ABSTRACT

The present study was designed to assess the nature and physico-chemical characteristic of water samples collected from in and around Puliyankannu Lake, Ranipet, Vellore Dt., Tamilnadu. The physico-chemical parameters such colour, pH, odour, Biological oxygen demand (BOD), Chemical oxygen demand (COD), Calcium, Hardness, Alkalinity, chloride, Nitrate and magnesium were studied. The results obtained showed a fluctuation in this parameter’s which gave an idea about the intensity of pollution caused by industrial and tannery effluents. In the present study revealed that the lake water was alkaline. The chloride and conductivity concentrations were high. The water quality was found to be hard which was due to excess of calcium and magnesium through surface run-off. Every parameter showed a significant correlation with increased lake water pollution. The determined physico-chemical parameters were compared with the BIS and ICMR standards for the drinking water to know about the quality of the groundwater.

Keywords: Puliyankannu lake, Vellore, groundwater, water pollution.

INTRODUCTION

Water is an essential element for life. Freshwater comprises 3% of the total water on earth. Only a small percentage (0.01%) of this freshwater is available for human use [1]. Unfortunately even this small proportion of freshwater is under immense stress due to
rapid population growth, urbanization and unsustainable consumption of water in industry and agriculture. Pollution is an undesirable change in the physical, chemical and biological characteristics of our air, land and water. That may or will affect human life or that of desirable species \(^2\). Water is the elixir of life, a precious gift of nature of mankind and millions of other species living on the earth. It is fast becoming a scare commodity in most part of the world \(^3\). Water is an essential requirement of human and industrial development and also it is one of the most delicate parts of the environment \(^4\). Water, due to its great solvent power, is constantly threatened to get polluted easily. Pollution in broad sense refers to any change which causes misbalance in the natural quality of the environment brought about through physical, chemical or biological processes. These industrial pollutants degrade ecosystem many fold; pollute the water bodies or stream, damage aquatic ecosystem, damage the soil fertility and soil subsystem. The effluent contains various inorganic and organic substances in different concentration may affect the nature and quality of Lake Water. Over burden of the population pressure, unplanned urbanization, unrestricted exploration and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water \(^5\). There are various ways as ground water is contaminated such as use of fertilizer in farming \(^6\), seepage from effluent bearing water body \(^7\). Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of ground water \(^8\). The incidence of ground water pollution is highest in urban areas where large volumes of waste are concentrated and discharge into relatively small areas \(^9\). The hydro-geochemical conditions are also responsible for causing significant variations in ground water quality \(^10\).

The requirement of water in all forms of lives, from micro organisms to man, is a serious problem today because of all water resource have been reached to point of crisis due to unplanned urbanization and industrialization \(^11\), of the total water resource of the earth, 97.3% is salt water and the rest 2.7% is fresh water. Of this, about 77.2% is permanently frozen, 22.4% occurs as ground water and soil moisture, 0.35% is found in lakes and wetlands and 0.01% in rivers and streams.

Due to migration of population, it becomes necessary for the corporation to give clean drinking water for the entire population. The effluents of the leather industries, usage of the chemical fertilizers for agriculture and small scale dying industries falls heavily on the quality of the drinking water. The impact is felt very much on the drinking water. Different
activities of man have created adverse effects on all living organisms. Today the environment has become foul, contaminated, undesirable and therefore harmful for the health of the living organisms including the man.

Besides pesticides, another group of contaminants which could jeopardize the fresh water aquatic resources include heavy metals such as Zn, Cu, Cd, Pb, Fe, Mn, Hg and Cr. Results of studies on metal in pollution are well documented revealing the toxic effects of these metals on aquatic organisms. These contaminants bring various pathological changes including tissue damages, asphyxiation, enzyme abnormalities and also behavioral abnormalities [12].

In this study, the quality of the water in open wells and the bore wells located on the bank of the Pulliyankannu lake was studied by determining the physico-chemical parameters of the water during the south-west monsoon season (June to September). These studies generate a baseline regarding the quality of the water which is used for agriculture and other household purposes. In the present study to carry out qualitative analysis of physico-chemical parameters of ground water in the study area.

MATERIALS AND METHODS

Study area

The water samples were collected from Pulliyankannu Lake, Ranipet, Vellore Dt., and Tamilnadu. Ranipet is an industrial town in Chennai – Bangalore highway 130 kms away from Chennai. The present investigation was to estimate the mineral content of the contaminant water area in an around Ranipet (lake).

Sample collection

The samples which were used extensively for agricultural purposes were identified. The lake water samples collected from one locations using spot sampling procedure. The samples were collected in the pre-cleaned polythene bottles with necessary precautions.

Analysis

The pH, temperatures, conductivity and total dissolved solids of the samples were noted at their sampling point itself. The samples were subjected to the physical and chemical tests. These include hardness, total dissolved solids and chlorides. Standard procedure involving volumetric was used for the experiment. Salinity was calculated for the samples collected.
The results were compared to ICMR standards. Dissolved oxygen was fixed immediately after collection and then determined by Winkler’s method. Nutrients (NH4+, NO3, and PO43) were determined by standard photometric method using Varian 50 Bio U.V visible spectrophotometer. Samples for BOD were incubated in laboratory for five days at 20°C. Turbidity was measured by Nephelometer using 0.02 NTU standards. Total hardness was estimated by the complex metric titration with standard EDTA solution using Eriochrome Black T as indicator. Whatman 541 filter papers were used for the determination of TSS and TDS methods [13].

RESULTS AND DISCUSSION

The collected samples were analyzed for different physico-chemical parameters such as pH, Turbidity, BOD, TDS, Total hardness, colour, odour, alkalinity, chloride, nitrate, calcium, and magnesium as per the standard methods and the results were compared with the Indian Standards (IS: 10500) for potable water. The results are presented in the (Table: 1)

The physico-chemical characteristics of effluent treated water were compared with the Indian Standard Specification for Drinking Water. The colour of the effluent treated water was greenish and brownish. The Sample collected from the effluent discharged water storage lake was found to have unobjectionable odour on prolong stay it gave foul smell; this may be due to organic waste from tanneries and chemical industries.

Our water analysis’s primary concern with the contaminated lake water analyzed with the drinking water specification: IS: 10500, 1992 and any adverse effects may affect the health. The physico chemical parameters of the contaminated lake water were analyzed by standard procedures.

PHYSICO-CHEMICAL PARAMETER

Colour
The contaminated lake water was slightly greenish in colour.

Odour
The odour of contaminated lake water was objectionable.

pH
The pH of the lake water sample is 7.19. The pH value of the lake water sample is under the normal range when compared with the drinking water standard (1993). Higher pH values of
studied lake water during summer could be ascribed to increased photo synthetic assimilation of dissolved inorganic carbon by planktons. The amount of acid in water 7.0 is neutral; Ph values below 6.5 may result in corrosive water; values above 7.5 may indicate hard water. pH is defined as the negative logarithm of the effective hydrogen-ion concentration. The normal pH range for drinking water is 6.5-8.5; lake water sample has a pH of 7.19 which falls under the normal range. A high pH will affect the mucous membrane. Water below 6.8 is beyond slightly acidic and approaching extremely corrosive (4.0-5.9). Evidence of this condition is green stains on sinks and porcelain fixtures. Obviously, any water this corrosive will be damaging to your pipes, fixtures and especially when heated by the hot water heater and becomes more aggressive. Water with a pH above 7.2 will leave deposits such as calcium and magnesium that will, over time, clog the pipes.

**Biological Oxygen Demand (BOD)**

BOD is a value of presence of organic materials in water which can support increasing of microbe organisms. Surface water (river, lake) containing BOD values 10 mgL-1 are consider being moderately and more than 20 mgL-1 as to be highly polluted water. The greater the decomposable matter present, greater the oxygen demands and greater the BOD values. The biological oxygen demand of the lake water is 50mg/l. The lake water has high BOD level when compared to the drinking water standard, would therefore be easy to deplete the oxygen content if any material were present which would react with oxygen. The material could be organic as well as inorganic. Typical natural water has a BOD from 30 mg/l. Thus a high content of BOD in sample (50 mg/l) shows high organic and inorganic waste materials that require oxygen for oxidation. This shows the seepage of organic and inorganic waste materials from the effluent into nearby lake water.

**Chemical Oxygen Demand (COD)**

The maximum permissible value of COD is 10 mgL-1 for drinking water the chemical oxygen demand of the normal drinking water standard is 250mg/l in comparison the lake water contain a high level of COD (300mg/l). COD can be applied for rapid analysis of heavily polluted samples. According to the general standards for discharge of environmental pollutions the cod level is 250 mg/l. The lake water level has a COD range (300 mg/l). Increased level of COD in sample shows the higher level of contamination.
Alkalinity
The total alkalinity of the contaminated water was noted that 600mg/l thus the total alkalinity is very high in the lake water sample. Alkalinity for a standard drinking water is 200mg/l. in the lake water the alkalinity is 600 mg/l. It Indicates the presence of bicarbonates, carbonates and hydroxides Above the normal value the water taste becomes unpleasant high alkalinity should be corrected for both economic and health concerns. Measure of alkalinity is useful in water treatment, softening and control of corrosion.

Hardness
The total hardness of calcium carbonate in the water sample is 600mg/l, the normal value is 300mg/l. hard water is arbitrary, the Indian Geological survey uses the following classification: 1-60 mg/l is considered moderately hard, 121-180 mg/l is considered hard, and above 180g/l is considered very hard. Total Hardness (CaC03 - calcium carbonate) “Hardness” refers to the amount of calcium and magnesium in the water and is measured in grains per gallon. Hard water consumes soap before lather will form and Creates scale in boilers, water heaters, and pipes.

Chloride
Higher concentration of chloride in water is often found in combination with higher sodium concentration. ICMR and BIS have prescribed 250 mg/l as the maximum permissible value. If the chlorine value exceeds 300 mg/l and the presence of a major cation is sodium, then the water becomes salty. Sources of chlorides are from soluble salts such as sodium chloride. The chloride content of the lake water showed a high level of 318mg/l. The high level of chlorine beyond 250mg/l affects the taste, palatability and corrosive effect of water. When combined with sodium, gives salty taste to drinking water and may increase the corrosiveness of water.

Nitrate
In general, increase downstream the pollution input gives a sufficient indication of the deteriorating quality of water due to entry of wastewater in river. The total concentration of nitrate is 45mg/l. The desirable amount of nitrate in drinking water standard is also 45mg/l. High concentrations of nitrate suggest pollution. Some animals such as ruminants (cud chewers) can be poisoned by nitrate if the concentration is high. High level of Nitrate encourages growth of algae and other organisms. Nitrates are one of the major inorganic salts regulating the productivity of phytoplankton. The tolerance limit for the nitrate is 45mg/l
beyond this causes methanemoglobinemia. Infants below the age of six months who drink water containing nitrate in excess could become seriously ill and if untreated may die. Symptoms include shortness of breath and blue-baby syndrome.

**Calcium**

Magnesium as co factor for various enzymatic transformations within the cell especially in the trans-phosphorylation in algal, fungal and bacterial cell the normal concentration of calcium according to the drinking water standards is 75mg/l. The concentration of contaminated lake water is 200mg/l. thus the level of calcium is found to be very high which contributes to the hardness of water. Calcium is an important content in natural water which determines the rigidity of water. The Indian Standard for Drinking Water Specification stated the tolerance limit of calcium as 75mg/l. The high level of calcium in the lake water results in Encrustation in water supply structure and adverse effects on domestic use.

**Magnesium**

Magnesium as co factor for various enzymatic transformations within the cell especially in the trans-phosphorylation in algal, fungal and bacterial cell [14]. The level of magnesium in the contaminated lake water is 150mg/l. the contaminated lake water has high level of magnesium when compared with the drinking water standards (30mg/l). Magnesium is one of the main constituent in natural water and it’s an important contributor for hardness of water. Thus the presence of high level of calcium and magnesium indicate the contamination of lake water which contributes to the hardness of water. Most of the hardness and scale-forming properties of water which for example, consume soap; water low in calcium and magnesium is desirable in the electroplating, tanning, dyeing and textile manufacturing industries as well as for boiler use.

**Table.1: Analysis of Physiochemical parameters in lake water of Pulliyakanu village.**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameters</th>
<th>Drinking water standard</th>
<th>Effluent contaminated lake water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Colour</td>
<td>clear</td>
<td>Green-brownish yellow</td>
</tr>
<tr>
<td>2.</td>
<td>Odour</td>
<td>unobjectionable</td>
<td>unobjectionable</td>
</tr>
<tr>
<td>3.</td>
<td>pH</td>
<td>6.5-8.5</td>
<td>7.19</td>
</tr>
<tr>
<td>4.</td>
<td>BOD</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>
5. COD 250 300
6. Alkalinity 200 600
7. Hardness 300 600
8. Chloride 250 318
9. Nitrate 45 45
10. Calcium 75 200
11. Magnesium 30 150

Results of chemical examination expressed in mg/l except pH. BOD- Biological oxygen demand; COD- chemical oxygen demand.

CONCLUSION
The underground water is deteriorating in Vellore and the sampling station Pulliyankannu lake needs special attention, as all the parameters such as TDS, chloride, hardness and salinity is found high. Polluted water could cause much disease to human being. It may cause laxative effects on health of the people consuming that water and it is not much suitable for irrigation purpose also. So we Special care should be taken to keep clean water.

REFERENCES


