	790	690	940	840
6	TDS	525	602	506	442	602	538
7	DO	7.1	14.2	13.2	14.2	12.1	10.1
8	BOD	70	65	72	85	79	84
9	COD	36	38	38	45	49	48
10	Alklainity	110	106	108	142	123	156
11	Carbonate	Nil	Nil	Nil	Nil	Nil	Nil
12	Bicarbonate	110	106	108	142	123	156
13	Chloride	96	106	104	114	112	116
14	Sulphate	36	34	39	56	58	54
15	Phosphate	0.02	0.05	0.04	0.05	0.06	0.03
16	Nitrate	0.18	0.14	0.09	0.05	0.06	0.03
17	Fluoride	3.06	3.12	3.09	2.98	2.87	2.95
18	Hardness	137	138	134	151	151	148
19	Calcium	98	96	91	95	97	96
20	Magnesium	39	42	43	56	54	52
21	Sodium	19	22	20	22	25	26
22	Potassium	0.19	0.18	0.20	0.22	0.16	0.23

Note: All the values are expressed in mg/l expect pH and EC (µmhos.cm^{-1})

TABLE-III

HEAVY METALS

S.no	Heavy metal	S_1	S_2	S_3	S_4	S_5	S_6
1	Copper	0.01	0.01	0.01	0.01	0.01	0.01
2	Iron	0.04	0.05	0.04	0.05	0.03	0.03
3	Manganese	0.02	0.03	0.03	0.02	0.02	0.01
4	Lead	Nil	Nil	Nil	Nil	Nil	Nil

Note: All the values are expressed in mg/l

CONCLUSION

The ground water samples were collected from six different places in Andakudi village in Thanjavur district. The samples were subjected to physic-chemical analysis. The results of the above work shows that most of the physic-chemical parameters like EC, TDS, DO, BOD, COD and fluoride are well above the permissible limit of WHO (1998). The result shows that the most of the ground water sampling stations are polluted by the intrusion of fiver water, dumping of waste and percolation of domestic sewage by inhabitants. The ground water samples are not much polluted in the Kollidam river areas, but in future this may polluted due to the heavy pollution load, domestic sewage and other waste by thickly populated inhabitants will become unfit for drinking and other purposes. It is high time to preserve and protect this valuable ground source. Based on the results and analysis of water samples, it is recommended to use water only after boiling and filtering or by Reverse Osmosis treatment for drinking purpose by the individuals. Hence dumping of waste polluted material should be avoided and they should not be let into the river.

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