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# Groundwater Quality Assessment Using Physicochemical Parameters and Water Quality Index

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**Abstract:** *Water quality assessment is essential for evaluating the suitability of water for drinking, agricultural, and industrial purposes. The present study focuses on the analysis of major physicochemical parameters of water including pH, total dissolved solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), hardness, alkalinity, chloride, nitrate, and sulphate. Standard analytical procedures were applied to determine these parameters in collected water samples. The obtained results were compared with recommended drinking water standards to evaluate water safety and pollution levels. The analysis revealed that variations in physicochemical parameters significantly influence water quality and ecosystem health. Elevated concentrations of certain ions and organic loads may indicate contamination from anthropogenic activities such as agriculture, domestic waste, and industrial discharge. The study highlights the importance of routine monitoring and proper management strategies to maintain sustainable water resources. Overall, systematic water quality analysis plays a vital role in environmental protection and public health management.*

**Keywords**: Water quality, Physicochemical parameters, TDS, BOD, COD, Dissolved oxygen, Hardness, Alkalinity

## I. INTRODUCTION

Water is among the major essential resources for the sustenance of humans, agriculture and industry. Social and economic progress are based and sustained upon this pre-eminent resource1. Availability and easy access to safe and quality water is a fundamental human right2 and availability of clean water and sanitation for all has been listed as one of the goals to be achieved by the year 2030 for sustainable development by the United Nations General Assembly (UNGA)3.

The physical, chemical, biological and aesthetic properties of water are the parameters used to describe its quality and determine its capability for a variety of uses including the protection of human health and the aquatic ecosystem. Most of these properties are influenced by constituents that are either dissolved or suspended in water and water quality can be influenced by both natural processes and human activities4·5. The capacity of a population to safeguard sustainable access to adequate quantities and acceptable quality of water for sustaining livelihoods of human well-being and socioeconomic growth; as well as ensuring protection against pollution and water related disasters; and for conserving ecosystems in a climate of peace and political balance is regarded to as water security6.

Although the world's multitudes have access to water, in numerous places, the available water is seldom safe for human drinking and not obtainable in sufficient quantities to meet basic health needs7. The World Health Organization (WHO) estimated that about 1.1 billion people globally drink unsafe water and most diarrheal diseases in the world (88%) is attributed to unsafe water, poor sanitation and unhygienic practices. In addition, the water supply sector is facing enormous challenges due to climate change, global warming and urbanization. Insufficient quantity and poor quality of water have serious impact on sustainable development, especially in developing countries8.


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India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the potability of water. All life is depend on water and exists in nature in many forms like ocean, river, lake, clouds, rain, snow and fog etc. However, strictly speaking

agriculture and industry, the quality of water can be quite flexible and water polluted up to certain extent in general sense can be regarded as pure. The health of lakes and their biological diversity are directly related to health of almost every component of the ecosystem. Lakes are also subjected to various natural processes taking place in the environment like the hydrologic cycle, with unprecedented development activities; human beings are responsible for choking several lakes to death. Storm water runoff and discharge of sewage into the lakes are few of the common causes where various nutrients enter the aquatic ecosystems resulting in their death.

**Purpose and Objective of Water Quality Testing**

The result of overall development, industrialization, and urbanization is felt in the water resources the quantity is falling short and quality is deteriorating with time. Urbanization and development have not remained concomitant with the development of municipal infrastructure to handle the wastes generated in urban areas. This has resulted in a shortfall of treatment capacities and consequently untreated wastes are discharged in water courses/bodies unscrupulously resulting in gross pollution of precious and diminishing resources. The impact can be easily observed by increasing health issues despite the availability of advanced and enhanced medical facilities.

With the ever-increasing use of water for municipal, industrial and irrigation needs, the monitoring and assessment of water quality continually has become essential on the part of the associated authorities. A well-equipped laboratory with modern amenities is essential to achieve this goal. This manual emphasizes the following major objectives: Different types of water and their utilization in various activities, depending on their physical, chemical, and biological characteristics. The simple estimation procedures and significance of each analytical test in terms of water quality and pollution assessment. Water-quality requirements and criteria set up by international and governmental agencies in different continents for drinking, domestic, and commercial activities.

**Study Area Description**

The Nagpur district is located in the central part of India and falls within the Vidarbha region of Maharashtra. Geographically, it lies between approximately 20°35′ to 21°44′ North latitude and 78°15′ to 79°40′ East longitude. The district experiences a tropical climate with hot summers, moderate monsoons, and mild winters.

The geology of the region is predominantly composed of Deccan basalt formations, which significantly influence groundwater occurrence and quality. Groundwater in this district is mainly obtained from dug wells and bore wells, which serve as major water sources for rural and semi-urban populations.

Different regions within the district exhibit variations in land use patterns, including agricultural zones, industrial areas, and densely populated urban settlements. These variations contribute to differences in groundwater quality. Agricultural practices involving fertilizers and pesticides, along with domestic sewage and industrial discharge, are major factors affecting well water quality in certain areas.

**Table-1**

**List of substances found naturally in some ground waters which can cause problems in operating wells**

| Substance | Types of problems |
|---|---|
| Iron | Encrustation ,staining of laundry and toilet fixtures |
| Manganese | Encrustation ,staining of laundry and toilet fixtures |
| Chloride | Portability, Corrosiveness |
| Fluoride | Fluorosis |
| Nitrate | Methemoglobenemia |

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| | |
|---|---|
| Sulphate | Portability |
| Dissolved Gases | Corrosiveness |
| Dissolved Oxygen | Corrosiveness |
| Hydrogen Sulphide | Corrosiveness |
| Carbon dioxide | Corrosiveness |
| Radio Nuclides | Portability |
| Miner Constituents | Portability, Health aspects |
| Calcium and Magnesium | Encrustation |

## LITERATURE REVIEW

Groundwater plays a vital role in meeting the daily water requirements for drinking, agriculture, and industrial use, particularly in countries like India where a large population depends on it. Although groundwater is often considered safer than surface water due to natural filtration through soil layers, its quality can still be affected by various environmental and human-related factors.

Over the years, many researchers have studied groundwater quality to understand its suitability for consumption. One widely accepted method is the Water Quality Index (WQI), proposed by Ramakrishnaiah C.R. et al. (2009). This method simplifies complex analytical data into a single value, making it easier to interpret the overall condition of water.

Further studies, such as those conducted by Wang X. et al. (2010), have shown that groundwater quality is not constant throughout the year. Seasonal variations, especially rainfall and recharge processes, can significantly influence the concentration of dissolved substances. For example, during the rainy season, dilution effects may improve water quality, whereas in summer, evaporation can increase the concentration of salts.

Groundwater analysis generally includes the evaluation of physical, chemical, and biological parameters. Physical parameters like color, turbidity, and temperature provide a preliminary understanding of water quality. In most cases, groundwater appears clear, but changes in taste or odor may indicate contamination.

Chemical analysis is more detailed and provides crucial information about the composition of groundwater. Parameters such as pH, electrical conductivity, total dissolved solids (TDS), hardness, and alkalinity are commonly measured. The presence of calcium and magnesium ions is mainly responsible for hardness, which is often linked to the dissolution of rocks like limestone and dolomite. In addition, higher nitrate concentrations are usually associated with agricultural runoff and the excessive use of fertilizers.

To ensure safe drinking water, international and national agencies such as the World Health Organization and the Bureau of Indian Standards have established permissible limits for various water quality parameters. Comparing experimental results with these standards helps determine whether groundwater is fit for human consumption.

Biological contamination in groundwater is generally low, but it can occur in shallow wells due to infiltration of surface pollutants. The presence of microorganisms, especially coliform bacteria, indicates possible contamination and health risks.

Recent developments in analytical techniques, including atomic absorption spectroscopy and ion chromatography, have improved the accuracy of groundwater analysis, particularly for detecting trace elements and heavy metals. These advancements have helped researchers better understand the extent of groundwater pollution.

In urban areas such as Nagpur district, groundwater quality is increasingly influenced by rapid urbanization, improper waste disposal, and industrial activities. These factors often lead to elevated levels of dissolved solids, hardness, and nitrates in groundwater.

## PARAMETERS AFFECTING THE QUALITY OF WATER

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physic-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Water

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does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. For obtaining more and more quality and purity water, it should be tested for its trace metal, heavy metal contents and organic i.e. pesticide residue. It is obvious that drinking water should pass these entire tests and it should content required amount of mineral level. Only in the developed countries all these criteria's are strictly monitored. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated analytical instruments and well trained manpower. Following different physic chemical parameters are tested regularly for monitoring quality of water.

1. Physical parameters
2. Chemical parameter
3. Biological parameters

**Physical characteristics of water:**

**Colour:** Colour in water means those hues inherent within the water itself which result from colloidal substances and materials in solution. In natural waters colour may occur due to the presence of humic acids, fulvic acids, metallic ions, suspended matter, phytoplankton, weeks and industrial effluents. Algal flora imparts green colour to water while water with excess of slit appears brownish. Organic matter and iron impart a yellow hue to the water.

**Odour and Taste:** Decaying water weeds like chara, rotten hay and stravy impart an odour like that of decaying fish. Contamination with sewage water may give the odour of hydrogen sulphide. Fungi growing on decaying plant material yield a musty odour. Chlorinated waters with phenol traces give very strong chlorophenol odour. Taste of water too depends upon the impurities in water and it is also linked with the odour.4 Odour is generally measured as threshold odour number (T.O.N) which is equal to dilution ratio of the sample at which odour is just detectable. The sample is diluted with odour free water until at least perceptible odour is detected by the tester. Obviously, smaller is the value of T.O.N; better is the quality of water.

**Temperature:** It is measured immediately after collecting the water sample preferably on the site itself. This parameter is useful for calculating various factors such as alkalinity or acidity of water. The elevated temperature has adverse ecological consequences on water. All thermometers must be calibrated before measurement. The depth temperature is required for limnological studies, which may be measured with a reversing thermometer or thermophone or thermistor. The last devise, viz., thermistor is the most reliable amongst measuring instruments.

**Turbidity[15] :** Suspension of particles in water interfering with passage of light is called turbidity. Turbidity is caused by wide variety of Suspended particles. Turbidity can be measured either by its effect on the transmission of light which is termed as Turbiditymetry or by its effect on the scattering of light which is termed as Nephelometry. As per IS: 10500-2012 the acceptable and permissible limits are 1 and 5 NTU respectively.

**Conductivity :** Conductivity is a numerical expression of an aqueous solution's capacity to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valence and relative concentrations, and on the temperature of the liquid. Solutions of most inorganic acids, bases, and salts are relatively good conductors. In contrast, the conductivity of distilled water is less than 1 µmhos/cm. Because conductivity is the inverse of resistance, the unit of conductance is the mho (ohm spelled backwards), or in low-conductivity natural waters, the micromho.

**Solids:** These may be present in suspension or in solution and may be divided into organic matter and inorganic matter. Total dissolved solids (TDS) are due to soluble materials whereas suspended solids (SS) are discrete particles which can

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be measured by filtering a sample through a fine paper. Settleable solids are those removed in a standard settling procedure using a 1 litre cylinder. They are determined from the difference between SS in the supernatant and the original SS in the sample. The WHO International Standards set the permissible limit for dissolved solids as 500 mg/l.

**Chemical characteristics of water:**

**Alkalinity :** Alkalinity is the sum total of components in the water that tend to elevate the pH to the alkaline side of neutrality. It is measured by titration with standardized acid to a pH value of 4.5 and is expressed commonly as milligrams per liter as calcium carbonate (mg/L as CaCO3). Alkalinity is a measure of the buffering capacity (ability to resist changes in pH) of the water, and since pH has a direct effect on organisms as well as an indirect effect on the toxicity of certain other pollutants in the water, the buffering capacity is important to water quality. Commonly occurring materials in water that increase alkalinity are carbonates, bicarbonates, phosphates and hydroxides. Limestone bedrock and thick deposits of glacial till are good sources of carbonate buffering. Lakes within such areas are usually well-buffered.

**Hardness:** The total hardness is defined as the sum of calcium and magnesium concentration expressed both as the calcium carbonate hardness in milligram per litre. It is greater than the sum of bicarbonate and carbonate alkinity. This is terme4d as carbonate hardness. The calculated hardness is obtained from amount of calcium and magnesium present while hardness is experimentally evaluated by titration technique. The heavy metal inferences in complexometric titration. They are eliminated by use of CDTA as inhibitor. Various indicators like erichrome black T, calmagite, mureoxide are used in EDTA titration for determination of calcium and magnesium.

## CLASSIFICATION OF HARDNESS:

As a matter of fact hardness should have been classified as the chemical property of water. Hardness of water is caused due to the presence of sulphates and chlorides of calcium and magnesium. Hardness sometimes is attributed due to sulphates or chlorides of iron, manganese and aluminium. This causes what is called the permanent hardness, while temporary hardness is caused due to the presence of bicarbonates of calcium and magnesium and can be eliminated by mere boiling of water. In order to ascertain the hardness of water, one has to use soap test. Water will form soft and beautiful lather with soap if water is soft. However, if water is hard than Ca and Mg will combine with stearates of form soap to form curd or insoluble lather of calciumsterate or magnesium-sterate. Alkali metal sterates are soluble. Usually, hardness is expressed in terms of CaCO3/litre. Thus, water with 25mg/ 5CaCO3 is considered soft water, while water with 500mg/litre of CaCO3 is termed as hard water. The usual method for analysis of hardness is titration method, one involving KMnO4 titration, while an another method is involving the use of EDTA for the purpose, latter is more popular. The indicator used is Eriochrome black T, where pH is maintained at 10.0. EDTA combines first with Ca from water; then magnesium can be first precipitated as Mg(OH)2. So titration value gives the amount of calcium only. Solochrome dark-blue can also be used instead of mureoxide indicator, with equal efficiency for calcium. When erichrome black-T is used, one gets reading for both Ca and Mg. Usually, EBT is grounded with solid NaCl in the ratio of 1:1, and is used during titration. A new indicator called Patton Reeder indicator is best for determination of calcium in hard water. It permits simultaneous analysis of both calcium and magnesium in water. So far we have considered physical properties of water. Such as colour, conductivity and turbidity. However, physical properties alone cannot give definite information on quality of water. Most of the methods so far discussed are largely physical with few exceptions like hardness based upon the physiochemical properties. Similarly, acidity/alkalinity or salinity is classified in chemical composition of the water.

**pH[15]:** pH of solution is taken as –ive logarithm of H2 ions for many practical practices. Value range of pH from 7 t0 14 is alkaline, from 0 to 7 is acidic and 7 is neutral. Mainly drinking water pH lies from 4.4 to 8.5. The pH scale commonly ranges from 0 to 14.

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**Calcium :** It is measured by complexometric titration with standard solution of ETDA using Patton's and Reeder's indicator under the pH conditions of more than 12.0. These conditions are achieved by adding a fixed volume of 4N Sodium Hydroxide. The volume of titre (EDTA solution) against the known volume of sample gives the concentration of calcium in the sample.

**Magnesium :** It is also measured by complexometric titration with standard solution of EDTA using Eriochrome black T as indicator under the buffer conditions of pH 10.0. The buffer solution is made from Ammonium Chloride and Ammonium Hydroxide. The solution resists the pH variations during titration.

**Chloride:** Chloride occurs naturally in all types of waters. The most important source of chlorides in the water is the discharge of domestic sewage. Chloride is highly soluble with most of the naturally occurring cations and does not precipitate. The maximum limit for chloride in drinking water as recommended by WHO and Indian Standards are 250 mg/l and 300 mg/l respectively. It is harmless up to 1500 mg/l concentration but produces a salty taste at 250-500 mg/l level. It can also corrode concrete by extracting calcium. Usual methods for determination of chloride are Mohr's & Volhard's methods.

**Dissolved oxygen (DO) :** Dissolved oxygen of water is of paramount importance to all living organisms and is considered to be the lone factor which to a great extent can reveal the nature of the whole aquatic system at a glance, even when information on other chemical, physical and biological parameters is not available. The solubility of oxygen depends upon temperature, salinity, water movements etc. Dissolved oxygen in water is essential to aquatic life. DO is the most important factor in determining whether aerobic or anaerobic organisms carry out biological changes. The estimation of DO is done by the titrimetric method. The oxygen of the water combines with manga nous hydroxide which on acidification liberates iodine equivalent to that of oxygen fixed. This iodine is titrated by standard sodium thiosulphate solution using starch as an indicator.

Deficiency of dissolved oxygen in receiving waters gives rise to odiferous products of anaerobic decomposition. If sufficient DO is available, aerobic organisms oxidizes the wastes to innocuous products. If DO is deficient, anaerobes take part in conversion and reduce the waste often to obnoxious end products. Thus the measurement of DO is important for maintaining aerobic conditions in the receiving waters and in the aerobic treatment of sewage and industrial waste waters.[14]

**Biochemical oxygen demand (BOD):** It is the most commonly used parameter to define the strength of municipal or organic industrial waste water. BOD is a measure of the amount of oxygen used in the respiratory processes of micro-organisms in oxidizing the organic matter in the sewage and for the further metabolism (oxidation) of cellular components synthesized from the wastes. BOD value approximates the amount of oxidizable organic matter present in the solution. The basic principle underlying the BOD determination is the measurement of dissolved oxygen content of the sample before and after five days incubation at 20°C.12 A permissible value of 10.0 mg/l recommended to be the drinking water standard by WHO.

**Chemical oxygen demand (COD):** It is the amount of oxygen required by organic substances in water to oxidize them by a strong chemical oxidant.14,16 The determination of COD values are of great importance where BOD values cannot be determined accurately due to the presence of toxins and other such unfavorable conditions for growth of micro-organisms. In general, COD is more than the BOD values for most of the industrial wastes. COD values are taken as the basis for calculation of the efficiency of the treatment plants and also figure in the standards for discharging industrial/domestic effluents in various kinds of water. A threshold value of 10.0 mg/l has been proposed to be the drinking water standard by WHO.

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**Table-2**

**Physical and chemical properties of tube well water as per IS 10500-201218**

| Sr. No. | Parameter | Unit | Accept. Limit | Permi. Limit |
|---|---|---|---|---|
| 1 | Colour | Hazen Unit | 5 | 15 |
| 2 | Odour | | Agreeable | Agreeable |
| 3 | $p^H$ | | 6.5-8.5 | No relaxation |
| 4 | Turbidity | NTU | 1 | 5 |
| 5 | Total Dissolved Solids | mg/l | 500 | 2000 |
| 6 | Calcium | mg/l | 75 | 200 |
| 7 | Chloride | mg/l | 250 | 1000 |
| 8 | Magnesium | mg/l | 30 | 100 |
| 9 | Nitrate | mg/l | 45 | No relaxation |
| 10 | Total Alkalinity | mg/l | 200 | 600 |
| 11 | Total Hardness | mg/l | 200 | 600 |
| 12 | Temperature | °C | - | - |
| 13 | Iron | mg/l | 0.3 | No relaxation |
| 14 | Fluoride | mg/l | 1 | 1.5 |

## WATER QUALITY PARAMETE

**Determination of Physical Characteristics**

Physical parameters of water quality refer to the measurable characteristics of water related to its physical properties. These parameters provide valuable insights into the physical state and condition of water, which can have a profound impact on its general quality and usefulness. Some important physical water quality parameters include Turbidity, Temperature, Colour, Taste and odour, EC, and Solids.

**1. Colour -True and Apparent**

Pure water is colourless, but foreign substances both in suspended and dissolved states impart colour to water. Colour imparted temporarily by suspended matter in water is called apparent colour because it disappears on the removal of suspended matter by filtration. Colour imparted permanently to water, which remains even after the removal of suspended matter, is known as true colour. Hence, true colour is due to the presence of coloured dissolved solids in water. The estimation of colour is not included in routine domestic wastewater analysis. It should be done if domestic wastewater is receiving highly coloured industrial wastes. In potable water, secondary and tertiary- treated effluent and industrial water analysis measurement of true colour is essential.

**Principle:** The true colour of water samples can be measured by the Pt-Co method, which uses Potassium Chloroplatinate (K2 Pt C16) as the standard. One unit of the true colour of a centrifuged a sample is equivalent to the colour produced by 1 mg/L of Pt in the form of Chloroplatinate ion. The results are expressed as Pt-Co units of true colour.

**Apparatus**

- Spectrophotometer
- Sample cells
- Volumetric flasks
- Pipettes
- Centrifuge

**Reagents**

- DDW: Colour free
- Standards: Hatch Standard solution containing 500 Pt-Co units.

**Procedure**

- Centrifuge the sample to remove any kind of suspended matter causing turbidity.

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- Fill a sample cell with 10 ml of DDW to represent the blank. Wipe the cell, keep it the cell holder, and adjust zero.
- Fill another sample cell with a centrifuged sample up to the 10-ml mark. Wipe the cell and keep them in the cell holder.
- Set the wavelength at 465 nm.
- Record the reading directly and note it as Pt-Co units.

**Calculation**

Read directly from the readings of the spectrophotometer or calculate the colour units from the calibration curve.

**II. Temperature**

This is one of the most essential parameters to determine in water and wastewater systems. has a significant impact on the growth and activity of ecological Life. Also, it greatly affects the solubility of essential gases such as oxygen in water. thus it is an important parameter to measure during the aeration of wastewater in the activated sludge treatment process.

**Principle:** The temperature of a water sample can be measured with the help of an ordinary mercury or digital thermometer.

**Apparatus**

- Thermometer
- Sampling bottle

**Procedure**

- Measure the water temperature by dipping the thermometer to the required depth in water or wastewater stream or aeration basins and wait until a constant reading is obtained.
- Where direct measurement is not possible, collect 5 L. water in a sampling bottle. Immediately measure the temperature with a thermometer.

**III. ODOUR AND TASTE - THRESHOLD ODOUR NUMBER (TON) METHOD**

Odour and taste are two closely associated terms. Both depend on the stimulation of a human receptor cell by the presence of some chemicals in water. Hence, these terms are often included in "chemical senses." The substances producing odour in water mostly impart an objectionable teste as well. The reverse is not always true. There are many minerals known that impart a brine or salty taste to water without any contribution to odour production.

**Principle:** The malodorous compounds responsible for producing objectionable odour in water can be detected by diluting a sample with odour- free water until the least detectable odour level is achieved. This is recorded as TON (Threshold Odour Number). The concentration of malodorous gases such as hydrogen sulphide, ammonia, merchantman's etc. emitted into the air from wastewater can be measured by any commercially available gas monitor.

**Apparatus**

- Sampling bottles
- Dilution flasks
- Measuring cylinders of different capacities
- Pipettes

**Reagents**

- Dilution water must be free from any sort of odour. DDW is used for this purpose.
-

**Procedure**

- Dilution water must be free from any sort of odour. DDW is used for this purpose.

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- Varying quantities of odorous samples are measured into separate dilution flasks. The sample in each flask is diluted to 200 ml with DDW.
- A blank is prepared by measuring 200 ml DDW into a dilution flask.
- An assembled panel of five to ten "noses" is used to determine the mixture in which the odour is just barely detectable to the smell and to record the results.

**Calculation**

The extent of odour present in the sample can be calculated by the following relation:

$$TON=A+B/A$$

Where A = Volume of odorous water sample(ml)

B = Volume of odour-free water to make up the final volume(ml)

## IV. TURBIDITY -NEPHELOMETRIC METHOD

Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divide organic and inorganic matter, and plankton and other microscopic organisms. Turbidity is a expression of the optical property that causes light to be scattered and absorbed rather than transmitted with no change in direction or flux level through the sample. The correlation turbidity with the weight or particle number concentration of suspended matter is difficult because the size, shape, and refractive index of the particles affect the light-scattering properties of the suspension.

Principle: This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard referent suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity.

**Apparatus**

- Nephelometric turbidity meter
- sample cell

**Reagents**

- Solution I: Dissolve 1.000 g hydrazine sulphate, (NH2)2.H2SO4 in distilled water and dilute to 100 mL in a volumetric flask.
- Solution II: Dissolve 10.00 g hexamethylenetetramine, (CH2)6N4, in distilled water and dilute to 100 mL in a volumetric flask.
- 4000 NTU suspension: In a flask mix 5.0 mL of Solution I and 5.0 mLof Solution II.
- Let stand for 24 h at 25 ± 3 °C. This results in a 4000 NTU suspension. Store in an amber glass bottle. The suspension is stable for up to 1 year. d. Dilute 4000 NTU stock use solution with distilled water to prepare dilute standards just before use and discard after use.

**Procedure**

- Calibrate the Nephelometric according to the manufacturer's operating instructions. Run at least one standard in each instrument range to be used.
- Gently agitate the sample. Wait until air bubbles disappear and pour the sample into a cell. Read turbidity directly from the instrument display.

**2. Determination of Inorganic and Non-metallic Constituents**

The analysis of water samples to determine the presence and concentration of inorganic and non-metallic constituents is essential for assessing water quality, identifying potential pollutants, and ensuring human and environmental safety.

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Inorganic constituents include ions and heavy metals, while non-metallic constituents encompass organic compounds and contaminants.

**2.1 pH-Electrometric Method**

pH is one of the most important parameters of water quality. It is defined as the negative logarithm of the hydrogen ion concentration. It is a dimensionless number indicating the strength of an acidic or a basic solution. pH of the water is a measure of how acidic/basic water is. Acidic water contains extra hydrogen ions (H) and basic water contains extra hydroxyl (OH) ions. pH ranges from 0 to 14, with 7 being neutral. pH of less than 7 indicates acidity. whereas a pH of greater than 7 indicates a base solution. Pure water is neutral, with a pH close to 7.0 at 25°C. Normal rainfall has a pH of approximately 5.6 (slightly acidic) owing to atmospheric carbon dioxide gas. Safe ranges of pH. for drinking water are from 6.5 to 8.5 for domestic use and living organisms' needs.

**Principle:** The pH value is determined by measurement of the electromotive solution and a reference electrode. Contact between the test solution and the force of a cell consisting of an indicator electrode immersed into the test reference electrode is usually achieved through a liquid junction which forms part of the reference electrode. As shown in Fig 4.2. The electromotive force is measured with a pH meter a high-impedance voltmeter calibrated in terms of pH.

**Apparatus**

- pH meter
- Beakers Stirrer

**Reagents**

- Buffer solutions

**Procedure**

- After calibration, rinse the electrode with DDW.
- Take the sample in a beaker. Bring the temperature of the sample to room temperature.
- Place the beaker on a magnetic stirrer. Bring the sample to homogeneity by stirring.
- Place the electrode in the sample in such a way that the bar magnet will not touch the electrode. Record the reading, which will give the pH value of the sample.

**Calculation**

- The read-out of the pH meter will give a direct pH value of the sample.

**2.2 Alkalinity -Titrimetric Method**

Alkalinity of water is defined as the acid-neutralizing capacity of water, which represents the total concentration of all titratable bases present. It indicates the ability of water to resist changes in pH when acids are added. Alkalinity is an important parameter in water analysis because it helps in determining the amount of chemicals such as lime and soda required for water softening and plays a vital role in corrosion control, especially in boiler feed water treatment.

Alkalinity in natural water is mainly due to the presence of the following ions: Hydroxide ions ($OH^-$) Bicarbonate ions ($HCO_3^-$) Carbonate ions ($CO_3^{2-}$) These ions may exist individually or in combination, depending on the pH of the water. Hydroxide and bicarbonate ions generally do not coexist in significant amounts because they react with each other to form carbonate ions and water:

$$OH^- + HCO_3^- \rightarrow CO_3^{2-} + H_2O$$

Alkalinity is a crucial parameter in water chemistry that reflects the buffering capacity of water and is primarily controlled by hydroxide, carbonate, and bicarbonate ions. It is essential for water treatment processes and maintaining water quality.

**Principle:** Alkalinity is measured as carbonate, bicarbonate, and hydroxide ions which result during the dissociation or hydrolysis of solutes, which, in turn, react with standard acid, added to the sample.

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**Apparatus**

- Titration assembly- Volumetric flasks, Pipettes and Burette.
- Oven
- Desiccating cabinet
- Magnetic stirrer

**Reagents**

- Sodium carbonate solution: Na2CO3, 0.05N.
- Stock solution of $H_2SO_4$ or HCI, 0.1N.
- Standard solution of $H_2SO_4$ or HCl, 0.02N.
- Phenolphthalein indicator
- Mixed indicator Methyl
- orange indicator

**Procedure**

- Take 100 ml of an unfiltered sample or an aliquot diluted to 100 ml into a 250-ml Erlenmeyer flask.
- Keep the beaker on a magnetic stirrer. Insert bar magnet and pH meter electrodes in the beaker. Turn on the stirrer. Stir the sample with the magnetic stirrer so that the hard magnet does not touch the electrode.
- Record initial pH and temperature.
- If the initial pH is more than 8.3. titrate to 8.3 with 0.02N H2SO4 using the phenolphthalein indicator, till the pink colour disappears.
- Record the volume of the titrant used when the red colour disappears. This is the phenolphthalein end point (P).
- Continue titration by adding 2-3 drops of the mixed indicator until the colour of the indicator changes from green to red. This is the endpoint.
- Record the volume of the titrant. This is the total alkalinity (T).
- Prepare a blank with 100 ml DDW and run the titration by following the same procedure as described for the sample. Blank should be run in duplicate.

**Calculation**

Alkalinity, mg/L as $CaCO_3$ $= \frac{(A-B)\times N\times 50000}{\text{volume of sample. mL}}$

Where, A volume of 0.02 N H2SO4 used for the sample, ml
B= volume of 0.02 N H2SO4 used for Blank, ml
N-normality of acid

- Record the pH of the sample.
- If the pH of the sample is more than 4.0, add 0.02N H2SO4 in small increments to lower the pH to ≥ 4.0. Record the volume of acid used.
- Remove the pH probe.
- Titrate with 0,02 N NaOH titrant to pH 8.3 by adding the titrant in small increments to detect the endpoint accurately using the phenolphthalein indicator.
- Record the volume of alkali added.

**Calculation**

Acidity, as CaCO3 mg/L= $\frac{[(A-B)-N-(DXE)]\times 50000}{\text{volume of sample, ml}}$


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### 2.3 Hardness-EDTA Titrimetric Method

The quantity of dissolved magnesium and calcium in the water determines its hardness. If the hardness of water is high it may be observed that it is difficult to foam up when washing clothes and hands. The total hardness is the addition of magnesium and calcium concentration in the water which is expressed as $CaCO_3$ in mg/L. If the total hardness is greater than alkalinity, both are expressed as $CaCO_3$. The portion of hardness equal to the alkalinity is called carbonate hardness, and the excess hardness over alkalinity is called non-carbonate hardness. The non-carbonate hardness is caused by the association of hardness causing cation with chloride or nitrate, sulphate, and is known as permanent hardness. The hardness of water is classified as. Shown in Table 2.1 for water hardness ranges.

**Table 2.1 : Water hardness range**

| Sr. No. | Water type | Range |
|---|---|---|
| 1 | Soft Water | 0-60mg/L |
| 2 | Medium Water | 60-120mg/L |
| 3 | Hard Water | 120-180mg/L |
| 4 | Very Hard Water | >180mg/L |

**Principle:** EDTA method for determination of total hardness) depends on the ability of ethylenediamine tetra acetic acid (C10H16O8N2) or its disodium salt to form stable complexes with calcium and magnesium ions. When the dye Eriochrome black T (EBT) (C2OH13N3O7S) is added to a solution containing calcium and magnesium ions at pH 10.0, a Wine-red complex is formed this solution is titrated with a standard solution of the disodium salt of EDTA extracts calcium and magnesium from the dye complex and the dye is changed back original blue colour, Eriochrome black T is used to indicate the endpoint for the literation calcium and magnesium together.

**Apparatus**

- Burette,
- Bottle with stopper
- Pipette

**Reagents**

- Buffer solution
- Standard calcium solution
- Eriochrome black T indicator solution
- Standard EDTA solution

**Procedure**

- Take a 100-ml sample or aliquot quantity of sample diluted to 100 ml in a 250 Erlenmeyer flask. Add about 5 ml buffer to acquire a pH level of 10.0±0.1.
- Add 0.5-ml indicator. This will give a wine-red colour to the solution.
- Titrate slowly with EDTA, stirring constantly, until the reddish tinge disappears. the last few drops at an interval of 3-5 s. At the endpoint, the solution turns blue.
- Record the volume of the titrant consumed.

**Calculation**

Total hardness, as $CaCO_3$ mg/L = $\frac{(A-B)\times D\times 1000}{\text{volume of sample,ml}}$

Where, A = volume of titrant consumed for sample, ml

B = volume of titrant consumed for blank, ml

D = mg CaCO3 equivalent to 1.00 ml EDTA titrant


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**2.4. Chloride-Argentometric Method**

Chloride, in the form of chloride (Cl-) ion, is one of the major inorganic anions in water and wastewater. The salty taste produced by chloride concentrations is variable and dependent on the chemical composition of the water. The chloride concentration is higher in wastewater than in raw water because sodium chloride (NaCl) is a common article of diet and passes bunch through the digestive system. A high chloride content may harm metallic pipes and structure as well as growing plants.

**Principle:** In a neutral or slightly alkaline solution, potassium chromate can precipitated quantitate before red silver chromate is formed. indicate endpoint of the silver nitrate titration of chloride.

Apparatus

- Erlenmeyer flask, 250-mL..
- Burette, 50-ml..

**Reagents**

- Potassium chromate indicator solution.
- Standard silver nitrate titrant, 0.0141M (0.0141N)
- Standard sodium chloride, 0.0141M (0.0141N)
- Special reagents for removal of interference

**Procedure**

**(a) Sample preparation:**

- Use a 100-ml. sample or a suitable portion diluted to 100 mL.
- If the sample is highly coloured, add 3 ml, $Al(OH)_3$; suspension, mix ,let settle, and -----
- If sulphide, sulphate, or thiosulfate is present, add 1 mL $H_2O_2$ and stir for 1 min.

**(b) Titration:**

- Directly titrate samples in the pH range of 7 to 10.
- Adjust sample pH to 7 to 10 with H2SO4 or NaOH if it is not in this range. adjustment, preferably use a pH meter with a nonchlorine-type reference electrode is available, determine the amount of acid or Add mL K2CrO4 indicator solution.
- (If only a chloride-type electrode is available, determine the amount of acid or alum needed for adjustment and discard this sample portion.
- Treat a separate portion with the required acid or alkali and continue analysis.) Ad mL K2CrO4 indicator solution.
- Titrate with standard AgNO3 titrant to a pinkish-yellow endpoint. Be consist endpoint recognition.
- Standardize the AgNO3 titrant and establish reagent blank value by the titration me outlined above. A blank of 0.2 to 0.3 mL is usual.

**Calculation**

$$\text{mg } Cl^- / L = \frac{(A-B)\times N\times 35450}{\text{volume of sample,ml}}$$

Where A= ml. titration for sample

B = ml. titration for blank

N = normality of $AgNO_3$.

$$\text{mg NaCl / L} = (\text{mg } Cl^-/L) \times 1.65$$

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### 2.5 Calcium-EDTA Titrimetric Method

The average abundance of Ca in the earth's crust is 4.9%: in soils, it is 0.07 to 1.7% in stream it is about 15 mg/L.; and in groundwater ranges from 1 to > 500 mg/L. The most common form of calcium are calcium carbonate (calcite) and calcium-magnesium carbonate. Calcium compounds are widely used in pharmaceuticals, photography, lime production, de-icing, pigments, fertilizers, and plasters. The solubility of calcium carbonate is controlled by dissolved $CO_2$. The equilibrium among $CO_2$, $HCO_3^-$, and $CO_3^{2-}$ is the major buffering mechanism in fresh waters. Hardness is based on the concentration of calcium and magnesium salts and to is used as a measure of potable water quality.

**Principle:** In a solution containing both calcium and magnesium, calcium can be determined directly with EDTA (ethylenediamine tetra-acetic acid or its salts) when is made sufficiently high (12 to 13) so that the magnesium is largely precipitated as the hydroxide un an indicator is used which combines, only with calcium.

**Apparatus**

- Conical flasks
- Titration assembly
- Volumetric flasks
- Hot plate

**Reagents**

- Sodium Hydroxide Solution- IN
- Hydrochloric Acid-0.1 N
- Indicator solution
- Standard EDTA Solution-0.01 M
- Stock Calcium Solution
- Standard Calcium Solution

**Procedure**

- Take a 100-ml sample or aliquot quantity of sample diluted to 100 ml in a 250-ml Erlenmeyer flask.
- Add the same volume of IN NaOH solution used during standardization to acquire a pH level between 12 and 13 in the sample. Add 2-3 drops of mercury indicator also.
- Titrate with 0.01 M EDTA titrant slowly, stirring constantly, until the colour changes from pink to purple. Follow the same procedure as described for standardization to obtain the endpoint.

**Calculation**

$$\text{Concentration of } Ca^{2+} \text{ mg/L} = \frac{(C-B)\times D\times 400.8}{\text{volume of sample, ml}}$$

where B = volume of titrant consumed for Blank, ml

C = volume of titrant consumed for Sample, ml

### 2.6 Magnesium-Calculation Method

Magnesium occurs commonly in the minerals magnetite and dolomite. Magnesium is used in alloys, pyrotechnics, flash photography, drying agents, refractories, fertilizers, pharmaceuticals, and foods. The common aqueous species is $Mg^{2+}$. The carbonate equilibrium reactions from magnesium are more complicated than for calcium and conditions for direct precipitation of dolomite in natural waters are not common. Important contributors to the hardness of water, magnesium salts break down when heated, forming scale in boilers. Chemical softening, reverse osmosis, and ion exchange reduce magnesium and associated hardness to acceptable levels. Magnesium is an essential element in chlorophyll and in blood cells. Some salts of magnesium are toxic by ingestion or inhalation. Concentra greater than 125 mg/L also can have a cathartic and diuretic effect.

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**Principle:** A water sample containing Calcium as $CaCO_3$ is estimated and Total Hardness the sum of CaCO3 and $MgCO_3$. Magnesium hardness is determined by subtracting Calcium hardness from total hardness.

**Calculation**

Calculate the Total hardness as follows: Analysis for Total Hardness is carried out at pH using Eriochrome Black T indicator.

Total hardness (CaCO3) mg/L = [1000 (V1-V2)/V3] x CF

Where ,

$V_1$ = volume in mL of the EDTA standard solution used in the titrationfor the sample

V2 = volume in mL of the EDTA solution used in the titration for blank.

V3 = volume in mL of the sample taken for the test.

CF = X1/X2 correction factor for a standardised ion of EDTA.

$X_1$ = volume in mL of standard calcium solution taken for standardization.

X2 = volume of mL of EDTA solution used in the titration.

**Determine Total Dissolved solid (TDS )**

**Apparatus**

Evaporating dishes, 100 mL capacity of porcelain, platinum or high-silica glass made, Drying oven, 104 ± 1°C,2 Desiccator, Magnetic stirrer, Glass-fibre filter disk, Whatman grade 934 AH, Gelman type A/E, Millipore type AP40 or equivalent, diameter 2.2 to 12.5 m. Filtration apparatus, Membrane filter funnel.

**Procedure**

- Wash filter paper by inserting it in the filtration assembly and filtering 3 successive 20 Ml portions of distilled water. Continue suction to remove all traces of water. Discard washings.
- Dry evaporating dish at 104 ± 1°C for 1 h, cool and store in desiccator. Weigh immediately before use.
- Stir sample with a magnetic stirrer and while stirring pipette a measured volume on to the filter using a wide bore pipette. Choose sample volume to yield between 10 and 200 mg dried residue. Wash with three successive 10 mL volumes of distilled water. Continue suction for about 3 min after filtration is complete...
- Transfer total filtrate with washings to a weighed evaporating dish and evaporate to dryness in an oven at 104 ± 1°C. If necessary, add successive portions to the same dish after evaporation in order to yield between 10 and 200 mg dried residue. To prevent splattering oven temperature may
- be lowered initially by 2°C below boiling point and raised to 104 °C after evaporation for 1h. Cool in a desiccator and weigh.(Yusuf et al., 2002 )

**Calculation**

$$\text{mg Dissolved Solids/L} = \frac{(A-B) \times 1000}{\text{mL sample}}$$

where:

A = weight of dried residue + dish, mg

B= weight of dish, mg.

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## V. CONCLUSION

Groundwater analysis is essential for evaluating the suitability of water for drinking, agricultural, and industrial purposes. The study of various physical, chemical, and (where applicable) biological parameters reveals the overall quality and safety of groundwater in a given region.

In many cases, groundwater is found to be within permissible limits for most parameters, making it suitable for domestic use. However, elevated levels of hardness, dissolved salts, or contaminants in certain areas may render the water unsuitable without proper treatment. Continuous monitoring is therefore necessary to detect any changes in quality over time.

Overall, proper management, regular assessment, and implementation of treatment methods are essential to ensure safe and sustainable use of groundwater resources. Public awareness and effective environmental regulations also play a key role in protecting groundwater from contamination.

## REFERENCES

1. Taiwo, A.M., Olujimi, O.O., Bamgbose, O. & Arowolo, T.A. Surface water quality monitoring in Nigeria: Situational analysis and future management strategy. In *Water Quality Monitoring and Assessment* (ed. Voudouris, K) 301–320 (IntechOpen, 2012).
2. Corcoran, E., *et al.* Sick water? The central role of wastewater management in sustainable development: A rapid response assessment. United Nations Enviromental Programme UN-HABITAT, GRID-Arendal. https://wedocs.unep.org/20.500.11822/9156 (2010).
3. United Nations, The 2030 Agenda and the Sustainable Development Goals: An opportunity for Latin America and the Caribbean (LC/G.2681-P/Rev.3), Santiago (2018).
4. Hubert, E. & Wolkersdorfer, C. Establishing a conversion factor between electrical conductivity and total dissolved solids in South African mine waters. *Water S.A.* **41**, 490–500 (2015).
5. Department of Water Affairs (DWA). Groundwater Strategy. Department of Water Affairs: Pretoria, South Africa. 64 (2010).
6. Lu, Y., Nakicenovic, N., Visbeck, M. & Stevance, A. S. Policy: Five priorities for the UN sustainable development goals. *Nature* **520**, 432–433 (2015).
7. Shaheed, A., Orgil, J., Montgomery, M. A., Jeuland, M. A. & Brown, J. Why, "improved" water sources are not always safe. *Bull. World Health Organ.* **92**, 283–289 (2014).
8. WHO. *Guidelines for Drinking Water Quality* 4th Edn (World Health Organization, Geneva, Switzerland, 2011). http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf.
9. Ramakrishnaiah, C.R., Sadashivalah, C and Ranganna, G. (2009). Assessment of water quality index for groundwater in Tumkur Taluk, Karnataka State. Indian J. Chem. 6: 523-530
10. Wang, X., Han, J., Xu, L. and Zhang, Q. (2010). Spatial and seasonal variations of the contamination within water body of the Grand Canal, China. Environmental Pollution. 158: 1513-1520.
11. S.P. Gorde and M.V. Jadhav, Assessment of Water Quality Parameters: A Review, Journal of Engineering Research and Applications, 3(6), 2029-2035 (2013).
12. Adefemi S. O. and E. E. Awokunmi, (2010), Determination of physico-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria, African Journal of Environmental Science and Technology, 4(3), pp 145-148.
13. Adeyeye EI, (1994), Determination of heavy metals in Illisha Africana, associated Water, Soil Sediments from some fish ponds, International Journal of Environmental Study, 45, pp 231-240.
14. Srinivas Kushtagi and Padki Srinivas, Studies on water quality index of ground water of Aland taluka, Gulbarga(INDIA), International journal of applied biology and pharmaceutical technology, 2(4), (2011)

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15. Adnan, Amin, Taufeeq, Ahmad, Malik, Ehsanullah, Irfanullah, Muhammad, Masror, Khatak and Muhammad, Ayaz, Khan, (2010), Evaluation of industrial and city effluent quality using physicochemical and biological parameters, Electronic Journal of Environmental, Agricultural and Food Chemistry, 9(5), pp 931-939.
16. Aftab, Begum, S. Y, Noorjahan, C. M., Dawood, Sharif, S, (2005), Physico-chemical and fungal analysis of a fertilizer factory effluent, Nature Environment & Pollution Technology, 4(4), 529-531.
17. Agarwal, Animesh and Manish, Saxena, (2011), Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Gagan River at Moradabad- India, Advances in Applied Science Research, 2(2), pp 185 -189.
18. Manual on water and wastewater analysis, National Environment Engineering Research Institute, Nagpur, (1988)
19. APHA, (1985), Standard Methods For Examination of Water and Wastewater, 20th Edition, American Public Health Association, Washington D. C.
20. S.A. IQBAL AND H.C. KATARIA, (2006). Study of heavy metal contamination in Halali Dam water of Vidisha District near Bhopal (M.P.) India with reference to human health, Current World Environment Vol. 1(1),
21. H.k. pandey, s. gakhar and g. chawla, (2006). heavy metal toxicity inground water of khajuwala area Located in bikaner division of western rajasthan, Current World Environment Vol. 1(1), 41-44.
22. Water Management Forum. (2003). Inter-basin Transfer of Water in India-Prospects and Problems. The Institution of Engineers (India), Delhi. Wetzel, G.W. (2001). Limnology: Lake and River Ecosystems. Academic Press, New York. Pp. 15-42.
23. Yusuf, A. A., Arowolo, T. O. and Bamgbose, O., (2002), "Cadmium, Copper and Nickel levels in vegetables from industrial and residential areas of Lagos city, Nigeria", Global Journal of EnvironScience, 1(1), 1-6