Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 13, December 2019

HYDRO CHEMICAL CHARACTERISTICS IN GROUND WATER

Rekha M. M
Assistant professor, Department of Chemistry,
School of Sciences, B-II, Jain (Deemed to be University), Bangalore-560027, India.
Email Id: mm.rekha@jainuniversity.ac.in

Abstract

Groundwater samples were obtained from 50 sites in the region of Tirupur, Coimbatore District, Tirupur and Palladam, and the surrounding area. The intensive industrial farming activities and urbanization caused the aquifer to become contaminated. Water samples were obtained to analyze groundwater contamination in an area of 180 km2 and tested for essential cations and anions. Increased EC, TDS, K, and NO3 concentrations pollute most regions. For the classification of broad hydro chemical facies, the Piper trilinear diagram is used.Based on the US salinity diagram, most of the samples fall in the C3S1 region, suggesting high salinity and low sodium water, which can be used for almost all soil types with little risk of exchangeable sodium. Many tests are not appropriate for domestic purposes, and far from the quality of drinking water. PI values therefore suggest that groundwater is sufficient for irrigation.

Keywords: *Hydro geochemistry, Drinking and Irrigation, Water salinity, Tamilnadu, India.*

I. INTRODUCTION

A natural resource that is significant is groundwater. Depending on its use and consumption, it may be a renewable or a non-renewable resource. It is estimated that about one third of the world's population will use groundwater for drinking. In both urban and rural parts of India, groundwater is the principal source of domestic water supply. The most important of the numerous factors is the unavailability of potable surface water and the general belief that groundwater is purer and healthier than surface water due to the protective characteristics of the soil cover. It has been stated that groundwater quality is often measured by reference to drinking water requirements[1].

Groundwater quality is the product of all the processes and reactions that operate on the water from the moment it is diluted in the atmosphere before it is discharged by a well. Therefore it is important to evaluate the groundwater quality to observe the suitability of water for a particular use. The soil water quality issues are more severe in heavily populated and thickly developed areas with shallow groundwater tube wells. Geochemical groundwater studies offer a clearer understanding of future qualitative shifts as development progresses. The groundwater geochemistry defines the suitability of the groundwater for domestic and irrigation purposes.
Anthropogenic behaviors may change the relative contributions of the natural causes of variations and add the emission effects as well. Standard urban groundwater problems such as inadequately regulated groundwater depletion, excessive urban penetration and excessive underground contaminant load are caused by water, wastewater or solid waste disposal requirements. In some cases lateral pollution of underground shale formations occurs from stationary sources. Streams, reservoirs, drainage channels, wastewater disposal sites or stagnant ponds containing polluted water that laterally become connected to groundwater aquifers [2].
If it does, they allow the contaminant to spread through neighboring aquifers. In these cases it is recommended that wells should be located near the polluted water sources. It is important to predict the pollutants spreading to neighboring aquifers. These predictions are useful in determining the safe distance for the position of wells, or in predicting the water quality in already existing neighboring wells. There is a need for better understanding of the regulating processes and, where possible, the normal, geologically regulated baseline chemistry, for groundwater management purposes. This is especially relevant when evaluating the impacts of pollutants on ground waters. To understand the patterns and impacts of pollution on an aquifer, awareness of the natural baseline condition is important, so that enforced environmental change can be assessed with a reasonable degree of trust. Water quality control has to be successful. The key reasons why an change in the situation is difficult to achieve are high cleanup costs for effluent treatment and poor awareness among the general public [3].

II. METHODOLOGY

- **Study Area:**

The study area lies between 1110'N–1122'N latitudes and 7721'E–7750'E longitudes and is situated 50 km east of Coimbatore, Tamil Nadu, India. The total geographic area of the sample is approximately 180 km2. Tirupur region temperature ranges from 20 to 40C and receives scanty rainfall as the city lies on the leeward side of the Western Ghats mountain range. Tirupur receives 600 mm of rainfall. The Noyyal River flows across the city of Tirupur, splitting it literally into two parts [4].
Tirupur's annual rainfall is 600 mm. The Noyyal River runs through the entire town of Tirupur, effectively splitting it into two halves. Tirupur is characterized by an undulating

landscape with heights ranging from 295 to 324 m above mean sea level (MSL) and slowly sloping from west to east. It is one of the oldest textile manufacturing centers and produces 90 per cent of cotton knit wear from India. There are approximately 2,000 units manufacturing varieties of textile products.

Geologically, the region is underlined by a broad variety of peninsular gneissic system high-grade metamorphic rocks. Latest valley fills and alluvium in places weather such rocks heavily and overlain. Hornblende – biotite– gneisses is the most common type of rock in the region. Alluvial rocks, few deposits of quartz veins, and limestone deposits are also found in the region [5].

- **Materials And Methods:**

50 groundwater samples were obtained to determine the groundwater contamination. The water samples obtained in the field were analyzed in the laboratory using standard methods provided by the American Public Health Association for electrical conductivity (EC), pH, total dissolved solids (TDS), and major cations such as calcium, magnesium, sodium, potassium and anions such as bicarbonate, carbonate, chloride, nitrate and sulphate. The groundwater sites were selected to cover the whole region of the analysis and attention was given to the field where pollution is expected. The predicted pollutants in groundwater were chloride, nitrate, TDS etc. Approximately 30 per cent of the sampling locations are thus within the metropolitan area of Tirupur and the majority of the sampling locations in parts of Avinashi and Palladam taluks.

Sampling was performed using pre-cleaned containers made of polyethylene. The findings were measured according to World Health Organization drinking water quality guidelines [5].

III. RESULT AND DISCUSSION

- **Ground Water Chemistry**

Understanding the quality of groundwater is important because it is the main determinant of its suitability for drinking, domestic, agricultural and industrial purposes.

The physical and chemical parameters including statistical measures such as minimum, maximum, average, median and mode has been considered. The EC values range from 623 lS / cm with an average value of 2.118 lS / cm to 5.728 lS / cm. The groundwater pH value varies from 7.31 to 8.15, with a 7.60 average. This indicates that the study area's groundwater is predominantly alkaline in nature. TDS values range between 389 and 3572 mg / l with an average value of 1.282 mg / l [6].

- **Hydro-Chemical Facies:**

Through measuring the concentrations of significant cations and anions in the Piper trilinear diagram, the geochemical composition of groundwater can be understood. Groundwater is classified into six facies, based on chemical analysis.

ISSN: 0374-8588
Volume 21 Issue 13, December 2019

The plot shows that the groundwater samples fall within the NaCl region, mixed types of CaMgCl, CaHCO3, mixed CaNaHCO3 and NaHCO3 respectively, according to their dominance order. It is observed from the plot that alkalis (Na+ and K^+) surpass the alkaline earths (Ca^{++} and Mg^{++}) and that Cl – exceeds the other anions [7].

- **Drinking Water Quality:**

The physical and chemical specifications of groundwater experimental tests were correlated with the basic guideline values suggested for drinking and public health criteria by the World Health Organization (Table 2). The table presents the most acceptable limits and overall allowable limits with various parameters. The concentration of cations shows that 93, 34, and 6 per cent of K^+,Na, Ca^{++}. The concentrations are higher than the WHO maximum 60 per cent of the sample locations meet the norm for nitrate (NO3 –) [8].

Total dissolved solids:

In order to assess the suitability of groundwater for any reason, it is important that groundwater be graded according to its hydro chemical properties on the basis of its TDS values. The area's groundwater is fresh water for 40.3% of the sampling sites and the majority of the samples are brackish water. The study shows that only 8 percent of the sample is below TDS 500 mg / l which can be used without risk to drink [9].

Electrical Conductivity:

The electrical conductivity of groundwater in the Tirupur region is given in Table 3 and it is found that 37 percent of the samples are within the permissible limit and 45 percent of the samples fall within the not permissible limit but are of slightly low quality and only 18 percent of the sample locations can be categorized as hazardous according to the World Health Organization (WHO) standard. The dangerous content stems from the chemicals used in the study area for textile production.

Total hardness:

Groundwater classification, based on total hardness (TH) indicates that most groundwater samples fall into the group of very hard water. The hardness values range from 196 mg / l to 956 mg / l with a 460 mg / l mean. The legal permissible dose of TH is 500 mg / l for drinking purposes and the most suitable dose is 100 mg / l as per the international WHO standard. The most appropriate value for total hardness is 80–100 mg / l. Groundwater which exceeds the 300 mg / l limit is considered very difficult. Of the 62 collected, twenty-seven groundwater samples exceed the maximum allowable limit of 500 mg / l [10].

IV. CONCLUSION

The study's hydro chemical analysis reveals that the Tirupur region's groundwater is hard to very hard, in nature fresh to brackish, and alkaline. The order in which the major cations and anions abound is in the following order. That leads to groundwater type NaCl. However few groundwater samples reflect mixed types of CaMgCl, CaHCO3 and mixed types of

ISSN: 0374-8588
Volume 21 Issue 13, December 2019

CaNaHCO3. A total of 40.32 per cent of the study's groundwater reached TH's permissible cap. Approximately two thirds of the sample area's groundwater surpassed the permissible TDS cap as per the international drinking water standard. The potassium ion concentration for drinking purposes is not below the allowable limit, except in some areas. Groundwater exceeded the permissible sodium limit in one third of the study area. Nitrate ion is the most contamination hazard to groundwater in the show.

60 per cent of the study area's concentration of nitrate ions exceeds the maximum allowed consumption level. Fluoride concentration is below the permissible limit for drinking except in certain areas. Because of the medium to very high salinity hazard, more than 75 percent of the study region exceeds the maximum permissible limit for irrigation even though it has low alkalinity hazards.

V. REFERENCES

[1] K. Ramesh and L. Elango, “Groundwater quality and its suitability for domestic and agricultural use in Tondiar river basin, Tamil Nadu, India,” Environ. Monit. Assess., 2012, doi: 10.1007/s10661-011-2231-3.

[2] K. Brindha and L. Elango, “Hydrochemical characteristics of groundwater for domestic and irrigation purposes in Madhuranthakam, Tamil Nadu, India,” Earth Sci. Res. J., 2011.

[3] K. Usharani, K. Umarani, P. . Ayyasamy, K. Shanthi, and P. Lakshmanaperumalsamy, “Physico-Chemical and Bacteriological Characteristics of Noyyal River and Ground Water Quality of Perur, India,” J. Appl. Sci. Environ. Manag., 2010, doi: 10.4314/jasem.v14i2.57830.

[4] Y. Srinivas, O. D. Hudson, R. A. Stanley, and N. Chandrasekar, “Quality assessment and hydrogeochemical characteristics of groundwater in Agastheeswaram taluk, Kanyakumari district, Tamil Nadu, India,” Chinese J. Geochemistry, 2014, doi: 10.1007/s11631-014-0681-3.

[5] S. Venkatramanan, S. Y. Chung, T. Ramkumar, G. Gnanachandrasamy, and S. Vasudevan, “A multivariate statistical approaches on physicochemical characteristics of ground water in and around Nagapattinam district, Cauvery deltaic region of Tamil Nadu, India,” Earth Sci. Res. J., 2013.

[6] G. Gnanachandrasamy, T. Ramkumar, S. Venkatramanan, S. Vasudevan, S. Y. Chung, and M. Bagyaraj, “Accessing groundwater quality in lower part of Nagapattinam district, Southern India: using hydrogeochemistry and GIS interpolation techniques,” Appl. Water Sci., 2015, doi: 10.1007/s13201-014-0172-z.

[7] S. Krishna Kumar et al., “Evaluation of water quality and hydrogeochemistry of surface and groundwater, Tiruvallur District, Tamil Nadu, India,” Appl. Water Sci., 2017, doi: 10.1007/s13201-016-0447-7.

[8] A. Amalraj and A. Pius, “Assessment of groundwater quality for drinking and agricultural purposes of a few selected areas in Tamil Nadu South India: a GIS-based study,” Sustain. Water Resour. Manag., 2018, doi: 10.1007/s40899-017-0113-8.

[9] S. Kumar, D. Thirumalaivasan, N. Radhakrishnan, and S. Mathew, “Groundwater

vulnerability assessment using SINTACS model," Geomatics, Nat. Hazards Risk, 2013, doi: 10.1080/19475705.2012.732119.

[10] A. Annapoorania and A. Murugesan, "Groundwater quality assessment in coastal regions of Chennai City, Tamil Nadu, India, case study," Proc. India …, 2012.