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Evaluation of Drinking Water Quality Analysis in Kancheepuram District - using Indian Standard

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Abstract: Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water is usually described according to its physical, chemical and biological characteristics. Due to use of contaminated water, human population suffers from water borne diseases. It is therefore necessary to check the water quality at regular interval of time. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates and phosphates. Which are crucial for ensuring the water is safe for consumption and meets established health standards, with deviation from these parameters potentially indicating contamination and posing health risk. An assessment of the aquatic macroinvertebrates can also provide an indication of water quality. The result shows that esthetic water quality parameters had a potential interpretation of water quality as of the laboratory analysis. Finally, there suggests that due consideration of esthetic factors as measured parameters is fundamental for the sustainable use of drinking water infrastructures.

Keywords: TSS, TDS & Ultra violet spectroscopy analysis

I. INTRODUCTION

Water is one of the essential requirements for all life on earth, covering a majority of the planet's surface yet with only a limited portion accessible as fresh water, making its responsible management crucial for human survival and ecological balance; this project will explore various aspects of water including its nature, appearance, usage, and their physical & biological parameters. Drinking water, also known as potable water, is essential for the survival and well-being of all living organisms, especially humans. It is water that is safe for human consumption and meets the required health standards, free from harmful chemicals, pathogens, and pollutants. Clean drinking water is necessary for maintaining body functions such as digestion, circulation, temperature regulation, and waste elimination. Water hardness is important because it indicates the level of dissolved minerals like calcium and magnesium in the water, which can significantly impact the quality of water for domestic and industrial uses. In India, the parameters for drinking water quality are primarily governed by the **Indian Standard IS 10500:2012**.This standard specifies the requirements for the quality of drinking water, covering a range of physical, chemical, and microbiological parameters.

II. EXPERIMENTAL SECTION

2.1 COLOUR

Apparent colour - Fill the sample in Neesler cylinder to the 50 ml mark with water and compare with standards.

2.2 ODOUR

Sample taken for observation of odour shall be at room temperature.

2.3 pH

pH stands for hydrogen (H) potential and it represents the measure of concentration of H+ ions in a solution. As a mathematical consequence of the formula that defines pH, the units on the pH scale range from 0 to 14. A value of 7 indicates neutrality, values less than 7 are called acidic, and values greater than 7 are called basic or alkaline.

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In a 100 ml beaker take a pH 7.0 buffer solution and place it in an electrode, and stir well. Now place the electrode in the beaker containing the stirred buffer and check the reading in the pH meter. If the instrument is not showing a pH value of 7.0, using the calibration knob adjust the reading to 7.0. Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue. After we used to calibrate that using buffer 4.01 solution. The pH range of the sample (EHS360/TR/2024-25/N14691) was 6.58.

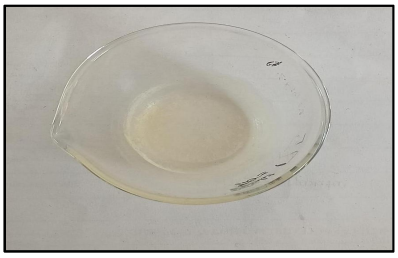
2.4 ELECTRICAL CONDUCTIVITY (EC)

Connected the conductivity meter to AC to avoid the effect of polarisation. Dipped the cell and thermistor (temperature probe) in a beaker containing 0.1N KCl. (EC = 1413 μS / cm at 25°C). Adjusted the temperature to 25°C. Read the specific conductivity. Adjusted the cell constant screw until the display reads the correct specific conductivity of the solution, and Removed the cell and temperature probe and rinsed it with distilled water.

2.5 TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) is the amount of dissolved solids in a liquid, such as water. TDS includes inorganic salts, small amounts of organic matter, and other dissolved substances. The sample is filtered and the filtrate evaporated in a tare dish on a steam- bath. The residue after evaporation is dried to constant mass at 103-105°C or 179 - 181°C.

Heat the clean evaporating dish to 180°C for 1 hour. Cool in the desiccator, weigh and store in the desiccator until ready for use..Pipette the volume to a weighted evaporating dish placed on a steam-bath. Evaporation may also be performed in a drying oven. The temperature shall be lowered to approximately 98°C to prevent boiling and splattering of the sample. After complete evaporation of water from the residue. transfer the dish to an oven at 103-105°C or 179-181°C and dry to constant mass, that is, till the difference in the successive weighings is less than 0.5 mg. Weigh the dish as soon as it has cooled, avoiding residue to stay for a long time as some residues are hygroscopic and may absorb water from desiccant that is not absolutely dry.



2.6 TOTAL SUSPENDED SOLID (TSS)

The total suspended solids (TSS) procedure involves filtering a water sample through a glass fiber filter and then drying and weighing the filter. The increase in weight is the TSS. Weight a glass fiber filter and Dry the filter in an oven at 103–105°C. Let the filter cool in a desiccator. Place the filter in a funnel or crucible then attach the funnel or crucible to a vacuum system. Allow the sample to drain through the filter and wash the sides of the funnel with deionized water. Dry the filter and pan in an oven at 103–105°C. Let the filter and pan cool in a desiccator then weigh the filter to the nearest 0.0001 g .

Figure -1 After weight (w1) Filter paper placed in vacuum pump

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2.7 TOTAL HARDNESS

Todetermine the total hardness of water, we generally perform a titration method using EDTA (Ethylenediaminetetraacetic acid) as the titrant. Measure a known volume of the water sample (usually 50 mL) using a pipette and transfer it to a clean conical flask. Add 2 ml of Ammonia buffer and add a pinch of Eriochrome Black T solution to the sample. The water will turn Pink colour. Fill a burette with the standard EDTA solution. Slowly titrate the water sample with the EDTA solution while constantly swirling the conical flask.The EDTA will bind to the calcium and magnesium ions, and the color of the solution will change from red to blue, indicating the endpoint.

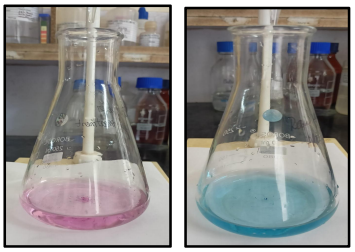

Figure- 2 End point of hardness pink turns into steel blue.

2.8 TOTAL CALCIUM

Measure a known volume of the water sample (usually 50 mL) using a pipette and transfer it to a clean conical flask. Add a 2 ml of NaOH buffer solution to the sample. Add a pinch of Patton Reeders indicator to the sample. Patton Reeders are commonly used for calcium titrations. The solution will initially be pink in color. Fill a burette with the standard EDTA solution (0.01 M or as required). Calcium ions (Ca^{2+}) will react with EDTA, and the color of the solution will gradually change from pink to steel blue as the calcium.The endpoint is reached when the solution turns from pink (indicating calcium is present) to steel blue (indicating the calcium has been complexed with EDTA).

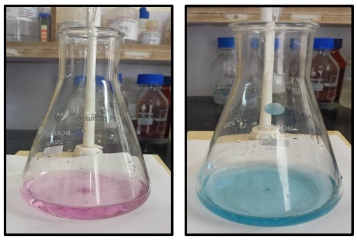

Figure - 3 End point of calcium pink turns into steel blue.

2.9 PHENOLPHTHALEIN ALKALINITY

The phenolphthalein alkalinity procedure is used to determine the concentration of hydroxide (OH^-) and carbonate (CO_3^{2-}) ions in a water sample. Pipette 50 mL of the water sample into a clean 250 mL conical flask. Addition of Phenolphthalein indicator to the sample. Typically, 1-2 drops of 0.1% phenolphthalein solution are sufficient for 50 mL of sample. Initially, the solution will be colorless in acidic or neutral conditions and will turn pink if alkaline (above pH 8.3). Fill the burette with the 0.02 N or 0.1 N Sulphuric acid solution. Record the initial volume in the burette. Continue until the pink color disappears, indicating that the hydroxide alkalinity has been neutralized.

2.10 TOTAL ALKALINITY

The purpose of this procedure is to determine the total alkalinity in a water sample, which reflects the concentration of alkaline substances (such as hydroxides, carbonates, and bicarbonates) that can neutralize acids. Use a pipette to transfer exactly 50 mL of the sample into a clean 250 mL conical flask. Add 1-2 drops of methyl orange indicator to the same sample. Methyl orange will turn green in alkaline conditions and pink in acidic conditions. Add the acid slowly while swirling the sample until the solution changes color from green to pink.

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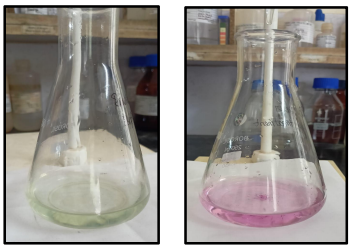

Figure- 4 End point of Alkalinity green turns into pink.

2.11 CHLORIDE

To determine the amount of chloride (in the form of Cl^-) present in the given water sample by Argentometric titration (Mohr's method). If water containing chlorides is titrated with silver nitrate solution, chlorides are precipitated as white silver chloride. Potassium chromate is used as an indicator, which supplies chromate ions. Pipette a known volume of the water sample into a conical flask and add a few drops of potassium chromate indicator solution, which will give the solution a yellow color. Slowly add a standard silver nitrate solution from a burette to the sample, stirring continuously, until a faint reddish-brown precipitate appears, indicating the endpoint.

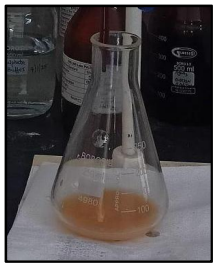

Figure - 5 After titrate with silver nitrate end point (brick red colour)

2.12 UV- SPECTROMETER ANALYSIS

2.12.1 SULPHATE

To measure sulfate using UV spectroscopy, a common procedure involves reacting sulfate ions with barium ions to form a precipitate of barium sulfate, which then creates turbidity in the solution, and this turbidity is measured by its light scattering properties at a specific wavelength (usually around 420nm) using a UV-Vis spectrophotometer. Add a known excess of barium chloride solution to the sample to precipitate the sulfate as barium sulfate. Mix the solution well and allow sufficient time for the barium sulfate precipitate to form and settle. Blank measurement- Use a solution containing all reagents except the sample to zero the spectrophotometer. Measure the absorbance of the sample solution at a predetermined wavelength (typically around 420nm).

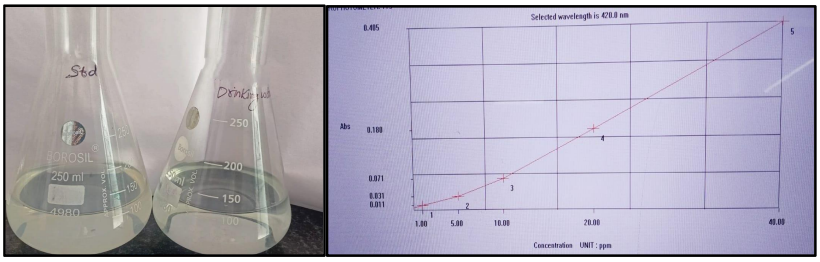

Figure - 6 Absorption of drinking water (around 420 nm)

2.12.2 IRON

To measure iron (Fe) concentration using UV spectroscopy, a common procedure involves forming a colored complex with a chelating agent like 1,10-phenanthroline, which then allows you to measure the absorbance of the complex at a specific wavelength in the visible range using a UV-Vis spectrophotometer; essentially, the higher the absorbance, the

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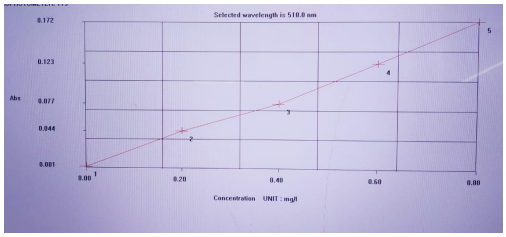
greater the iron concentration in the sample. Take the sample (e.g., water- (EHS360/TR/2024-25/N14691), final make up volume is (50 ml). If necessary, reduce Fe(III) to Fe(II) using a reducing agent like hydroxylamine hydrochloride. Add a known excess of 1,10-phenanthroline reagent to the sample solution. Adjust the pH of the solution to the optimal range for complex formation (typically around 3-4) using a buffer solution. Prepare a series of standard iron solutions with known concentrations and measure their absorbance at the chosen wavelength (usually around 510 nm).



2.12.3 NITRATE

To determine nitrate concentration using UV spectroscopy, a common procedure involves measuring the absorbance of a sample at a specific wavelength (typically around 220 nm) where nitrate absorbs UV light. Set the wavelength to 220 nm and zero the instrument with a blank solution (deionized water). Measure the absorbance of the sample at 220 nm, recording the value.

III. RESULT AND DISCUSSION

S. No	Parameters	Unit	Results	Limit as per IS 10500: 2012
1.	Colour	Hazen	< 5	5
2.	Odor	-	Agreeable	Agreeable
3.	pH @ 25 C		6.58	6.5 - 8.5
4.	Conductivity @ 25 C	$\mu S / cm$	61	-
5.	Total dissolved solids	mg/l	22.0	500
6.	Phenolphthalein Alkalinity	mg/l	Nil	-
7.	Total Hardness as $CaCO_3$	mg/l	5.0	200
8.	Total Alkalinity as $CaCO_3$	mg/l	6.0	200
9.	Calcium as Ca	mg/l	1.20	75
10.	Chloride as Cl	mg/l	8.41	250
11.	Sulphate as so_4	mg/l	BDL (DL:1.0)	200
12.	Iron	mg/l	BDL (DL:0.1)	0.3
13.	Nitrate	mg/l	4.85	45

BDL - Below Detection Limit, **DL** - Detection Limit

IV. CONCLUSION

In conclusion, the analysis of drinking water under various quality parameters plays a critical role in ensuring its safety, potability, and suitability for human consumption. By evaluating factors such as pH levels, turbidity, hardness, heavy metals, microbial contamination, and the presence of toxic substances, we can determine whether the water meets national and international standards (such as those set by WHO or EPA).

We conclude that the water sample (EHS 360/TR/2024-2025/N14691) in Kancheepuram is the pH range of this sample is 6.58. The Hardness is 5.0 and also they involve the limited range as per IS 10500:2012. If hardness is excessive in drinking water, it can lead to noticeable effects like dry skin and hair, potential digestive issues due to high mineral content (mainly calcium and magnesium). In this sample are analysed heavy metals using UV-VIS Spectroscopy in various nm and parameters already discussed in result and disscusion. The above submitted water sample does meet the requirement as per IS:10500:2012 with respect to the above test conducted.

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