DETERMINATION OF WATER QUALITY PARAMETERS

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Submitted By

SHALI S	**23519101014**
SURYA P	**23519101015**
ABHISHEK S	**23519101016**

DEPARTMENT OF CHEMISTRY

BISHOP MOORE COLLEGE, MAVELIKARA

CERTIFICATE

This is to certify that the dissertation bound here with is an authentic record of the project work entitled "DETERMINATION OF WATER QUALITY PARAMETERS" carried out by SHALI S, SURYA P AND ABHISHEK S under my supervision in partial fulfilment of the requirement for the award of the Degree of Bachelor of Science of University of Kerala and further that no part thereof has been presented before for any other degree.

Counter signed by

Ms. Siji K. Mary

Head of the Department of Chemistry

Bishop Moore College, Mavelikara

Dr. Tressia Alias Princy Paulose

Assistant Professor

Bishop Moore College, Mavelikara

DECLARATION

We hereby declare that the dissertation entitled 'DETERMINATION OF WATER QUALITY PARAMETERS' is the original project work carried out by me under the supervision of Dr. Tressia Alias Princy Paulose, Assistant Professor, Department of Chemistry, Bishop Moore College, Mavelikara, and it has not previously formed the basis of award of another degree, diploma, or other title.

SHALI S

SURYA P

ABHISHEK S

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Shali S

Surya P

Abhishek S

ABSTRACT

Water is considered as one of the most important factors in shaping the land and regulating the climate. Water can profoundly influence life. The quality of water is usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water borne diseases. It is therefore necessary to check the water quality at regular intervals of time. In this study we checked parameters like pH, Conductivity, Total Dissolved Solids (TDS) and Total Hardness of water collected from different areas of Mavelikara Taluk.

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CHAPTER - 1

INTRODUCTION

INTRODUCTION

1.1. WATER

Water is a substance composed of the chemical elements hydrogen and oxygen and existing in gaseous, liquid, and solid states. It is one of the most plentiful and essential of compounds. It is a tasteless and odourless liquid at room temperature. It has the important ability to dissolve many other substances. Water is an excellent solvent because of its polarity and high dielectric constant. Polar and ionic substances dissolve well in water, including acids, alcohols, and many salts. Water is amphoteric. In other words, it can act as both an acid and as a base. The molar mass of water is 18.01528 g/mol. The boiling point of water is 99.98 degrees C (211.96 degrees F; 373.13 K).The melting point of water is 0 degrees C (32.00 degrees F; 273.15 K)

1.2 WATER QUALITY

Water quality describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose such as drinking or swimming, collecting a water sample. Water quality is measured by several factors, such as the concentration of dissolved oxygen, bacteria levels, the amount of salt (or salinity), or the amount of material suspended in the water (turbidity). In some bodies of water, the concentration of microscopic algae and quantities of pesticides, herbicides, heavy metals, and other contaminants may also be measured to determine water quality.

Having safe drinking water and basic sanitation is a human need and right for every man, woman and child. People need clean water and sanitation to maintain their health and dignity. Having better water and sanitation is essential in breaking the cycle of poverty since it improves people's health, strength to work, and ability to go to school. Yet 884 million people around the world live without improved drinking water and 2.5 billion people still lack access to improved sanitation, including 1.2 billion who do not have a simple latrine at all. Many of these people are among those hardest to reach: families living in remote rural areas and urban slums, families displaced by war and famine and families living in the poverty-disease trap, for which improved sanitation and drinking water could offer a way out.

1.3. DRINKING WATER QUALITY

Drinking water quality standards describes the quality parameters set for drinking water. Despite the truth that every human on this planet needs drinking water to survive and that water may contain many harmful constituents. There are no universally recognized and accepted international standards for drinking water.

We find our drinking water from different places depending on where we live in the world. Three sources that are used to collect drinking water are:

1. Ground water -Water that fills the spaces between rocks and soil making an aquifer, ground water depth and quality varies from place to place. About half of the world's drinking water comes from the ground.

2. Surface water- Water that is collected from a stream, river, lake, pond, spring or a single source is termed as surface water. Surface water quality is generally unsafe to drink without treatment.

3. Rainwater-Water that is collected and stored using a roof top, ground surface or rock catchment. The quality of rainwater collected from a roof surface is usually better than a ground surface or rock catchment.

Water is in continuous movement on, above and below the surface of the earth as water is recycled through the earth; it picks up many things along its path. Water quality will vary from place to place, with the seasons, and with various kinds of rocks and soil which it moves through. Even though water may be clear, it does not necessarily mean that it is safe for us to drink. It is important for us to judge the safety of water by taking the following three qualities into consideration.

1. Microbiological-bacteria, viruses, protozoa and worms.

2. Chemical-minerals, metals and chemicals.

3. Physical-temperature, color, smell, taste and turbidity.

Safe drinking water should have the following microbial, chemical and physical qualities:

- Free of pathogens
- Low in concentrations of toxic chemicals
- Tasteless and colorless
- Clear

When considering drinking water quality, in most cases microbiological contamination is the main concern since it is responsible for the majority of illness and deaths related to drinking unsafe water.

1.4. PARAMETERS OF THE QUALITY ANALYSIS

Mainly pH, conductance, TDS, hardness and dissolved chlorine are determined for checking the quality of water. The principles of these parameters are given below:

1.4.1. CONDUCTANCE:

Conductance is the expression of the ease of the passing of the electrons. Specific conductance is given for most analyses and was determined by means of a conductance bridge and using a standard potassium chloride solution as a reference. Conductivity is a numerical expression of the tendency of an aqueous solution to carry an electric current.

An expression of how easily an ion flows across a membrane either through active pumps located in the membrane of ion channels; when specific ion channels open, conductance (g) for that ion increases. Electricity is conducted through an electrolytic solution due to the movement of ions. In general, the greater the number of ions in the solution greater is the conductance. The conductivity of electrolytic solutions is governed by the following factors.

1. Interionic attraction
2. Solvation of ions
3. The viscosity of the solvent
4. Temperature

1.4.2. pH

pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. pH of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water. Water that has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic. Since pH can be affected by chemicals in the water, pH is an important indicator of water that is changing chemically. pH is reported in "logarithmic units". Each number represents a 10-fold change in the acidity/basicity of the water. Water with a pH of five is ten times more acidic than water having a pH of six.

1.4.3. DISSOLVED CHLORINE

The presence of chlorine water is an indicator of germfree water. The presence of dissolved chlorine is detected by using silver nitrate solution.

1.4.4. TDS

TDS Total dissolved solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substances present in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form. TDS concentrations are often reported in parts per million (ppm). Water TDS concentrations can be determined using a digital meter.

Knowing the amount of total dissolved solids (TDS) in water is one of the important requirements that helps determine the efficiency of a particular water treatment device in removing bacteria or unwanted elements in the water.

1.4.5. HARDNESS

There are two types of hardness – temporary hardness and permanent hardness. Temporary hardness is also called 'Carbonate hardness'. This type of hardness refers to the calcium and magnesium carbonates and bicarbonates in the water. Heating the water or reacting it with lime removes this hardness. Permanent hardness is also referred to as ‘non-carbonate hardness. It is the hardness due to the presence of calcium or magnesium sulfates, chlorides and nitrates. For example, calcium sulfate, magnesium chloride etc. The addition of lime and soda ash removes permanent hardness. The amount of lime needed depends on the chemical composition of the water. Excess lime must be added when the magnesium hardness is high.

CHAPTER – 2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

William E Dobbins[1] studied BOD and oxygen relationship in streams.The equations of Streeter and Phelps for the BOD and dissolved-oxygen profiles along a natural stream are extended to take into account the effects of longitudinal dispersion, removal of BOD by sedimentation, addition of BOD along the path of flow, removal of oxygen by plant respiration and by the oxygen demand of benthal deposits, and the addition of oxygen by photosynthesis. Methods by which various coefficients in the equations might be evaluated from theory or from field measurements are examined. The effect of longitudinal dispersion on the BOD and dissolved-oxygen profiles is shown to be negligible in most fresh water streams. A theory of reaeration, based on the random replacement of the interfacial liquid-film, is presented. It is proposed that the micro-scale portion of the turbulent energy spectrum principally is responsible for the film replacement on which reaeration depends. Theoretical values of the reaeration coefficient are in good agreement with values reported in the literature.

Donald J O'Connor [2] studied the temporal and spatial distribution of dissolved oxygen in streams. The geophysical characteristics of the drainage basin and the biochemical and physical environment of the river affect the concentration of dissolved oxygen. These factors are embodied in the fundamental equation of continuity that describes the oxygen balance. The variation of the fresh-water flow and cross-sectional area is included, as well as the various sources and sinks of oxygen: natural and artificial aeration, the photosynthetic contribution, bacterial and algae respiration, carbonaceous and nitrogenous oxidation, and benthal deposits. Application of the basic equation is summarized by two general cases: the first in which bacterial respiration and spatial profiles are significant and the second in which the algae activity and the temporal changes are predominant. The equations provide technological functions for these cases to assess water quality and pollution and to determine the effect of many natural or artificial changes in the stream environment.

Robert R Lane et al [3] studied Water quality analysis of a freshwater diversion at Caernarvon, Louisiana. Mississippi River water has been diverted at Caernarvon, Louisiana, into Breton Sound estuary. Breton Sound estuary encompasses 1100 km2 of fresh and brackish, rapidly subsiding wetlands. Nitrite + nitrate, total Kjeldahl nitrogen, ammonium, total phosphorus, total suspended sediments, and salinity concentrations were monitored at seven locations in Breton Sound from 1988 to 1994. Statistical analysis of the data indicated decreased total Kjeldahl nitrogen with associated decrease in total nitrogen, and decreased salinity concentrations in the estuary due to the diversion. Spring and summer water quality transects indicated rapid reduction of nitrite + nitrate and total suspended sediment concentration as diverted Mississippi River water entered the estuary, suggesting near complete assimilation of these constituents by the ecosystem. Loading rates of nitrite + nitrate (5.6–13.4 g m−2 yr−1), total nitrogen (8.9–23.4 g m−2 yr−1), and total phosphorus (0.9–2.0 g m−2 yr−1) were calculated along with removal efficiencies for these constituents (nitrite + nitrate 88–97%; total nitrogen 32–57%; total phosphorus 0–46%). The low impact of the diversion on water quality in the Breton Sound estuary, along with assimilation of TSS over a very short distance, suggests that more water may be introduced into the estuary without detrimental effects. This would be necessary if freshwater diversions are to be used to distribute nutrients and sediments into the lower reaches of the estuary, in an effort to compensate for relative sea-level rise, and reverse the current trend of rapid loss of wetlands in coastal Louisiana.

Deepshikha Sharma et al [4] studied Water quality analysis of River Yamuna using water quality index in the national capital territory, India (2000–2009).River Yamuna, in the national capital territory (NCT), commonly called Delhi (India), has been subjected to immense degradation and pollution due to the huge amount of domestic wastewater entering the river. Despite the persistent efforts in the form of the Yamuna Action Plan phase I and II (YAP) (since 1993 to date), the river quality in NCT has not improved. The restoration of river water quality has been a major challenge to the environmental managers. In the present paper, water quality index (WQI) was estimated for the River Yamuna within the NCT to study the aftereffects of the projects implemented during YAP I and II. The study was directed toward the use of WQI to describe the level of pollution in the river for a period of 10 years (2000–2009). The study also identifies the critical pollutants affecting the river water quality during its course through the city. The indices have been computed for pre-monsoon, monsoon and post-monsoon season at four locations, namely Palla, ODRB, Nizamuddin and Okhla in the river. It was found that the water quality ranged from good to marginal category at Palla and fell under poor category at all other locations. BOD, DO, total and fecal coli forms and free ammonia were found to be critical parameters for the stretch.

Devendra Dohare et al [5] studied down water quality parameter.Due to human and industrial activities the ground water is contaminated. This is the serious problem now a day. Thus the analysis of the water quality is very important to preserve and prefect the natural eco system. The assessment of the ground water quality was carried out in the different wards of Indore City. The present work is aimed at assessing the water quality index (WQI) for the ground water of Indore City and its industrial area. The ground water samples of all the selected stations from the wards were collected for a physiochemical analysis. For calculating present water quality status by statistical evaluation and water quality index, following 27 parameters have been considered Viz. pH, color, total dissolved solids. Electrical conductivity, total alkalinity, total hardness, calcium, chromium, zinc, manganese, nickel. The obtained results are compared with Indian Standard Drinking Water specification IS: 10500-2012. 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.

Elbert Earl Whitlatch Jr [6]studied optimal sitting of regional wastewater treatment plants.The problem of determining the optimal number, location and level of treatment for regional domestic sewage treatment plants along an estuary or river is considered. The formulation is one of minimizing the sum of treatment and transport (piping and pumping) costs subject to water quality improvement goals for dissolved oxygen in the estuary. Restrictions may also be placed upon the overall level of treatment (required secondary, required uniform or least cost) if desired. An optimization procedure is developed which utilizes dynamic programming, linear programming and heuristic location techniques in a series of steps which lead to progressively improved (lower total cost) solutions. The location procedure is intended for use by an engineer-planner during the design stage and requires his participation and skilled judgment during the course of the algorithm. The technique is illustrated for the Delaware Estuary for 22 domestic waste sources

Williamocampo et al [7] studied Water quality analysis in rivers with non-parametric probability distributions and fuzzy inference systems: Application to the Cauca River, Colombia. The integration of water quality monitoring variables is essential in environmental decision making. Nowadays, advanced techniques to manage subjectivity, imprecision, uncertainty, vagueness, and variability are required in such complex evaluation process. We here propose a probabilistic fuzzy hybrid model to assess river water quality. Fuzzy logic reasoning has been used to compute a water quality integrative index. By applying a Monte Carlo technique, based on non-parametric probability distributions, the randomness of model inputs was estimated. Annual histograms of nine water quality variables were built with monitoring data systematically collected in the Colombian Cauca River, and probability density estimations using the kernel smoothing method were applied to fit data. Several years were assessed, and river sectors upstream and downstream the city of Santiago de Cali, a big city with basic wastewater treatment and high industrial activity, were analyzed. The probabilistic fuzzy water quality index was able to explain the reduction in water quality, as the river receives a larger number of agriculture, domestic, and industrial effluents. The results of the hybrid model were compared to traditional water quality indexes. The main advantage of the proposed method is that it considers flexible boundaries between the linguistic qualifiers used to define the water status, being the belongingness of water quality to the diverse output fuzzy sets or classes provided with percentiles and histograms, which allows classify better the real water condition. The results of this study show that fuzzy inference systems integrated to stochastic non-parametric techniques may be used as complementary tools in water quality indexing methodologies.

CHAPTER - 3

AIMS AND OBJECTIVES

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1. Collection of water from different places of Mavelikara Taluk
2. Evaluation of water quality parameters like pH, TDS, conductance.

CHAPTER -4

MATERIALS AND METHODS

MATERIALS AND METHODS

4.1 MATERIALS

The water samples from 4 different places of Mavelikara Taluk are collected:

WATER SAMPLES	PLACES OF WATER COLLECTED
A	THAZHAKKARA
B	PUTHIYAKAVU
C	KALLUMALA
D	BUDHA JUNCTION

4.2 METHODS OF ANALYSIS

4.2.1 CONDUCTANCE AND TDS

Apparatus

1. Beaker
2. Conductivitymeter
3. Stirrer

Procedure

- Take water sample in a beaker and dip the conductivity cell into it.
- The conductance of water is measured by connecting the terminal of conductivity cell with conductivity bridge.
- TDS is obtained by multiplying conductance value with conversion factor.

4.2.2 pH

Apparatus Required

1. pH meter
2. Beaker

Procedure

- All the samples are taken in beaker one by one.
- pH value is recorded for all the sample using pH meter

4.2.3 Total Hardness

Solutions and Reagents Required

1. Water sample
2. Buffer solution
3. Mg-EDTA complex
4. Eriochrome Black T
5. Standard EDTA solution

Procedure

- 60ml of water sample is pipetted out in to 250 ml conical flask
- Add 2ml of buffer solution.
- 0.5ml of Mg-EDTA complex solution and 5 drops of indicator is added.
- The colour of the titration mixture at this stage is wine red
- Titrated with standard EDTA from burette with constant stirring.
- Add EDTA solution slowly and drop wise near the end point.
- The colour changes from wine red through purple to a clear blue at the end point

4.4 Calculations

1. Total Hardness

Molarity of standard EDTA solution, M_1 = M

Volume of EDTA solution used. V_1= ml

Volume of water sample=V_2=60ml

Molarity of Ca^{2+}/Mg^{2+} in water sample= M_2

$M_1 X V_1 = M_2 X V_2$

$M_2 = M_1 X V_1/V_2$

Total hardness of sample in mg of $CaCO_3/dm^3 = M_2$ X 100 X 100 = ……..ppm

2. Conductance

From conductivity meter

3. Total Dissolved Solids (TDS)

TDS =conductivity X conversion factor.

4. pH

From pH meter

CHAPTER 5

RESULT AND DISCUSSION

RESULT AND DISCUSSION

5.1 CONDUCTANCE

Conductance is a measure of its ability to conduct electricity. In many cases, conductivity is directly linked to the total dissolved solids. The electrical conductivity of pure water is 0.05ps/cm. The drinking water has a conductivity of 200-800ps/cm.

SAMPLE	CONDUCTANCE
A	213.7
B	225.3
C	256.5
D	239.1

5.2 pH

pH is a measurement of how acidic or alkaline the substance is. If the pH is less than 7 then it is acidic, if the pH is about 7 it is neutral and if the pH is greater than 7 it is alkaline.

SAMPLE	pH
A	6.039
B	6.182
C	5.897
D	5.435

5.3 TOTAL HARDNESS

It is the measurement of mineral content in a water sample. It can be equivalent to calcium and magnesium hardness. A value ranging from 17-60 mg/L corresponds to slightly hard; 60-120 mg/L indicates moderately hard 120-180 for hard and value greater than 180 for very hard. The experimental data is given in the table

SAMPLE	HARDNESS (ppm)
A	50
B	33
C	83
D	200

5.4 TDS (Total Dissolved Solids)

Total Dissolved Solids are the total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water. A very low TDS give water a flat taste where increased concentrations of dissolved solids can produce hard water. TDS value less than 500 ppm are acceptable for drinking:

SAMPLE	TDS
A	267.125
B	281.625
C	320.625
D	298.875

CHAPTER 6

CONCLUSION

CONCLUSION

In this study the quality of drinking water was analysed using the following parameters: conductance, TDS, pH, and hardness. Samples from four different areas of Mavelikara Taluk are collected and analysed. All the samples are tested and found suitable for drinking purpose. But treatment has to be conducted in terms of pH since most of the samples are acidic in nature. We propose to reduce the acidity of water by using a neutralising filter containing lime stone or magnesia to raise the pH.

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