Analysis of Pollution Trends in Subsurface Water At Poovanthuruth, Kottayam

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***Abstract*— Water is one of the essential requirements of all livelihoods. Humans need water in many daily activities like drinking, washing, bathing, cooking, etc. If the quality of water is not good, then it becomes unfit for drinking and other activities. A water quality audit is a study of an entity. It starts when water enters the premises and goes up to the point where wastewater is discharged, critically examining all aspects of use. A water audit is an effective management tool for minimizing losses, optimizing various services, and enabling considerable water conservation. Drinking water safety and security is of high importance as it affects public health and economic life. These audits are an essential way for checking how the water quality is performing and ensuring that the drinking water regulations have complied. This audit recommends how to reduce the wastage as well as consumption of water. This paper focuses on understanding the quality of water.**

Keywords:-Water quality, audit, hardness, alkalinity, pH.

I. INTRODUCTION

Water is the source of life, and its security and safety are of paramount importance. Clean and safe water is an absolute need for a healthy and productive life. The quality of the water supply is vital in determining the health of individuals and whole communities. The rates of these water bodies vary widely depending on the location and environmental factors. The safety of drinking water is today one of the most critical issues since various hazards can threaten public health. The World Health Organization has recorded 27 different waterborne diseases and other water-related hazards. The safety of drinking water is increasingly recognized as a challenge. Contaminated water can cause epidemics, interrupt economic life, and create massive panic.

Water quality audit is an effective management tool for minimizing losses, optimizing various uses, and thus enabling considerable conservation of water not in the irrigation sector alone but other sectors of water use such as domestic, power, and industrial as well. The quality of water is described according to its physical, chemical, and biological characteristics. It is, therefore, to check the water quality at regular intervals of time. Parameters that may be tested include pH, Temperature, Turbidity, TDS, Total Hardness, Chloride, Total alkalinity etc. Water quality auditing is an analytical technique that quantifies water usage and quality while simultaneously allowing for an investigation into the behavior aspects of water management. Water quality audit is an important management tool for effective conservation of water.

The site selected for this study is Poovanthuruth, Kottayam district. There are small-scale industries located at Poovanthuruth. The effluents discharged from the industries contaminate the well water. Therefore the water is not suitable for drinking purposes. So this study focuses on the quality of drinking water from the well of surrounding houses(near the industrial area) at Poovanthuruth. It is, therefore, to check the water quality at regular intervals of time. The quality of water from the wells has significant importance because it is generally used for several purposes such as drinking, domestic, and residential water supplies. The quality of this water mainly depends on numerous interconnected parameters with a local and temporal variation which are influenced by the water flow rate throughout the year [4]. Organic and inorganic pollutants have been routinely detected at unsafe levels in groundwater, rendering this important drinking water resource practically unusable [5]. A proactive approach is needed to prevent human health and ecological consequences from ingestion of contaminated groundwater.

II. LITERATURE REVIEW

The groundwater quality parameters in the surrounding wells of Jawaharnagar, in the upper Musi catchment area of Ranga Reddy district in Andhra Pradesh was studied. [1] The bore wells data was collected from the study area for two seasons, i.e., post-monsoon in December 2007 and pre-monsoon in June 2008. The groundwater was acidic and very hard. It is done by using Arc GIS software. The study reveals that the concentrations of major constituents are well within the permissible limits of IS-10500-1994, except in few cases where total hardness and fluoride concentrations are high. The fluoride concentration exceeded the permissible limit. From the analysis, it was observed that the groundwater is polluted in the entire study area. During the last few years, the utilization of surface and groundwater for drinking, manifolds, but consequently it is observed that the water is polluted and affecting the human health, soil nutrients, livestock, biomass and environment in certain areas.

The Water Quality Index(WQI) has been calculated for different surface water resources, especially lakes, in Nagpur city, Maharashtra (India), for the session January to December 2008; comprising of three seasons, summer, winter and rainy season. [2] Sampling points were selected based on their importance. The water quality index was

calculated using the water quality index calculator given by National Sanitation Foundation (NSF) information system. The WQI for various lakes, showed fair water quality in the monsoon season, which then changed to medium in winter, and for poor for the summer season. Gorewada Lake showed a medium water quality rating in all seasons except monsoon season. So the reason to import water quality change and measures to be taken up in terms of surface water (lakes) quality management are required.

A study of water quality planning and management alternatives for the Great Lakes that are used to identify cost-effective pollution control strategies.[3] Mathematical models and other systems analysis techniques are applied to estimate pollution loadings, specific water quality problem areas, costs, and pollutant reductions offered through alternative management strategies. A determination of how these alternatives may be expected to achieve water quality objectives for the Great Lakes is made. Data from a diversity of Great Lakes research efforts are compiled, integrated, and used to project local and lake-wide water quality conditions over the next twenty years. Findings from the study support a staged approach to pollution control, whereby the most cost-effective programs are implemented and their results assessed before more expensive control measures are undertaken.

III. METHODOLOGY

Water quality audit of an existing system is carried out from source to tap in SMC areas. A cross-sectional study was carried out for drinking water quality audits using simple random sampling for sample collection at Poovanthuruth, Kottayam. Total of five samples from the well of surrounding houses was analyzed.

A. Steps of Water Audit

- Water Supply and usage :-
  A study of the availability of water sources and post-consumption patterns for various sectors is necessary to understand the present water utilization and projecting future requirements—the survey which gives the availability of good quality water and previous water quality details also.
- Process Study :-
  The water quality of the distribution system needs to be monitored regularly at strategic points to determine the level and nature of contaminants present in the water. Depending on the types of application and degree of purity needed, the treatment system can be designed and developed.
- System Audit:-
  The current water usage and quality can be studied to check their efficiency and purity of water. The scope for any modification or up-gradation will depend on the status of the existing system.
- Discharge Analysis:-
  The domestic wastewater, effluents from industries need to be studied for conformity to environmental standards, the possibility of recovery of valuable by-products, and the opportunity to recycle waste water.
- Water Audit Report:-
  Adequate planning and standard procedures are necessary before undertake the water audit of a system. It can be accomplished based on the water allowed for service and water utilized for that service.

B. Water Quality Monitoring Procedure

- Identify the location
- Preliminary site survey
- Select
  a)Operational Surveillances
  b)Trend Monitoring
  c)Or Both
- To identify the local facilities to carry out the water quality test.
- Carry Out Data Processing to:
  a)Alert To pollution incidents (Operational Surveillance)
  b)Update database to provide management information (Trend Monitoring)

C. Assessment of Water Quality

Water quality is determined by assessing three classes of attributes: biological, physical, and chemical. There are standards of water quality set for each of these three classes of attributes. The chemical attributes of a waterway can be important indicators of water quality. Nowadays, the increase in industrial wastewater in this place is discharged significantly contributed to the pollution of the surface and sub-surface water. The aim of the present study was to assess the water quality of sub-surface water in Poovanthuruth, Kottayam, for drinking purposes. For the assessment of water pollution status of the water bodies, the following water quality parameters were analyzed:

- pH:-
  pH is an important parameter of water quality. It determines the suitability of water for various purposes such as drinking, cooking, washing, etc., The desirable limit of the pH level of water is 6.5 to 8.5 as per **B**ureau of **I**ndian **S**tandards (BIS). The pH of water on a scale of 0 to 14 measures the concentration of hydrogen ions. Pure distilled water is considered neutral with a pH reading of 7. Water is basic. If pH is greater than 7, water with pH of less than 7 is considered acidic [6].
- Electrical Conductivity:-
  Conductivity is the numerical expression of the ability of an aqueous solution to carry an electric current [7]. It is directly related to the concentration of ionized substances in water and may also be related to problems of excessive hardness. According to BIS, the permissible limit of conductivity is 600 micrometer/ Cm. The abi;it depends upon the presence of ions, total concentration, mobility, relative concentrations, and on the temperature of measurement.

- Temperature:-

  Temperature is critical water quality and environmental parameter because it regulates the maximum dissolved oxygen concentration of the water and influences the rate of chemical and biological reaction. It is measured using a digital thermometer. The thermometer is immersed in water samples collected from the well of surrounding houses, and temperature is recorded. It plays vital role in water chemistry. The rate of chemical reactions generally increases at a higher temperature. Water, particularly groundwater, with higher temperatures can dissolve more minerals from the rocks. Therefore, it will have a higher electrical conductivity. Temperature exerts a major influence on biological activity and growth. The efficiency of coagulation is strongly temperature-dependent, and the optimum pH for coagulation decreases as temperature increases.

- Total Dissolved Solids(TDS):-

  Total Dissolved Solids (TDS) are made up of inorganic salts (mainly sodium chloride, calcium, magnesium, and potassium) and small amounts of organic matter dissolved in water. There are areas of the world that have naturally high amounts of TDS in their drinking water. TDS in drinking water comes from natural sources, sewage, urban runoff, and industrial wastewater. According to BIS, the desirable limit of TDS within 500 mg/L. Drinking water with a high concentration of total dissolved solids will not make people sick. Although there are no immediate health concerns, TDs concentrations greater than 1200 mg/l (e.g., brackish or saline water) cause a bitter or salty taste. Some people can taste salt in drinking water at levels around 500 mg/l, and it may cause them not to use it and choose another, possibly contaminated, water source instead. Water with extremely low TDS concentrations (e.g., rainwater) may also be unacceptable because of its flat taste. The presence of chemicals (such as calcium and magnesium ions) gives water the ability to conduct electricity. Thus electrical conductivity of water is an indirect measure of dissolved chemicals. TDS of all water samples were found to lie within the desirable limit specified by the IS:10500-2012.

- Total Alkalinity:-

  Alkalinity is the capacity of water to resist acidification. The maximum permissible limit is 600 mg/L. Excessive alkalinity may cause eye irritation in humans and chlorosis in plants. Alkalinity can be estimated by titrating with standard hydrochloric acid (0.02N) at room temperature using a methyl orange indicator. The color changes from yellow to orange.The standard desirable limit of alkalinity of potable water is 120 mg/L. Excessive alkalinity may cause eye irritation in humans and chlorosis in plants.

- Total Hardness:-

  The desirable limit of total hardness value for drinking water is to be within 300 mg/L of $CaCO_3$.A higher concentration of hardness was found due to the natural accumulation of salt, or surface runoff; water enters from direct pollution by human activities.

- Chloride:-

  Chloride is one of the important parameters of water quality assessment. It can be an indicator of pollution. A high concentration of chloride leads to corrosion in the distribution system. Chloride in drinking water comes from sewage, industrial effluents..etc. If the test is done regularly on a water supply and there is a sudden increase, it may indicate pollution due to the ingress of sewage or other chloride-rich wastes. Many groundwaters have chloride content high enough to be of objectionable taste. By using the chloride test, the well with the lowest amount of chloride content can be identified. If several wells are being pumped, it can be planned so that the lowest amount of chloride content is obtained.The desirable limit of chloride in drinking water is 250 mg/L as specified by the BIS.

- Turbidity:-

  Turbidity is the suspension of particles in water interfering with passage of light [8]. The nephelometer instrument measures the intensity of scattered light by turbid particles at the right angle to the incident beam of light compared to the intensity of light passing through the sample. Scattering of light is a function of the Tyndall effect exhibited by colloidal suspended particles. The maximum permissible level is 5 NTU(**N**ephelometric **T**urbidity **U**nits). Turbid waters are undesirable from an aesthetic point of view in drinking water supplies and may also affect products in industries. Turbid water also poses several problems in the water treatment plant.

VI.RESULT AND DISCUSSIONS

Changes in water quality are reflected in its physical, chemical, and biological conditions. It is essential to assess and compare the water quality parameters of drinking water from the wells of surrounding houses (near the industrial area) at the Poovanthuruth, Kottayam. From the preliminary site survey, it's understood that the main causes of deterioration in water quality might be due to the discharge of industrial waste.

Table: 1 water quality analysis

Parameters	Samples at different locations					Limits as per IS:10500-2012
	1	*2*	*3*	*4*	*5*	
Temperature	25	25	25	25	25	25°C
Turbidity	0	0	0	0	0	10 NTU
pH	5	5.9	5.4	5.9	5.5	6.5 - 8.5
Conductivity x 10^3	0.2	0.2	73	99	0.3	1476µS
Total Dissolved Solids	287	216	145	230	340	500 mg/L
Alkalinity	8	40	8	16	12	200 mg/l as $CaCO_3$
Total Hardness	62	8	4	2	132	300 mg/l as $CaCO_3$
Chloride	22	12	8	14	22	250 mg/l as Cl

Five samples were collected from the several wells of surrounding houses near the Rubber factory at Poovanthuruth, Kottayam and analyzed the water quality parameters. From the analysis of water samples, indicates that the water is unfit for drinking purposes. Drinking water quality parameters of all water samples are within the permissible limit, except pH. The pH of all water samples was less than 7, so the water is considered acidic. According to BIS, the permissible limit of the pH level of water is 6.5 – 8.5.

Often, acidic water is due to industrial pollution, with low pH. Acidic water has a pH of 6.5 or less and can be caused by natural phenomena and industrial pollution. Due to the industrial effluents, the water becomes unfit for drinking purposes. The effluent from latex rubber processing industries is acidic. Different extents of acid usage in the different industries attribute to the pH variation of different effluents. Due to acid in latex coagulation, the effluent discharged from the rubber industries is acidic. The effluent comprises mainly carbonaceous organic materials, nitrogen, and sulfate. The quantity of acid used for Coagulation of the latex, specifically in skim latex after centrifugation operation, is generally higher than the actual requirement.

From the analysis, the highest value of conductivity was observed in samples 3 &4, which indicates the high dissolved solids in sub-surface waters. Drinking water can have a range of conductivity of 1500 mm/cm. The conductivity qualitatively measures the extent of mineralization. Higher mineralization impacts bad taste in the water.

The study of pollution trends in sub-surface water shows that the well water is unfit for drinking purposes. The water pollutants must be removed by proper water treatment. After the treatment, these well waters can be used for drinking purposes. This study and analysis clearly indicates that drinking water safety is increasingly recognized as a challenge—all other water quality parameters of five water samples within the permissible limit as specified by the IS:10500-2012.

IV. CONCLUSION

Sub-surface water is the most important source of water supply for drinking purposes. Increasing population and its necessities have to lead to the deterioration of the surface and sub-surface water. The cause of sub-surface water gets pollute and creates health problems. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source. Therefore it becomes imperative to regularly monitor the quality of groundwater and to devise ways and means to protect it. So before using of water, investigate the qualitative analysis of some Physico-chemical parameters of water.

From the analysis of water samples collected from the well of surrounding houses (near the industrial area) at Poovanthuruth, the study showed that the well waters are unfit for drinking purposes without proper treatment if the parameter exceeds the desirable limits as per IS:10500-2012.

The data obtained from the water quality analysis of water samples were within natural standards and BIS guidelines. However, pH was not at a satisfactory level. The study showed that the water is to be acidic. From the study, it was observed that the water was not safe for drinking without proper purification. Therefore, it is very essential and important to test the quality of water before it is used for drinking, domestic and agricultural purposes. This study concludes that the water samples from the Poovanthuruth need proper purification before it is used for drinking otherwise it is not safe for use.

V. REFERENCES

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