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A Case Study on the Quality of Ground Water – A Case Study in Government Science Collge Bangalore

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ABSTRACT: *Ground water is a precious component among the most widely distributed resources of earth. Basically ground water is an integral part of the environment, and hence it is a major life-sustaining resource for all the living beings. In India, as also in certain parts of the world, water crisis is becoming a regular phenomenon, more perhaps due to improper or lack of scientific management of water resources and continuing environmental degradation. It is always a social and economic necessity to exploit the ground water potential, supplementing the water provided by the canals for irrigation purposes and meeting manifold requirements of the community, this will helps to play a positive role in fully mobilizing the available resources for extending the benefit of irrigation to larger areas. Secondly, pumping out the ground water ensures lowering of depth of water table beyond root zone in water logged areas; thirdly, such conjunctive irrigation (surface and ground water) will not permit salinization and alkalinisation of water sources. However, this needs a sound planning for utilizing the ground water in the command area. The quantum of ground water available for use should be studied in depth and equally important is to assess the quality of ground water. In the light of the above a detailed programme was initiated and carried out to investigate the physic-chemical characteristics of the ground water in the Govt. Science college Bangalore area In order to assess the overall ground water quality, sampling points were located in the study area, which constituted 2 locations followed by sampling and laboratory analysis. The samples were collected in sterilized polythene cans. The overall quality of the ground water samples is found to vary from good range, in which the samples were found safe for drinking, irrigation and recreation purposes. The result of the samples analysed in the month of March and April found almost same, this may be explained to the reason that the time period did not have any rains. The both the months are referred under summer.*

***KEYWORDS*:** *Alkalinity, Calcium, Hardness, Chloride, Mathemoglobinemia, P ^{H}Quality Pollution, Turbidity*

I. INTRODUCTION

Rivers usually start as small streams and get larger as they flow downstream. The water they gain is often groundwater. Such a stream is called a gaining stream. It is also possible for streams to lose water to the ground at some points, in these cases; aquifers are replenished by water from the losing stream. A stream, which flows near the surface of an aquifer, will lose water to the aquifer if the water surface in the stream is higher than the water table of the aquifer. A stream will gain water if the water surface of the stream is lower than the water table in the adjacent land. Sinkholes also play an important role in connecting groundwater and surface water. Lakes commonly occupy the depressions created by sinkhole collapse. Some streams lose their entire flow at low-flow stages to the upper Floridian aquifer through swallow holes in the stream bed. Springs and wells bring the water from the aquifer up to the surface. Since groundwater moves slowly, many years may pass before a pollutant released on the land surface above the aquifer is detected in water taken from the aquifer some distance away. Unfortunately, this means that contamination is often widespread before being detected. Even if release of the contaminant is stopped, it may take many years for an aquifer to purify itself naturally. Groundwater and surface water (along with precipitation and Evapotranspiration) are interdependent parts of the hydrological cycle. Unlike groundwater, surface water can be seen all around lakes, ponds, rivers, streams and wetlands. Subsurface water contained in the interconnected pores below the water-table of an aquifer is termed 'Groundwater'. Groundwater occurs when water flows through the impermeable surface barrier that lets water to flow through the unsaturated zone and collect in the spaces made by interconnecting pores. The impermeable layer can be of bedrock or that of one rock. Once the water flows down to the saturated zone, it flows from the high water-table point to a lower point, this flow of water occurs due to percolation. Water percolating within the saturated zone may, eventually, flow to streams, rivers of other surface water bodies. How does groundwater become contaminated? Sometimes groundwater contamination occurs naturally, but serious contamination is usually the result of human activities on the land surface. Each human activity has a particular impact on groundwater. Some agricultural activities add nitrate nitrogen and pesticides to groundwater. Residential areas with septic systems usually add nitrate nitrogen, bacteria, viruses, and synthetic organics used in household cleaning products and septic tank cleaners. Industrial activities tend to add organic chemicals and metals, though in widely varying amounts. Gasoline storage areas (including service stations) may have leaks and spills of petroleum products. Roadways contribute petroleum pollutants leaked from vehicles and metals from exhaust fumes. The most concentrated impact comes from older sanitary landfills, whose leach ate may contain many different chemicals at relatively high concentrations. Except where contaminated water is injected directly into an aquifer, essentially all groundwater pollutants enter the aquifer through recharge water from the land surface. Sinkholes are a special case as they can provide a direct connection to the aquifer and allow contaminants in surface runoff to move straight to the groundwater.

OBJECTIVES OF MONITRING OF GROUND WATER

- To analyze ground water quality.
- To check the ground water quality with BIS permissible limit.

II. M ATERIALS AND METHODS:

2.1. GEOGRAPHICAL LOCATION AND EXTENT OF THE STUDY AREA:

Bangalore located at 12~58 'N latitude and 77~35' E longitudes and at an average altitude of 921 MSL, encompasses 1279 square kilometre of Comprehensive development area with a current population of nearly 6 million. It has received tremendous attention from international investment companies especially the Residential sector. This attention is attributed to various factors including a salubrious climate, skilled manpower availability, and a large number of educational institutions amongst others. A Preliminary groundwater survey was conducted in the study area. Then an extensive sampling programme was undertaken in the command and catchment area. The proposed study has been programmed in two phases in March and in April. Water samples were collected in the campus of Govt. Science College, which is being extensively used for drinking during march- April 2007. The results obtained will be used as baseline information and compared with the BSI Standards. When it becomes available in future and thus it is possible to find out the degree of ground water quality proposed project sampling area. A sampling site is identified during preliminary survey and 2 samples were collected, in the college campus pH, Electrical conductivity , TDS, Alkalinity, Chlorides, Total hardness, Calcium hardness, Magnesium hardness, Nitrate, Sulphate, Phosphate, Fluoride, Sodium, Potassium, were determined employing standard methods of analyses (APHA,1995).

2.2 CLIMATE:

The climate in Bangalore is divided into four main seasons. The cold weather season, from December to February is a period of generally fine cool weather with mainly clears blue skies. It is a period of little or no rainfall. The hot weather season begins in March, which is a dry month with low humidity. April & May are the months of considerable thunderstorm activity. The southwest monsoon from June to September is a moist, cloudy and rainy period. It is also a period of fairly strong and steady winds, blowing from the Southwest to west. The northeast monsoon season from October is also a moist and rainy period but with slightly less clouding. The maximum and minimum temperatures in the study area are 35.2°C and 22.8°C, during summer and 28.7°C and 15°C during winter respectively. The average annual rainfall is about 63.4mm, with 1.3mm as the lowest and 207.7mm as the highest rainfall received (during Nov-2002 and Oct-2003). The monthly mean Relative humidity was found to be a maximum of 88 % and a minimum of 33 % at 0830 hrs IST and 1730 hrs IST respectively.

2.3 TEMPERATURE

The winter season starts from December and continuous till the end of February. Mean maximum temperature is observed at (34°C) in the month of May. And the mean minimum temperature at (13°C) is observed in the month of January. Both the day and night temperatures increase rapidly during the onset of pre monsoon season from March to May. During the pre monsoon the mean maximum temperature is observed to be 29.9°C for the month of June with the mean minimum temperature at 24.8°C during May. An appreciable drop in mean maximum temperature during Monsoon Season is observed to be 29.7°C and mean minimum temperature is observed to be 21.3°C. By the end of September with the onset of post monsoon season (October to November), day temperatures drop slightly with the mean maximum temperature at 27.9°C in the month of November.

2.4 RELATIVE HUMIDITY

Relative humidity is recorded at 08.30 hrs and 17.30 hrs. The pre-monsoon period is the driest part of the year with the maximum relative humidity around 78% at 08.30 hrs and 42% at 17.30 hrs observed in the month of June. During the monsoon season the mean maximum humidity observed at 08.30 hrs is 84% (August) and at 17.30 hr is 38% (August).

2.5. pH: pH of the samples was determined by using pH meter (EUTEOH CYBERSCAN 510). The ph meter was calibrated using ph 4.01 and pH 9.20 buffer solutions, and the reading, for the samples were recorded.

2.6 Electrical conductivity: The electrical conductivity was determined using conductivity meter (SYSTRONIC conductivity- TDS METER 308). The temperature compensation knob of the conductivity meter was adjusted to the temperature of the sample and calibrated to CAL mark **with the cell** dipped into the sample and reading was noted. The reading was recorded from the scale and was expressed µmhos/cm.

2.7. Turbidity: Turbidity of the sample was determined using colorimeter (HACH DR/890 Colorimeter). The sample was shaken well and suitable aliquot was transferred into curettes was placed inside the cell compartment and turbidity was read directly NTU.

2.8. Alkalinity: The Alkalinity of sample was determined by titration method. 10ml of sample is titrated against 0.02 N solution using methyl orange as indicator. Formula: total alkalinity = (ml of titrant/ml of sample X 1000 mg/L) as

2.9. Total Hardness: Total hardness of a sample was determined by titrimetric method 10ml of the sample was titrated against 0.01 M EDTA (Disodium salt) by adding q ml of ammonia buffer and Erio -chrome black T indicator. Formula: T.H. = (ml of titrant / ml of sample) X 1000 mg / L as $CaCO_3$

2.10. Calcium Hardness: Calcium hardness of sample was estimated by titrating the sample against 0.01 M EDTA (Disodium salt) with addition of 1 ml of Sodium hydroxide (NaOH) and murexidé indicator.
Calcium Hardness = (ml of titrant / ml of sample) X 1000 mg/L as $CaCO_3$**.**

2.10.1 Magnesium Hardness: Magnesium hardness was calculated from the difference calcium and total hardness values obtained as below.
Formula used
Magnesium hardness = (total hardness – calcium hardness) x 0.243 mg/L.

2.10.2. Chloride: The procedure adopted for estimation of chloride was titrimetric method which involves titration with standard silver nitrate solution. 1 ml of sample was titrated against 0.02 N silver nitrate solution and using potassium chromate as indicator.
Formula used
Chlorides = (VxN) of $AgNO_3$ x 34.55 X 1000 / volume of sample mg/l.

2.10.3. Sulphate: Sulphate was estimated by turbido metric method to a sample aliquot of 100 ml, 10 ml of conditioning reason reagent and 0.5g of barium chloride was added. Sample taken was kept aside for turbidity development of 15 min. And absorbance of solution was noted at 420 nm by using spectrophotometer.

2.10.4. Phosphate: Phosphate in the sample (as orthophosphate) was determined by the molybdenum blue method using stannous chloride. To a sample volume of 100 ml, 4 ml ammonium molybdate and 0.5 ml of stannous chloride solution was added. After 10 min. The colour developed is measured as absorbance at 690 nm using spectrophotometer

2.10.5 Ni**trate :** Nitrate estimation was done by phenol-di-sulphonic acid method (PDA method). An aliquot of sample was taken and silver sulphate was added to remove chlorides. The filtrate obtained after removing chlorides was fully evaporated. The residue obtained was dissolved by adding 2 ml of phenol-di-sulphonic acid and made up to 50 ml with distilled water 6 ml of 30% liquid ammonia was added for colour development and absorbance noted at 410 nm using spectrophotometer.

2.10.6 Fluoride: Fluoride estimation was done by Colorimeter using SPADNS Reagent is the water samples were mixed well and fed into the cuvettes and readings were noted.

2.10.7. Sodium and Potassium: Sodium and Potassium were estimated using flame photometer. Samples were fed into the flame through the capillary tube and readings were noted.

: Fluoride content is one of the vital indicative parameters of the ground water quality for human consumption. It occurs in the earth's crust along with the fluoride rich mineral bearing rocks. High Fluoride contents in ground water and their continued consumption by community can cause fluorosis among the consuming populations. The concentration of fluoride was observed to be 1.0 mg/L among the samples studied.

2.10.8. Nitrate : The occurrence of nitrate in ground water samples is mainly attributed to leaching of fertilizers used in agricultural activities through infiltration, open drainage systems, irrigated water, animal wasted, leachates through sewers, direct disposal of waste etc. In the sampling site nitrate value was found to be 0.2 mg/L.

2.10.9. Sulphate : The Sulphate in the ground water is contributed mostly from the domestic waste through open drainage. Sulphate rocks, soil and amphibolites and iron rich rocks. The excess of sulphate in ground water also affects human health .The sulphate values in the sampling site was 0.001 mg/L.

2.10.10. Sodium and Potassium: Sodium values have found to be 20 mg/L, while potassium values have found to be 1.0 mg/l.

III. FIGURES AND TABLES
IV.

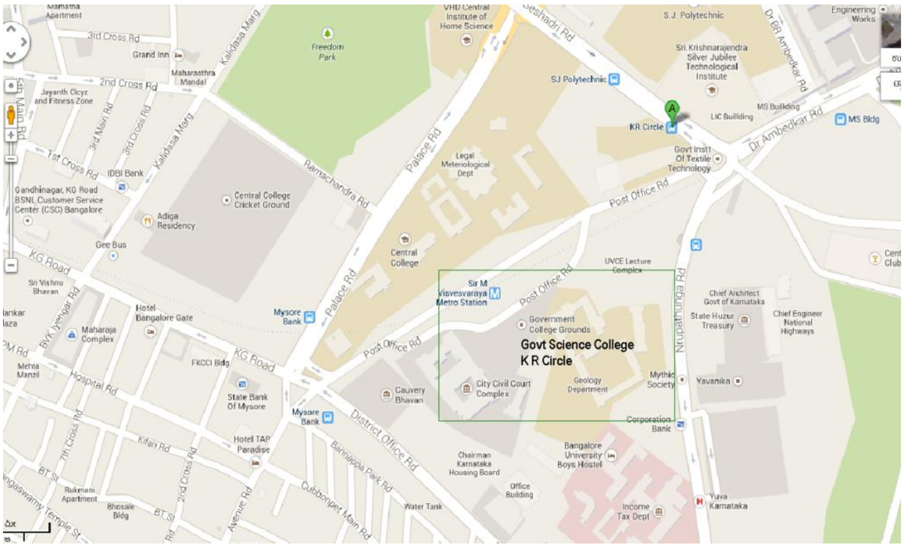

fig. 1. Govt science college K R circle map

3.1. OBSERVATIONS ON SECONDARY DATA
RAIN FALL

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV
Monthly mean maximum temperature (degree)	29.3	31.6	33.6	32.7	33.9	30.3	28.5	28.1	28.2	27.4	26.2
Monthly mean minimum temperature (degree)	16.8	17.9	20.5	21.7	21.7	20.8	20.2	19.9	19.9	19.7	17.3
Monthly total rainfall (mm)	0.6	7.7	1.2	80.3	150.1	108.0	163.0	229.3	181.0	605.8	60.9
Monthly mean relative Humidity at 08.30 hrs(%)	79	64	68	72	78	84	88	87	87	91	82

Monthly mean relative humidity at 1730 hrs(%)	42	29	27	47	47	60	76	68	66	78	67
Monthly mean station level Pressure at 0830hrs (hpa)	912.5	913.1	912.0	910.9	908.7	906.7	908.6	908.4	908.4	909.8	911.6
Monthly mean station level pressure at 1730hrs (hpa)	909.1	909.6	908.4	907.1	905.1	904.2	905.0	906.0	905.5	906.8	908.9
Total hrs of sunshine	193.2	222.8	235.9	184.4	211.8	114.1	74.5	96.9	115.3	82.2	142.0

3.2. MICRO

METEOROLOGY OF THE STUDY AREA

A meteorological data was collected during the study period. The predominant wind pattern is shown below

Period (hrs)	***Predominant Winds***	***Wind Speed in km/hr***
06:00-06.00	*SW-NE*	*43 33 11 13*
6.00-14.00	*W-E*	*29 30 22 19*
14.00-22.00	*SW-NE*	*29 32 19 20*
22.00-06.00	*SW-NE*	*20 24 33 23*

3.3. RESULTS FOR THE MONTH OF MARCH

NO	PARAMETER	RESULT
01	pH	6.98
02	Electrical conductivity	1010µmhos/cm
03	Turbidity	0 NTU
04	Total Dissolved Solids	110 ppm
05	Alkalinity	12 Mg\lit
06	Chloride	60 Mg\lit
07	Total Hardness (TH)	180 Mg\lit
08	Calcium hardness	40 Mg\lit as $CaCO_3$
09	Magnesium hardness	6 Mg\lit
10	Fluoride	1.0 Mg\lit
11	Nitrate	0.2 Mg\lit
12	Sulphate	0.001 Mg\lit
13	Phosphate	0.001 Mg\lit
14	Sodium	20 Mg\lit
15	Potassium	1.0 Mg\lit

3.4. RESULTS FOR THE MONTH OF APRIL

NO	PARAMETER	RESULT
01	pH	6.97
02	Electrical conductivity	1010µmhos/cm
03	Turbidity	0 NTU
04	Total Dissolved Solids	111 ppm
05	Alkalinity	12 Mg\lit
06	Chloride	62 Mg\lit

07	Total Hardness (TH)	180 Mg\lit
08	Calcium hardness	42 Mg\lit as $CaCO_3$
09	Magnesium hardness	6 Mg\lit
10	Fluoride	1.0 Mg\lit
11	Nitrate	0.2 Mg\lit
12	Sulphate	0.001 Mg\lit
13	Phosphate	0.001 Mg\lit
14	Sodium	20 Mg\lit
15	Potassium	1.0 Mg\lit

3.5. COMPARISON BETWEEN THE TWO RESULTS OF THE MONTH MARCH AND APRIL

NO	PARAMETER\RESULT	MARCH	APRIL
01	pH	6.97	6.97
02	Electrical conductivity	1010µmhos/cm	1010µmhos/cm
03	Turbidity	0 NTU	0 NTU
04	Total Dissolved Solids	111 ppm	111 PPM
05	Alkalinity	12 Mg\lit	12 Mg\lit
06	Chloride	62 Mg\lit	62 Mg\lit
07	Total Hardness (TH)	180 Mg\lit	180 Mg\lit
08	Calcium hardness	42 Mg\lit as $CaCO_3$	42 Mg\lit as $CaCO_3$
09	Magnesium hardness	6 Mg\lit	6 Mg\lit
10	Fluoride	1.0 Mg\lit	1.0 Mg\lit
11	Nitrate	0.2 Mg\lit	0.2 Mg\lit
12	Sulphate	0.001 Mg\lit	0.001 Mg\lit
13	Phosphate	0.001 Mg\lit	0.001 Mg\lit
14	Sodium	20 Mg\lit	20 Mg\lit
15	Potassium	1.0 Mg\lit	1.0 Mg\lit

3.6. BSI STANDARDS

NO	PARAMETER	RESULT
01	pH	6.5-6.8
02	Electrical conductivity	750
03	Turbidity	5 NTU
04	Total Dissolved Solids	500 ppm
05	Alkalinity	200 Mg\l
06	Chloride	1000 Mg\l
07	Total Hardness (TH)	500 Mg\l
08	Calcium hardness	<100 Mg\l
09	Magnesium hardness	<20 Mg\l
10	Fluoride	<10 Mg\l
11	Nitrate	40 Mg\l
12	Sulphate	<1 Mg\l
13	Phosphate	0.3 Mg\l
14	Sodium	<100 Mg\l
15	Potassium	<3 Mg\l

V. RESULTS AND DISCUSSION:

RESULTS:

pH: The hydrogen ion concentration of the ground water samples are mainly regulated by the various chemical reactions and ionic equilibrium in the solution. The pH of the samples ranged between 6.97 to 6.98.

Electrical Conductivity: Electrical conductivity is measure of the dissolved sait concentration and salinity of the water. This affects the quality of water used for various purposes. EC i.e the sampling sides was 1010 μmhos/cm.

Turbidity: The presence of suspended and colloidal particles contributes to turbidity in water. The turbidity of samples in sampling site was 0 NTU. Turbidity of 0 NTU found in both the sample, as the water was clear from suspended matter and colloidal particle.

Total Dissolved Solids: Total dissolved salts constitute dissolved salts of both cationic and anionic forms. TDS in sampling sites ranged between 110 to 111 ppm. The least TDS value was from sample which was collected in March and highest belonged to sample which was collected in April.

Alkalinity: Alkalinity of ground water is due to the presence of carbonate, bicarbonate and hydroxides. Alkalinity in sampling site was found to be 12 mg/L.

Chloride : Chloride is a measure of salinity of the water. Excess of chlorides in ground water imparts salinity in water and affects human consumption. Chloride contents were found to be values ranging from 60 to 62 mg/L.

Total Hardness (TH): The presence of carbonate and bicarbonate of calcium and magnesium, sulphates, chlorides, nitrates in excess amounts influences the ground water to become hard. TH in the sampling site was found to be same in both the samples of 110 to 111 mg/L. As $CaCO_3$.

Calcium hardness : Calcium constitutes 3.6 percent of the earth's crust and is widespread in soil and ground water. The presence of calcium and magnesium bicarbonates contributes to calcium hardness in the ground water, which in excessive concentrations affects quality of water and health of community when consumed. In the sampling site calcium hardness ranged from 40 to 42 mg/L as $CaCO_3$.

Magnesium hardness : Magnesium hardness in the investigated samples have found out to be similar in both the sample as 6 mg/L.

Fluoride : Fluoride content is one of the vital indicative parameters of the ground water quality for human consumption. It occurs in the earth's crust along with the fluoride rich mineral bearing rocks. High Fluoride contents in ground water and their continued consumption by community can cause fluorosis among the consuming populations. The concentration of fluoride was observed to be 1.0 mg/L among the samples studied.

Nitrate : The occurrence of nitrate in ground water samples is mainly attributed to leaching of fertilizers used in agricultural activities through infiltration, open drainage systems, irrigated water, animal wasted, leachates through sewers, direct disposal of waste etc. In the sampling site nitrate value was found to be 0.2 mg/L.

Sulphate : The Sulphate in the ground water is contributed mostly from the domestic waste through open drainage. Sulphate rocks, soil and amphibolites and iron rich rocks. The excess of sulphate in ground water also affects human health .The sulphate values in the sampling site was 0.001 mg/L.

Sodium and Potassium: Sodium values have found to be 20 mg/L, while potassium values have found to be 1.0 mg/L.

VI. DISCUSSION:

In view of the lithogenic constituents and anthropogenic pollutants, which are widespread and which ultimately find their way into various components of the ecosystem in particular the soil regime, and associated ground water components. It has become imperative to evaluate their effects on the ground water quality. The physic-chemical quality of ground water samples of GOVT. SCIENCE COLLEGE BANGALORE area was analyzed for the months of March, 2007, and the significance of the results obtained are discussed in the following paragraphs.

pH: The pH value of water is largely governed by carbon dioxide, carbonates and bicarbonates equilibrium. pH of water may also be altered due to many reasons like acid rain, acid mine drainage, discharge of acidic and alkaline effluence from industries etc. pH values specified for drinking water by BIS is 6.5 to 8.5. The pH values in the samples varied from 6.97 to 6.98 during the study period which are well within the permissible levels specified for drinking water by BIS. pH values beyond this value would affect mucous membrane in humans and affects water supply

Electrical conductivity : Conductivity is the capacity of water to carry an electrical current and which varies with the number and types of ions the solution contains, which in turn is related to the concentration of ionized substances in water. Most dissolved substances in water are in the ionized form and hence they contribute to conductance. The conductivity standard prescribed by BIS for drinking water is 750 μmhos/cm. The samples have shown a value of 1010 μmhos/cm. The slightly high value of conductivity of samples can be attributed to the fact that ground waters have generally high concentration of dissolved inorganic constituents.

Turbidity: Turbidity in water is due to the colloidal and extremely line dispersion or suspended matter such as clay, silt, finely divided organic and inorganic matter. Plankton and other microorganisms also contribute to turbidity, considerably. Generally turbidity in water samples is not acceptable to consumers due to aesthetic reasons. The standard prescribed for turbidity by BIS is 5 NTU (Nephelometric Turbidity Unit). The samples showed turbidity value 0 NTU. Thus it's not exceeding the permissible limits in samples.

Alkalinity: Alkalinity of water is a measure of its capacity to neutralize acidic inputs and the value prescribed by BIS is 200 mg/L (as CaCO3). Alkalinity values in the samples were 12 mg/L (as CaCO3). This may be due to presence of carbonates, bicarbonates, borates, silicates and phosphates along with the hydroxyl ions in the free state. However the major contributors to alkalinity are hydroxides, carbonates and bicarbonates, which may be ranked in order of their association with high pH values. Alkalinity of water has little sanitary significance. However it is significant in many uses and treatments of natural and wastewaters, particularly in coagulation of water softening and operational control of anaerobic digestion.

Total dissolved solids: In natural waters. The dissolved solids consist mainly of bicarbonates, carbonates, sulphates, chlorides, nitrates and other substances. No particular harmful effects are seen due to high dissolved solids. Water samples analyzed show a range of values from 110 to 111 ppm. In general. Water with total dissolved sodium content of 500 ppm is desirable. Beyond 500 ppm, palatability of water decreases and may also cause gastro-intestinal irritation.

Hardness : Total Hardness value in the samples have be noticed as 180 mg/L as (CaCO3). Calcium is the major contributor to the hardness of samples compared to magnesium. The calcium hardness of samples is found to vary from 40 to 42 mg/L Caco3). Magnesium hardness has be found as 6 mg/L (as CaCO3) Calcium is an essential element and human body requires approximately 0.7 to 2g of calcium per day as a food element. But high calcium contents in water are undesirable for household uses like washing etc. because of greater demand for soap/detergent consumption. Calcium salt also tends to cause on cooking utensils and water heaters. Magnesium is also an essential element for human beings. Although magnesium is relatively non toxic to humans' higher magnesium concentration imparts unpleasant taste to water. In combination with sulphates, magnesium salts have a laxative effect. But the water samples investigated in the study are well within permissible limit.

Chloride : Chloride is generally present in natural waters and its presence can be attributed to the interaction of water body with the surrounding geological matrix, discharges of effluents from industries, sewage discharges, irrigation drainage, contamination from refuse dump leachates etc. The ground water analyzed has chloride concentration reaching a 60 mg/L. However the maximum permissible limit chloride is 1000ppm, in the absence of alternate drinking water source. Because chlorides are not generally harmful to human beings, usually the cation i.e, Sodium, magnesium etc. Associated with chloride that produces certain deleterious effects. High chloride content above 1000 mg/L imparts corrosive effect on metallic pipes and may affect agricultural plants.

Phosphate: Phosphates may occur in surface or ground waters as a result of leaching from minerals or ores, agricultural run of from lands with chemical fertilizer application. And as a major component of municipal sewage clue to widespread usage of detergents in households and industry. The maximum permissible limit for phosphates prescribed by BIS is 0.3 mg/L. The samples analyzed have shown very low levels of phosphates i.e

0.001 mg/L, and the observed concentrations of phosphates are not significant for drinking water and purposes. However presence of phosphates has great significance in water and waste water treatment and in practice phosphates in small concentrations are used as additives in water supplies for various purposes such as to reduce scale formation, to increase carrying capacity of mains, to avoid corrosion in water mains, to remove iron and manganese in micro quantities and to aid in coagulation, especially in acidic conditions.

Nitrate : Nitrates are believed to occur in ground waters mainly due to leaching from soil organic matter, leaching of fertilizers applied to soil, leachates from refuse dumps and industrial discharge which also contribute to presence of nitrates. Nitrates when present in high concentrations in drinking water is considered injurious for infants because they get reduced to nitrites in their intestinal system and this causes 'methemoglobinemia' or 'blue baby syndrome'. The disease 'cyanosis' in which the haemoglobin of the blood stream apparently becomes incapable of transporting oxygen to the vital organs of the human system is also attributed to high concentrations of nitrates in the waters, used for preparing feeding formulae (Manivasakam 1996). However the samples of study area have nitrates concentration well within the permissible limit of 45 mg/L. Prescribed BIS (10500:1991).

Sulphate : Sulphate ions originate in natural waters due to oxidation of sulphate ores, or solution of gypsum and other sulphur bearing ores, present in earth's crust. Sulphates to the total solids contents and they are readily soluble in water. Sulphate concentration also generally decreases with depth of the ground water table. The water samples analysed have very low concentrations of Sulphate, well within the prescribed drinking water limits (BIS-10500:1991). However sulphates when present in combination with magnesium can cause a laxative effect. High amounts can also impart bitter taste to water. Sulphates cause a problem of scaling in industrial water supplies and can cause a problem of odour and corrosion in wastewater treatment following its reduction to hydrogen sulphide.

Fluoride : Fluoride ions have a dual significance in water supplies. High concentrations of fluoride causes dental fluorosis, while concentrations less than 1 mg/L results in dental caries. Hence it is essential to maintain fluoride concentration between 0.8 to 1.0 mg/L. Daily absorption of 20 to 80 mg/L or more fluoride in the body for ten years results in the eventual development of the above stated, severely crippling disease fluorosis, which is caused by an increased fluoride deposition in the bones.

Fluoride being an electronegative element is attracted by positively charged ions like calcium. Bone and teeth having considerable amounts of calcium in the body, are prone to excessive deposition of fluoride as calcium fluorapatite crystals, causing severe fluorosis. The water samples in the study area can be considered as safe for drinking, since the samples have fluoride levels less than 1.5 mg/L as prescribed by BIS-(10500:1991).

Sodium and Potassium: Sodium and Potassium are electropositive elements. Sodium is the most abundant of the alkali elements. Deficiency of Sodium causes muscular cramps in animals and humans. On the other hand when present as sodium chloride in concentrations more than 500 mg/L. It makes the water unpalatable and causes appetite disturbances. It has been found that an excessive amount of sodium is harmful to persons suffering from cardiac, renal and circulatory diseases. The ground water samples have found to be 20 ppm in sodium concentration and 0.1 ppm in potassium concentration. Potassium ranks seventh among the elements in the order of abundance in the earth's crust, but its concentration is usually less than that of sodium. Potassium is an essential nutrient and the standard prescribed by ICMR in drinking water for potassium is 10 ppm. For calcium and magnesium to precipitate as carbonates and for the relative proportion of sodium to increased as a consequence. The bicarbonate values

VII. CONCLUSIONS:

A close study of all the parameters analysed arrived at, reveals some interesting and important information about the quality or ground water in the study area. In the study place, the overall quality of the ground water in the study area is suited for drinking purpose and domestic purpose.

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