Physico-Chemical and Biological Analysis of Ground Water in Mamsapuram Region, Virudhunagar District, Tamil Nadu, India.

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Abstract : Quality of water is an important criterion for evaluating the suitability of water for drinking. The ground water samples were collected and subjected for a comprehensive physico – chemical and Biological analysis. The following 18 parameters have been examined viz. pH, Electrical Conductivity, Total Alkalinity, Total hardness, Total Solids, Carbonate and non carbonate hardness, Chloride, Nitrate, Fluoride, Sulphate, Phosphate, dissolved oxygen, iron, manganese, Total colonies per ml on agar at 37°C, MPN of Coliform bacteria per 100ml, Nature of Coliform bacteria isolated. On comparing the results against drinking quality standards laid by World Health Organization, it was found that some of the water quality parameters were above the permissible limit and some were not. The study of physico-chemical and biological characteristics of this ground water sample suggests that the evaluation of water quality parameters as well as water quality management practices should be carried out periodically to protect the water resources.
Keywords: Biological Analysis, Physico-Chemical, Ground Water.

Introduction

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life[1]. Ground water is the major resource of drinking water. The ground water is clean and free from pollution when compared to surface water. The ground water is polluted due to excessive use of fertilizers and pesticides, increased human activities and rapid growth of industries[2]. Pollution of ground water aquifers has made many of these wells unfit for consumption. The availability of water through surface and groundwater resources has become a critical day today. Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consumption, transportation and waste disposal. There are several states in India where more than 90% populations are dependent on groundwater for drinking and other purpose[3].

According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored back easily and to device ways and means to protect it[4].

The present study was undertaken to investigate the impact of groundwater quality of some open wells and bore well water samples in selected locations of Mamsapuram region in Virudhunagar district. Thus, in this research work an attempt has been made to assess the physical and chemical parameters of groundwater like pH, electrical conductivity (EC), Total Solids (TS), Carbonate and Non-carbonate hardness, Total Hardness

(TH), Total Alkalinity (TA), Chloride, Nitrate, Fluoride Sulphate, Phosphate, Dissolved Oxygen (DO), Iron, Manganese, Total colonies per ml on agar at 37° C, NPN of Coliform bacteria per 100ml, Nature of Coliform bacteria isolated. The analyzed data were compared with standard values recommended by WHO to assess variousparameters.

1. Experimental

Groundwater samples were collected from 6 school locations of Mamsapuram region, Sampling is done at each station in polythene bottles of two-litre capacity. The samples were analyzed the various water quality parameters such as pH, electrical conductivity (EC), Total Solids (TS), Carbonate and Non-carbonate hardness, Total Hardness (TH), Total Alkalinity (TA), Chloride, Nitrate, FluorideSulphate, Phosphate, Dissolved Oxygen (DO), Iron, Manganese, Total colonies per ml on agar at 37^oC, MPN of Coliform bacteria per 100ml, Nature of Coliform bacteria isolated using standards procedures described in NEERI. The methods used for estimation of various physico - chemical and biological parameters are tabulated in Table 1.

Table – 1. Different Water Quality Parameters & estimated standard methods

S.No	Parameter	Unit	Test Method
1	pH		pH meter (Elico Make)
2	Electrical Conductivity	µs/cm	Digital conductivitymeter
3	Total Solids	mg/L	Gravimetric
4	Carbonate and Non-carbonate hardness	mg/L	EDTAtitration
5	Total Hardness	mg/L	EDTAtitration
6	Total Alkalinity	mg/L	Acidtitration
7	Chloride	mg/L	Argentometrictitration
8	Nitrate	mg/L	UV Spectrophotometric
9	Fluoride	mg/L	Selective Ion electrodeanalysis
10	Sulphate	mg/L	UV Spectrophotometric
11	Phosphate	mg/L	Ammonium molybdate blue method
12	Dissolved Oxygen	mg/L	Wrinkler's method
13	Iron	mg/L	Phenanthroline Spectrophotometric Method
14	Manganese	mg/L	Persulphate Spectrophotometric Method
15	Total colonies		Spread plate method
16	Coliform bacteria		Most probable number test

Results and Discussion

Turbidity, Colour & Odour

Turbidity is a measure of water clarity[5] how much the material suspended in water decreases the passage of light through the water that affects the transparency or light scattering of the water. It also affects the colour of the water. Since suspended particles absorb more heat therefore higher turbidity increases water temperatures. This, in turn, reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of DO. Results found within the range of 5 NTU. All the sampling site water is colorless and odorless.

pH

pH is one of the important parameters of water and determines the acidic and alkaline nature of water. The pH value of water ranged between 7.6 and 7.9. The pH of the samples was well within the prescribed WHO permissible limits 6.5 to 7.5 for drinking water

Electrical Conductivity

Electrical Conductivity (EC) has been universally accepted as a standard measure of water quality, but there is a great degree of variability in choosing the water classes on this basis. The electrical conductivity is an index of degree of mineralization. Higher EC affected the germination of crops and it may result in much reduced yield6. Higher the ionizable solids greater will be the EC. The electrical conductivity of the ground water samples range from 1590 - 2280 micro mhos/cm which exceed the WHO permissible limit 500 micro mhos/cm.

Total soilds

The total solids are important in judging the quality of water as these indicate hardness of water. The total solid range between 1100mg/l to 1600mg/l.

Hardness and Total hardness

Hardness, the most important property of water, is mainly due to the presence of carbonate, calcium and magnesium6. It is expressed as an equivalent amount of CaCO3. The hardness value is generally termed as hardness as CaCO3 or total hardness. Carbonate hardness includes only that portion of the hardness equal to the HCO3 + CO3. If the hardness exceeds alkalinity, the excess is termed as non-carbonate hardness. The carbonate hardness of the water samples ranges from　392 mg/l – 522 mg/l which exceed the maximum limit 200 mg/L prescribed by　WHO and non carbonate hardness ranges from 0 – 156 mg/l. Total hardness of water sample ranges from 392mg/l – 640mg/l which exceeds the WHO limit 500 mg/L.

Total alkalinity

Alkalinity value in water provides an idea of natural salts presents in water. In the present study the alkalinity are ranged from 416 – 576 mg/L which exceed the WHO limit 250 mg/l.

Chloride

Chloride is a major anion in potable and industrial water has no adverse effect on health, but imparts bad taste to drinking water. Chloride ions are generally more toxic than sulphate to most of the plants and are best indicator of pollution7. People accustomed to higher chloride in water are subjected to laxative effects (Fried and Combarnous, 1971). Chlorides of bore well water in the study area ranged from 172.46 to 247.94 mg/L which is below the permissible level 250 mg/L of WHO standard**.**

Nitrate

Nitrate is present in raw water and mainly it is a form of N2 compound. Nitrate is produced form chemical and fertilizer factories, matters of animals, decline vegetables, domestic and industrial discharge8. Trace amount of nitrate were found in all the sampling sites except one site which indicates presence of very less amount of organic pollutant in the study area. Nitrate content found in Sivanthi Vinayagar School is 11.4 mg/l which exceeds the permissible level 10 mg/l prescribed by WHO**.**

Fluoride ion

Ground water usually contains fluoride dissolved by geological formation. The desirable limit of Fluorides is 1-1.5 mg/l, beyond this limit the water is considered as poor quality. The fluoride values in the study area ranges from 0.06 to 0.1mg/l. The fluorides concentration in all the samples is below the WHO standard desriable limit 1.0 mg/l. Fluoride is beneficial for human beings as a trace element, this protects tooth decay and enhances bone development, but excessive exposure to fluoride in drinking-water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects9.

Sulphate

The sulphate in the water samples is trace amount.　According the WHO permissible limit 250 mg/L., low concentration in the study area is physiologically harmless. The overall concentration of sulphate in the study area is within the safe limit. Sulphates in the groundwater are usually derived from the oxidative

weathering of sulphide-bearing minerals such as pyrite (FeS_2), gypsum ($CaSO_4.2H_2O$) and anhydrite ($CaSO_4$). Jharia coals are poor in sulphur; usually contain less than 1% sulphur. However, mineral pyrite (FeS_2) is reported to occur as a secondary mineral in these coals and associated sediments[10]

Phosphate

Phosphate is one of the essential nutrients present in the water in small quantity. The phosphate in the water samples is trace amount.

Dissolved oxygen

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis. Dissolved oxygen (DO) is one of the important parameters of water and is essential to all forms of aquatic life including the organisms that break down man-made pollutants. In general, the concentration of dissolved oxygen will be the result of biological activity[11]. The Dissolved oxygen was found above WHO permissbile limit of 8.0 mg/l in sampling sites ranges from 10.0 to 20.0 mg/l which is more than the standard limit.

Iron (Fe)

Iron is the most fourth most abundant element by mass in the earth's crust. In water, it occurs mainly in ferrous or ferric state[12]. Water containing iron does not show deleterious effect on human health, its presence in drinking water is objectionable for various reasons. Excessive iron content makes the water turbid, discoloured and imparts an astringent taste to water. As per the standards set by WHO, the permissible level of iron is 1.0 mg/l. Above 1.00 mg/l of iron in drinking water is not considered to be suitable for drinking purposes. The concentrations of Iron in the present study in all the stations ranged between 0.2 and 0.05mg/L. Concentrations of Iron (Fe) in the study area showed wide variations which is within the permissible level.

Bacteriological Examination

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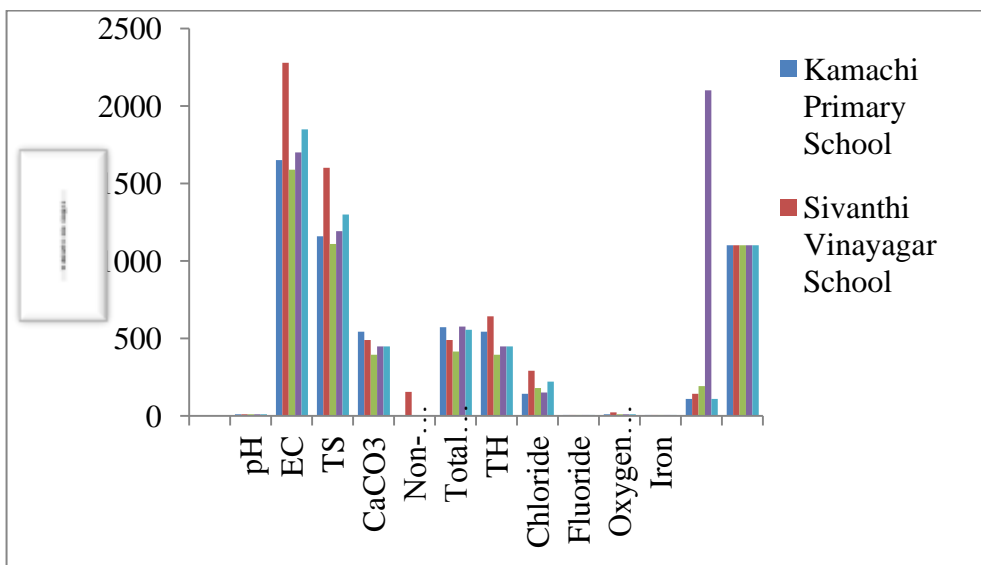

Fig.1. Water Quality parameter of ground water

Table -2.Physico-Chemical and Biological parameters of ground water at different locations

WQPs	Kamachi Primary School	Sivanthi Vinayagar School	Pasumpon Thevar High School	Ananda Primary School	Sivanthipatti Nadar School
Physical Examination					
Cololur	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	None	None	None	None	None
Turbidity	5	5	5	5	5
Chemical Examination (mg/l)					
pH	7.6	7.8	7.9	7.7	7.6
EC	1650	2280	1590	1700	1850
TS	1160	1600	1110	1190	1300
$CaCO_3$	544	488	392	448	448
Non-Carbonate	0	156	0	0	0
Total Alkalinity	572	488	416	576	556
TH	544	640	392	448	448
Chloride	140	290	180	150	220
Nitrate	Trace	Trace	Trace	Trace	Trace
Fluoride	0.6	1.0	0.6	0.8	1.0
Sulphate	Trace	Present	Present	Trace	Trace
Phosphate	Trace	Trace	Trace	Trace	Trace
Oxygen absorbed	10.0	20.0	10.0	10.0	10.0
Iron	0.2	0.2	0.05	0.05	0.05
Manganese	NIl	NIl	NIl	NIl	NIl
Total colonies	110	140	190	2100	110
NPN of Coliform	1100	1100	1100	1100	1100
Nature of Coliform	Citrobacter freundii II	Irregular II	K.Aerogenes II	E.Coli I	Citrobacter freundi II

Conclusions

Water quality is dependent on the type of the pollutant added and the nature of mineral found at particular zone of bore well. Monitoring of the water quality is done by collecting representative water samples and analysis of physico- chemical characteristics of water samples at different schools of Mamsapuram region. All the samples which are found to be satisfactory chemical quality for drinking it, but the samples should be disinfected by using BIS grade stable bleaching powder 4 grams or 20 ml of sodium hypochloride solution may be used for every 1000 litre of water for water disinfection purpose. On the basis of above discussion, it may conclude that the bore well water in all the sampling sites is highly polluted. Therefore the use of bore well water should be discouraged. People depend on this water are often porne to health hazard due to polluted drinking water. Therefore indigenous technology should be adopted to make water fit for drinking water after treatment of desalination.

Acknowledgments

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