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SCAN ME

Research Paper

A STUDY ON GROUND WATER QUALITY IN AND AROUND PERUNDURAI, ERODE DISTRICT, TAMILNADU

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Abstract

Water is one of the most valuable and precious resources on the earth. Adequate supply of potable safe water is absolutely essential and is the basic need for all human being on the earth. The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may hazardous to health. In this situation to create the environmental awareness among students and public, the study of quality of groundwater in and around Perundurai, Erode district has been undertaken. Twenty water samples were collected from twenty different locations in Perundurai, with necessary precautions. Their physico-chemical characteristics such as pH, total dissolved solids (TDS), electrical conductivity (EC), total hardness (TH), calcium (Ca^{2+}), magnesium (Mg^{2+}), chlorides (Cl^{-}), sulphates (SO_4^{2-}), sodium (Na^{+}), nitrates (No_3^{2-}), bicarbonates (HCO_3^{-}) and potassium (K), DO, BOD, COD, Total alkalinity are analysed and the result is compared with the BIS standards and WHO standards of drinking water quality.

Key words: pH, EC, TDS, Total Alkalinity.

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]. It is essential to ensure proper quality of water used for drinking and irrigation purposes. Use of inferior quality of water for drinking will adversely affect human health. In developing countries like India, most of the population use untreated groundwater for various purposes, as they do not have access to good quality water. The chemical hazards are the Calcium,

Magnesium, Nitrate etc. As the public health concern, the groundwater should be free from physical and chemical hazards. Human and ecological use of ground water depends upon ambient water quality. Groundwater is used for domestic and industrial water supply and also for irrigation purposes in all over the world [2]. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization [3]. Suitability of groundwater for drinking purposes depends upon its quality has been identified as one of the major threats to groundwater resources not only in India but throughout the world. The drinking quality of water depends on various suspended, dissolved and biological constituents. The Bureau of Indian Standards (BIS 2003) and the World Health Organization (WHO 2006) have prescribed maximum permissible limits for various dissolved ions in water used for human intake. Researchers around the world have studied the quality of water based on these standards [4]. According to WHO organization, about 80% of all the diseases in human beings are caused by water [5].

MATERIALS AND METHODS SAMPLING

AREA

Perundurai is a Town Panchayat and taluk in Erode district in the Indian state of Tamil Nadu. The total population in Perundurai is 24,930 as per the survey of census during 2011 by Indian Government. Perundurai is one of the major and fastest growing area in Erode. Textile and agriculture are main income generating business for this town. It is going to occupy an industrial special economic zone. Perundurai has a tropical climate. In winter there is much more rainfall in perundurai than in summer. The average annual temperature is 27.6 C. The normal annual rainfall is 663 mm.

GEOGRAPHY OF PERUNDURAI UNION

Perundurai is located at 11.27°N 77.58°E. It has an average elevation of 292 metres (958 feet).

WATER SAMPLING

In this study 20 water samples were collected from bore wells and hand pumps, of different places located in Perundurai is a Town Panchayat and Taluk limit. The places and sample ID's are S_1- Palapalayam, S_2 – Chinniyampalayam , S_3 – Vavikadai , S_4 – Karukkampalayam, S_5 – Kongu College, S_6- Pichandiyampalayam , S_7 – Maharaja Institutions , S_8 – Palanikattupudur, S_9- Kandhampalayam, S_{10} – Chettithoppu ,S_{11} – Vengamedu , S_{12}- Sellanagoundanpudur , S_{13} –

Chenniyamvalasu, S_{14}- Jeeva Nagar, S_{15} – Murugan Theatre S_{16} – Marudha Nagar, S_{17}- Ram Nagar, S_{18} – Perundurai Police Station, S_{19} – Majid Street, S_{20} – Ulavan Nagar.The samples were collected in polyethylene bottles which were cleaned with acid water followed by rinsing twice with distilled water. The analysis of water was done using procedure of standard methods.

RESULTS AND DISCUSSION

The water samples S_1,S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9, S_{10}, S_{12}, S_{13}, S_{14}, S_{15}, S_{16}, S_{17}, S_{18}, S_{19}, and S_{20} was collected and analyzed according to standard procedure.

Colour And Appearance

All the ground water samples were colourless, clear and odourless.

Odour

From the data all the twenty samples were found to be odourless which indicates that there is no dissolved organic substances or gases in the ground water which has been taken for this study.

Turbidity

According to BIS (10500: 2012) and WHO guidelines, the desirable limits are 1 NTU and permissible limit for turbidity is 5 NTU. All the samples had permissible turbidity level i.e 0 and 1 NTU.

Electrical Conductivity (EC)

The EC is a good indication of total dissolved solids which is a measure of salinity that affects the taste of potable water, the germination of crops and it may results in much reduced yield. The WHO permissible limit for EC in water is 600 µmhos / cm. The measured EC values for all the ground water samples are recorded within the range of 600 – 2000 µmhos/cm. In this study the minimum value was recorded as 623 µmhos / cm at sample (S3), while the higher values were found in all the other samples. The high values of EC are due to the concentration of ionic constituents present in the ground water and reflect the contribution from salinity intrusion as well as pollution by industrial and domestic wastes.

Total Dissolved Solids (TDS)

TDS in water are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chloride, phosphate, organic matter and other particles. The values of TDS for all the ground water samples vary between 300 – 1650

mg /L. The maximum allowable limit of TDS in ground water for domestic purpose is 1500 mg /L (WHO). The maximum value of 1650 mg/L is recorded at station S11 and the minimum value of 303 mg/L is recorded at station S3. According to classifications of drinking water on the basis of TDS values, among all the ground water samples Station 11 sample showed high TDS and the remaining are found to be non -saline.

pH

pH is used to determine whether a solution is acidic or alkaline. The pH values of all the samples are found to be in the range of 6.7 to 7.2. The highest value of 7.1 and 7.2 is observed at stations S3 and S4 respectively. Whereas the lowest value of 6.7 and 6.8 is observed at stations S11, S7, S9 and S13. The permissible limit of P^H for drinking water by BIS is between 6.5- 8.5, while WHO is between 7.0- 8.5. It is observed that there is no abnormal change of P^H in the ground water samples.

Total Alkalinity (TA)

Alkalinity value in water provides an idea of natural salts presents in water. As per WHO the permissible limit of alkalinity is 600 mg/L.in the present study alkalinity of water sample are ranged from 150-850 mg/L. In this study the minimum value was recorded as 158 at sample (S3), while the higher values (628 and 819 mg/L) were found at samples (S10 and S11).

Total Hardness (TH)

TH of water sample was in the range of 100 – 720 mg /L. The universal acceptable limit for TH is 500 mg/L. Hardness of water is due to the presence of salts of calcium and magnesium in the form of its carbonates, bicarbonates and chloride. The maximum value (590 and 716 mg /L) for the sample S10 and S11 respectively which shows those samples fall in the hard to very hard category. High amount of hardness gives an unpleasant taste to the water and make it unsuitable for domestic use.

Chloride (Cl^-)

Chloride a major anion in potable water has no adverse effect on health, but imparts bad taste to drinking water. The values of concentration of Cl^- ions found to zero. The maximum permissible limit of chloride in drinking water is 250 mg/L. The values of Cl^- ions for the entire sample were within the permissible limit of WHO and BIS guidelines.

Sodium (Na)

Sodium is naturally occurring (feldspars and clay minerals) elements in groundwater and also an industrial, domestic waste adds these salts to the

groundwater, making it unsuitable for domestic use. The sodium concentration more than 50 mg/l makes the water unsuitable for domestic use because it causes severe health problems like hypertension. High concentration (>250 mg/l) of Na^+ in drinking water may cause heart (cardiovascular diseases) problems, kidney problems and hypertension in human. In the present study, the concentration of Na^+ ions found to lie between 30 – 240 mg/L. It is confirmed that the values of sodium for the ground water samples are well within the permissible limit (200 mg/L) suggested by WHO except sample from Station 11.

Potassium (K)

The potassium values for the ground water samples are observed between 10 – 100 mg /L. The highest values (152 and 189 mg/L) are recorded at stations S10 & S11 respectively. The value of K for most of the samples varies far from the desirable limit of 12 mg/L. This is because of silicate weathering in the ground water but the quantities increase in the ground water due to the disposal of waste water from domestic and industrial areas.

Calcium (Ca)

Calcium may dissolve readily from carbonate rocks and limestone or be leached from soils. But calcium is an essential nutritional element for human being and aids in maintaining the structure of plant cells. In this investigation the estimated calcium values are recorded between 40 – 245 mg/L. All the samples are found within the maximum permissible limit (200 mg/L) except sample from S11.

Magnesium (Mg)

The magnesium values are recorded between 30 – 240 mg/L for the ground water samples. The highest values of magnesium (192 and 239 mg/L) were recorded for the samples S10 and S11 respectively. On comparison with WHO the remaining values are within the permissible limit (150 mg/L).

Fluoride (F^-)

The concentration of F^- ions in sample water threatens to be a potential danger when it crosses a limit of 1.5 mg/L (WHO & BIS). Excess concentration fluoride results in dental fluorosis and bone deformations. The analysis of 20 water samples showed that the F^- ions concentration for all the samples is zero except the sample at S10 and S11 (0.5 and 0.8 mg/L).

Nitrate (NO_3^-)

The acceptable nitrate range is 45 mg /L (WHO). The values varied from 0 – 1 mg /L which is far below the desirable limit. Presence of excess of nitrate more than 45 mg /L may cause serious health problem s such as Blue baby syndrome.

Sulphate (SO_4^{2-})

The sulphate values for the ground water samples are exhibited as zero value. The sulphate values for all the ground water samples are well within the permissible limit of 200 mg /L of WHO.

Phosphate (PO_4^{2-})

The value of phosphate in the ground water samples lie between 0 – 0.01 mg /L. The phosphate values are found within the permissible limit 0.1 mg /L suggested by WHO. The phosphate values for all the ground water samples do not pose any water quality problems.

Dissolved Oxygen (DO)

The Dissolved Oxygen values in the ground water samples have observed from 6 -7.5 mg /L. The concentration of Dissolved Oxygen in clean water is 8 – 10 mg /L. In this investigation, the DO is comparatively low in all the ground water samples. It indicates that the deoxygenation is due to the biological decomposition of organic matter. The dissolved oxygen is generally reduced in water due to respiration of biota, decomposition of organic matter and oxygen demanding wastes.

Chemical Oxygen Demand (COD)

COD is a measure of the oxygen required for the chemical oxidation of organic matter. The values of COD in the ground water samples found to be in the range of 2 – 3 mg /L. The COD values at all sampling stations are within the permissible limit of 10 mg /L according to the WHO.

Percent Sodium (% Na)

Sodium concentration is important in classifying irrigation water because sodium reacts with soil to reduce its permeability. Soils containing a large proportion of sodium with carbonate as the predominant anion are termed alkali soils; those with chloride or sulphate as the predominant anions are saline soils. The role of sodium in the classification of ground water for irrigation was emphasized because of the fact sodium reacts with soil and as a result of clogging of particles takes place, thereby reducing

permeability, (Todd 1980, Domenico and Schwartz 1990) The percent sodium is calculated by the equation.

$$\%Na = \frac{Na^{+} + K^{+}}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}} X\,100$$

The concentration of these ions is expressed in mille equivalents/Liter (meq /L). In the present study % Na values varied from 19.00 to 23.00 mg/L which are slightly higher than expected values. Wilcox (1948) proposed a method for rating irrigation waters based on percent sodium and electrical conductivity. The diagram consists of five distinct areas such as excellent to good, good to permissible, permissible to doubtful, doubtful to unsuitable and unsuitable. Wilcox diagram has revealed that out of 20 samples, 6 samples fall under excellent to good category, 14 samples are found to be within good to permissible category.

CONCLUSION

The ground water samples taken from the various places in Perundurai was analyzed for the various water quality parameters like P^{H} , Electrical Conductivity, Potassium, Calcium, Megnesium, Sodium, chlorides, Alkalinity, Hardness, TDS, Sulphates, Phosphates,Nitrates, DO and COD.

Most of the physico-chemical parameters measured for ground water samples were within the limits set by WHO. The study reveals that in few areas S10 and S11 water has high electrical conductivity, total dissolved solids, total alkalinity and hardness. The reason behind this may be due to urbanization, anthropogenic activities and increased human interventions in the ground water quality. Hence the water from these sources should be treated properly before it is taken for public consumption.

The bore water sample S11 is comparatively more polluted that the other stations and the ground water in this site is slightly unfit for drinking purpose. The parameters for the ground water samples S3, S18, S2, S1 and S6 showed within the water quality standards and the quality of ground water is good and it is fit for drinking purpose, remaining used for drinking after giving suitable water treatment processes.

The highest values of Potassium are recorded at stations S10 & S11 respectively. The high potassium levels in water may be due to dissolution of

potassium from rocks, salt and soil. These water sources should be treated with distillation, reverse osmosis and ion exchange methods before using for drinking and irrigation purposes. The Dissolved Oxygen value for all the samples are nearer to the minimum standard value, but this value does not have any impact for the water to use for drinking purpose.

According to this study, the ground water from in and around Perundurai is suitable for drinking purposes, agricultural utilization, and industrial purposes and generally it is not harmful to human beings.

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