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Department of AGE, BT & BI

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ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Vadlamudi Water Analysis

SUBMITTED BY

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February 2023

VIGNAN'S
Foundation for Science, Technology & Research
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CERTIFICATE

This is to certify that the field project entitled "**Vadlamudi Water Analysis**" is submitted by **UPPU OMSHRI (221FA12002), DRONADULA SAI VAMSI (221FA12003), LAKKARAJU SAI SRINIVAS (221FA12004)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology andResearch, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

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NAAC A Accredited

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Vadlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Vadlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Y P A prasad
పంచాయితీ కార్యదర్శి
గ్రామ పంచాయితీ, వడ్లమూడి
చేబ్రోలు మండలం, గుంటూరు జిల్లా

Objective:

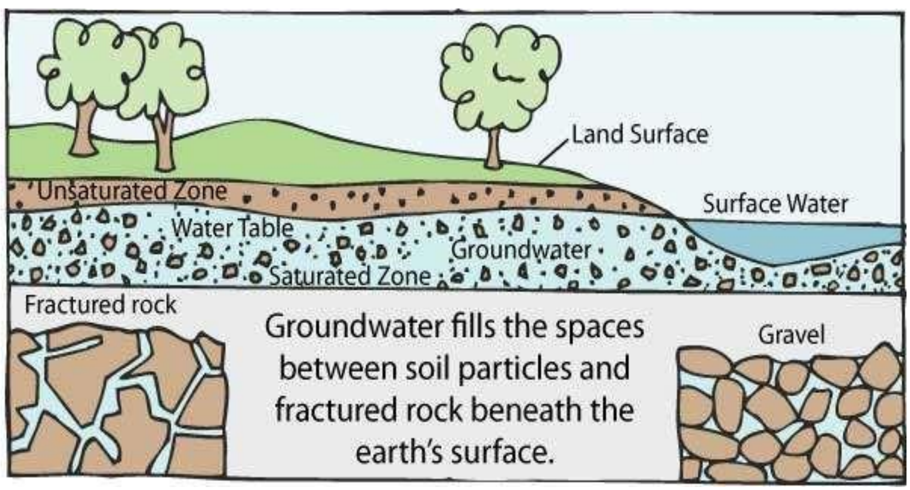
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Groundwater quality refers to the state of water that is located beneath Earth's surface. Groundwater can gather in cracks in subsurface rocks and in between soil particles. Since many compounds can dissolve in water and others can be suspended in water, there is a potential for contamination with toxic compounds. These include petroleum, hydrocarbons (oil), pesticides, minerals, and disease-causing (pathogenic) microorganisms. Groundwater tends to be less prone to contamination than surface waters such as streams, rivers, and lakes because the contaminants have to pass down through the ground to reach the water. Nevertheless, contamination can occur, especially if there are cracks in overlying soil and rock through which the toxic compounds can more easily flow. In recent years, the growth of industry, technology, population, and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes and chemical



fertilizers, herbicides, and pesticides not properly contained have entered the soil, infiltrated some aquifers, and degraded the ground-water quality. Other pollution problems include sewer leakage, faulty septic-tank operation, and landfill leachates.

Sample- collection

Water typically is not considered desirable for drinking if the quantity of dissolved minerals exceeds 1,000 mg/L (milligrams per liter). Water with a few thousand mg/L of dissolved minerals is classed as slightly saline, but it is sometimes used in areas where lessmineralized water is not available. Water from some wells and springs contains very

large concentrations of dissolved minerals and cannot be tolerated by humans and other animals or plants. Many parts of the Nation are underlain at depth by highly saline ground water that has only very limited uses. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Krishna dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Vadlamudi Krishna river. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our area and changes in climatic conditions river water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Krishna river water and I would like to analyze and submit the report on Krishna river water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200
pH	pH metric method	pH	pH metric method	6.5-8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	----
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	----

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes withEDTA. Certain dyestuffs like EBT which form weak colored complexes with cationscan serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[M\text{-}EBT]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA.Once all the metal ions formed EDTA complex, finally the indicator is displaced frommetalindicator (M-In) complex leaving free indicator. The color change accompanyingthis progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[M\text{-}EBT]\ \text{complex}} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[M\text{-}EDTA]\ \text{complex}} + \underset{\text{(Blue)}}{EBT\ \text{indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

Un Boiled:

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	7.6 ml	7.6 ml
2	20 ml	7.6 ml	21.2 ml	14.6 ml
3	20 ml	21.2 ml	31.6 ml	10.4 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 10.8 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 10.8}{20} = 0.0054\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0054 X 100 x 1000 = 540 mg/l or 540 ppm

Result: Total Hardness of given water sample before boiling process is 540 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator,Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, inconditioning the boiler feed water (internally), for calculating the amounts of lime andsoda needed for water softening and also in neutralizing the acidic solution produced bythe hydrolysis of salts. In boilers for steam generation, high alkalinity of water may notonly lead to caustic embrittlement but also to the precipitation of sludges and depositionof scales.The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonateion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimatedseparately by titration against standard acid, using phenolphthalein and methyl orange asindicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops ofphenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	4.9 ml	4.9 ml
2	20 ml	4.9 ml	9.6 ml	4.7 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.8 ml

N_2= Normality of hard water sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $of Hardwater = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 4.8}{20} = 0.024N$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

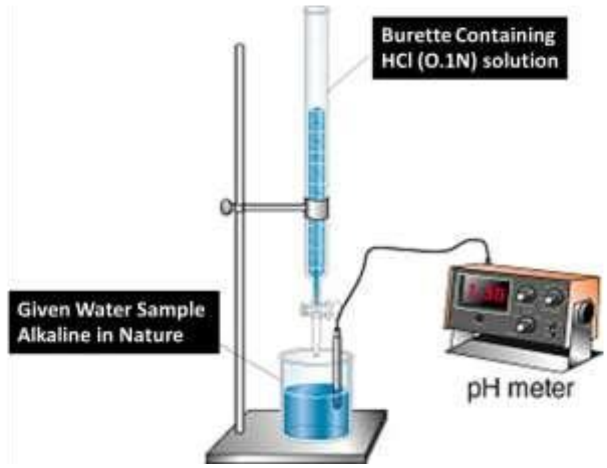
= 0.024 X 50 x 1000 = 1200 mg/l or 1200 ppm

Result: Total Alkalinity of given water sample before boiling process is 1200 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



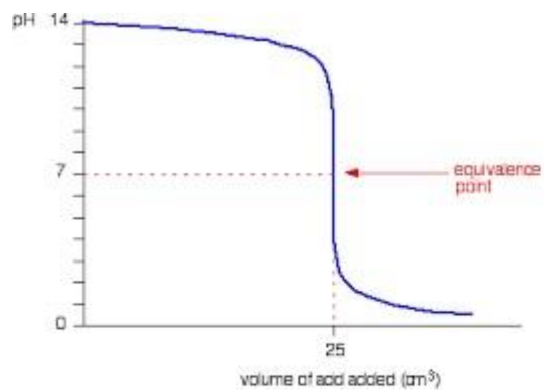
Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution .The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

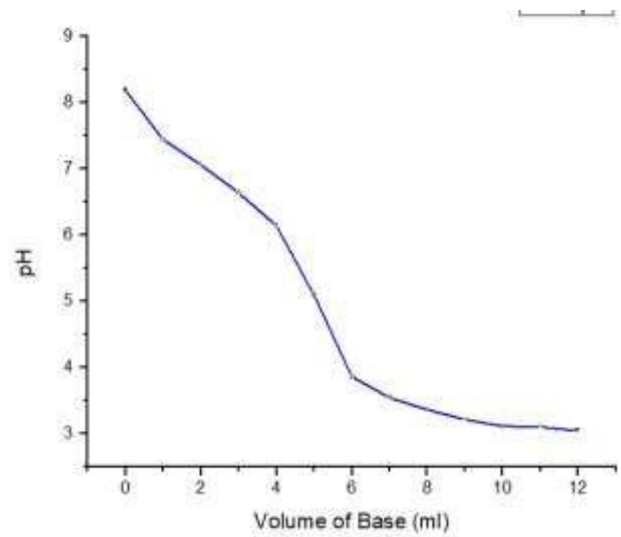
electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solutionproperly. Measure the temperature of the solution and set the temperature compensatecontrol accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put theselector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to theknown pH value of the buffer by burning the set buffer control. Put back the selector atzero position. Wash the electrode with distilled water and standardize the pH meter usingbasic buffer solution pH = 9.2. Same procedure to be followed except the selector switchis put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them withtissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conicaland immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time),shake the solution well and note the corresponding pH values. Near the endpoint, volumeof HCl added should be as small as possible because the base is neutralized and therewill a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decreasethe pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.



Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	10	0	8.19
2	10	1	7.44
3	10	2	7.06
4	10	3	6.64
5	10	4	6.14
6	10	5	5.09
7	10	6	3.86
8	10	7	3.54
9	10	8	3.36
10	10	9	3.21
11	10	10	3.11
12	10	11	3.10



13	10	12	3.04

Calculations:

Plot a graph between pH and volume of HCl added and find out the volume of HCl required (V_1 mL) for complete neutralization of alkaline water from the graph. Then find out thestrength of water (N_2).

$$20 \text{ x } N_1 = N_2 X\ V_2$$

Normality of Alkaline water sample (N_1) = (N_2 X V_2/20) = (---------N)

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_1 X 50 x 1000 mg/L

= ----------N X 50 x 1000 = -------- mg/l or -------- ppm

Result: Total Alkalinity of given water sample before boiling process is --------- ppm.

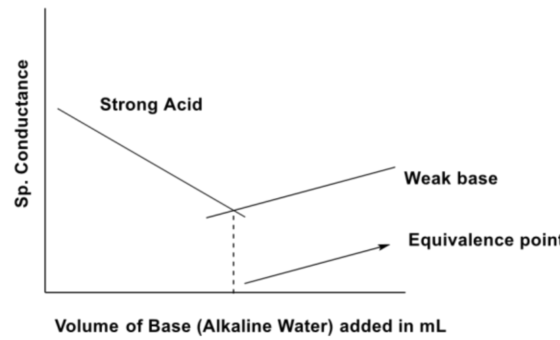
4. Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^-ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured.
3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.
10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.
11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken** **(V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added** **(V_1 = mL)**	**Sp. Conductance**
1	10	0	1.3

Result: the electrical conductance of water sample before boiling process is ---1.3------

5. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- € = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

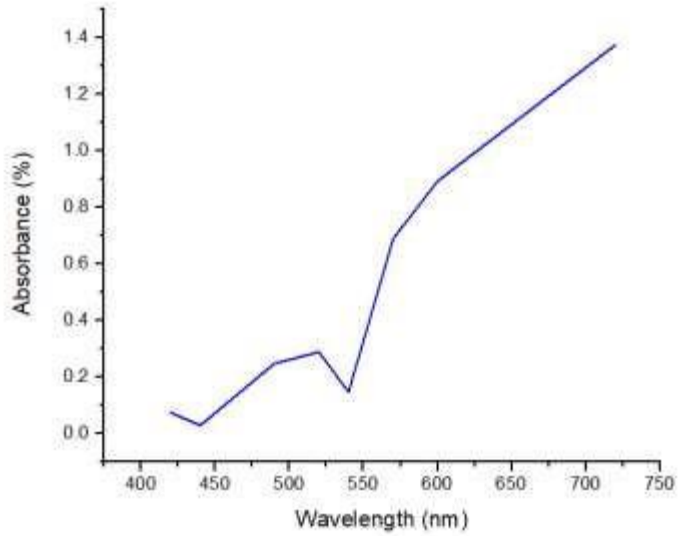
Determination $\lambda_{max}$for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graphis drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.073
2	440	0.028
3	490	0.247
4	520	0.288
5	540	0.146
6	570	0.688
7	600	0.893
8	720	1.375



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.288) and another one at 720 nm (abs: 1.375).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.4 ml	5.4 ml
2	20 ml	5.4 ml	10.8 ml	5.4 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 5.4}{20} = \mathbf{0}.0027\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0027 X 100 x 1000 = 270 mg/l or 270 ppm

Result: Total Hardness of given water sample before boiling process is 270 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint .Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint.The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	0.8 ml	0.8 ml
2	20 ml	0.8 ml	3.4 ml	2.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.7 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 1.7}{20} = 0.0085$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0085 X 50 x 1000 = 425 mg/l or 425 ppm

Result: Total Alkalinity of given water sample before boiling process is 425 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	20	0	8.80

Result: pH of given water sample after boiling process is **8.80**

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1	10	0.13

Result: Electrical conductance of given water sample after boiling process is ---0.13------

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.112**
2	**440**	**0.071**

3	**490**	**0.301**
4	**520**	**0.351**
5	**540**	**0.215**
6	**570**	**0.751**
7	**600**	**0.934**
8	**720**	**1.410**

Result: The graph shows maximum absorbanceat (□max) 520 nm (abs: 0. 351) and another one at 720 nm (abs: 1.410).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method (540 ppm)	Hardness	EDTA Method (270 ppm)	
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	
pH	pH metric method	pH	pH metric method	
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Vadlamudi Water Analysis

SUBMITTED BY

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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Vadlamudi Water Analysis**" is submitted by **SAKLENRAZA (221FA01001), MANMOHAN PRASAD SAH (221FA01003), AMRESH KUMAR (221FA01004),PRINCE KUMAR (221FA01005),BHUKKE VIDHYA VARSHINI (221FA01006), SAWAN**

KUMAR DAS (221FA01007), RITHIKA SURAPANENI (221FA01008) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956
NAAC Accredited A

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Vadlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Vadlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Y P A Prasad
పంచాయితీ కార్యదర్శి
గ్రామ పంచాయితీ, వడ్లమూడి
చేబ్రోలు మండలం, గుంటూరు జిల్లా

Objective:

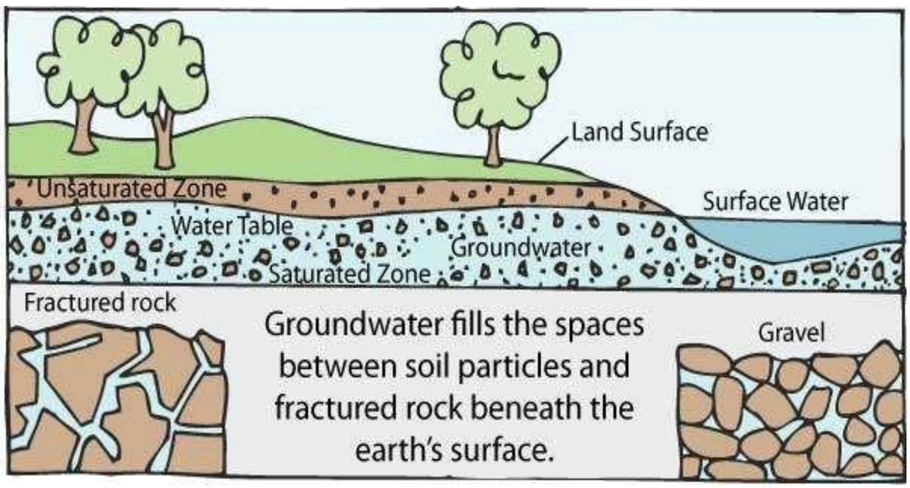
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Groundwater quality refers to the state of water that is located beneath Earth's surface. Groundwater can gather in cracks in subsurface rocks and in between soil particles. Since many compounds can dissolve in water and others can be suspended in water, there is a potential for contamination with toxic compounds. These include petroleum, hydrocarbons (oil), pesticides, minerals, and disease-causing (pathogenic) microorganisms. Groundwater tends to be less prone to contamination than surface waters such as streams, rivers, and lakes because the contaminants have to pass down through the ground to reach the water. Nevertheless, contamination can occur, especially if there are cracks in overlying soil and rock through which the toxic compounds can more easily flow. In recent years, the growth of industry, technology, population, and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes and chemical fertilizers, herbicides, and pesticides not properly contained have entered the soil, infiltrated some aquifers, and degraded the ground-water quality. Other pollution problems include sewer leakage, faulty septic-tank operation, and landfill leachates.



Sample- collection

Water typically is not considered desirable for drinking if the quantity of dissolved minerals exceeds 1,000 mg/L (milligrams per liter). Water with a few thousand mg/L of dissolved minerals is classed as slightly saline, but it is sometimes used in areas where lessmineralized water is not available. Water from some wells and springs contains very

large concentrations of dissolved minerals and cannot be tolerated by humans and other animals or plants. Many parts of the Nation are underlain at depth by highly saline ground water that has only very limited uses. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Krishna dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Vadlamudi Krishna river. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our area and changes in climatic conditions river water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Krishna river water and I would like to analyze and submit the report on Krishna river water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200
pH	pH metric method	pH	pH metric method	6.5-8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	----
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	----

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes withEDTA. Certain dyestuffs like EBT which form weak colored complexes with cationscan serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA.Once all the metal ions formed EDTA complex, finally the indicator is displaced frommetalindicator (M-In) complex leaving free indicator. The color change accompanyingthis progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

Un Boiled:

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.6 ml	7.6 ml
2	20 ml	7.6 ml	21.2 ml	14.6 ml
3	20 ml	21.2 ml	31.6 ml	10.4 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 10.8 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 10.8}{20} = 0.0054\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0054 X 100 x 1000 = 540 mg/l or 540 ppm

Result: Total Hardness of given water sample before boiling process is 540 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator,Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, inconditioning the boiler feed water (internally), for calculating the amounts of lime andsoda needed for water softening and also in neutralizing the acidic solution produced bythe hydrolysis of salts. In boilers for steam generation, high alkalinity of water may notonly lead to caustic embrittlement but also to the precipitation of sludges and depositionof scales.The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonateion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimatedseparately by titration against standard acid, using phenolphthalein and methyl orange asindicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops ofphenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	4.9 ml	4.9 ml
2	20 ml	4.9 ml	9.6 ml	4.7 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.8 ml

N_2= Normality of hard water sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 4.8}{20} = 0.024N$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

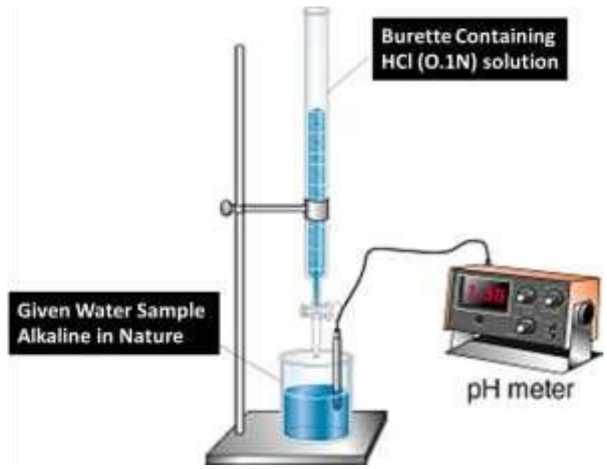
= 0.024 X 50 x 1000 = 1200 mg/l or 1200 ppm

Result: Total Alkalinity of given water sample before boiling process is 1200 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



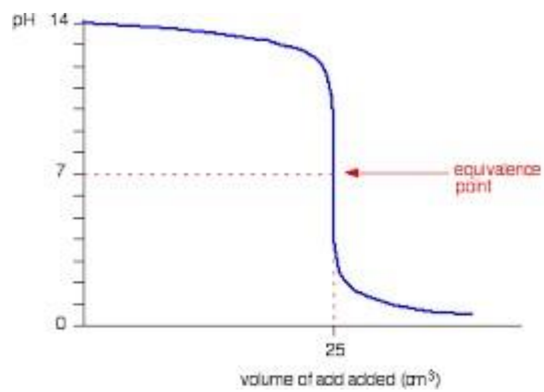
Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution .The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

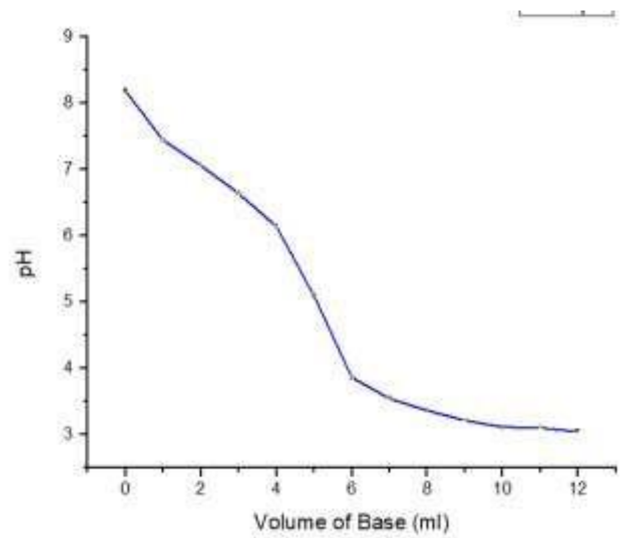
to the solutionproperly. Measure the temperature of the solution and set the temperature compensatecontrol accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put theselector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to theknown pH value of the buffer by burning the set buffer control. Put back the selector atzero position. Wash the electrode with distilled water and standardize the pH meter usingbasic buffer solution pH = 9.2. Same procedure to be followed except the selector switchis put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them withtissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conicaland immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time),shake the solution well and note the corresponding pH values. Near the endpoint, volumeof HCl added should be as small as possible because the base is neutralized and therewill a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decreasethe pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.



Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	10	0	8.19
2	10	1	7.44
3	10	2	7.06
4	10	3	6.64
5	10	4	6.14
6	10	5	5.09
7	10	6	3.86
8	10	7	3.54
9	10	8	3.36
10	10	9	3.21
11	10	10	3.11
12	10	11	3.10



13	10	12	3.04

Calculations:

Plot a graph between pH and volume of HCl added and find out the volume of HCl required (V_1 mL) for complete neutralization of alkaline water from the graph. Then find out thestrength of water (N_2).

$$20 \times N_1 = N_2 X V_2$$

Normality of Alkaline water sample (N_1) = (N_2 X V_2/20) = (---------N)

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_1 X 50 x 1000 mg/L

= ----------N X 50 x 1000 = -------- mg/l or -------- ppm

Result: Total Alkalinity of given water sample before boiling process is --------- ppm.

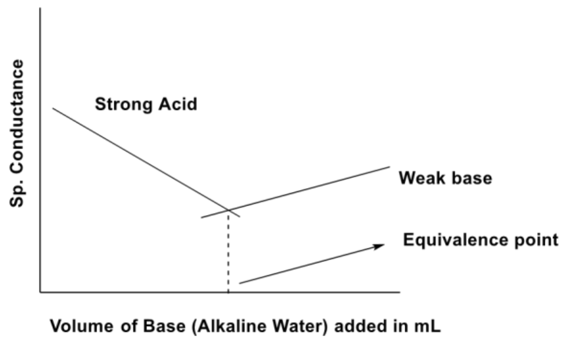
4. Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = mL)**	**Sp. Conductance**
1	10	0	1.3

Result: the electrical conductance of water sample before boiling process is ---1.3------

5. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution ($NH_4Cl + NH_4OH$ solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

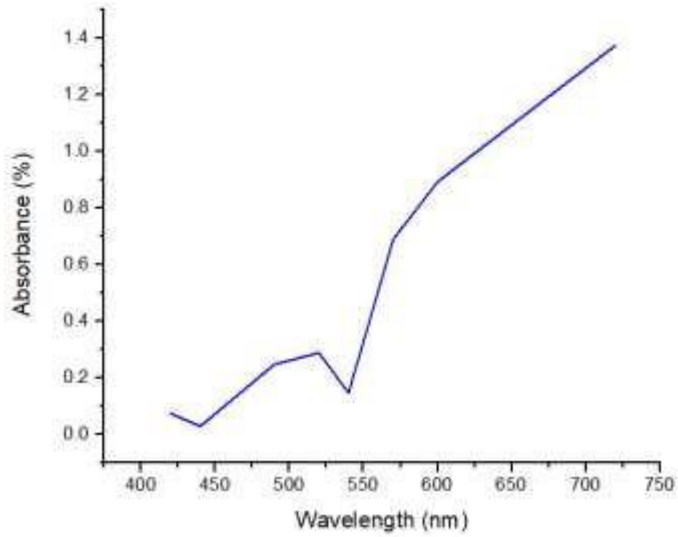
Determination $\lambda_{max}$for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graphis drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.073
2	440	0.028
3	490	0.247
4	520	0.288
5	540	0.146
6	570	0.688
7	600	0.893
8	720	1.375



Result: The graph shows maximum absorbanceat (□max) 520 nm (abs: 0.288) and another one at 720 nm (abs: 1.375).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.4 ml	5.4 ml
2	20 ml	5.4 ml	10.8 ml	5.4 ml

$$\boldsymbol{M_1XV_1} = \boldsymbol{M_2XV_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 5.4}{20} = \mathbf{0}.0027\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0027 X 100 x 1000 = 270 mg/l or 270 ppm

Result: Total Hardness of given water sample before boiling process is 270 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint .Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint.The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	0.8 ml	0.8 ml
2	20 ml	0.8 ml	3.4 ml	2.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.7 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 1.7}{20} = 0.0085$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0085 X 50 x 1000 = 425 mg/l or 425 ppm

Result: Total Alkalinity of given water sample before boiling process is 425 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	20	0	8.80

Result: pH of given water sample after boiling process is **8.80**

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1	10	0.13

Result: Electrical conductance of given water sample after boiling process is ---0.13------

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

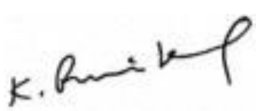
S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.112**
2	**440**	**0.071**

3	**490**	**0.301**
4	**520**	**0.351**
5	**540**	**0.215**
6	**570**	**0.751**
7	**600**	**0.934**
8	**720**	**1.410**

Result: Water Analysis Report 351) and another one at 720 nm (abs: 1.410).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**calculated**
Hardness	EDTA Method (540 ppm)	Hardness	EDTA Method (270 ppm)	270 ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	425 ppm
pH	pH metric method	pH	pH metric method	8.8
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	0.13
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	1.41



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Vadlamudi Water Analysis

SUBMITTED BY

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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

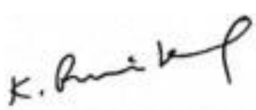
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Vadlamudi Water Analysis**" is submitted by **KUMBHA NAGA PRAVEEN (221FA01199), PILLI TRIVENI (221FA01200) ,MOLAKA VANI (221FA01201),NIDHI CHOWDARY (221FA01202),MAHAMMAD AAMINA ANZUM (221FA01203),**

KARASALA CHELSEA SLAVIN (221FA01205), MD SAHIL (221FA01206)in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Vadlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Vadlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Y P A Prasad
పంచాయితీ కార్యదర్శి
గ్రామ పంచాయితీ, వడ్లమూడి
చేబ్రోలు మండలం, గుంటూరు జిల్లా

Objective:

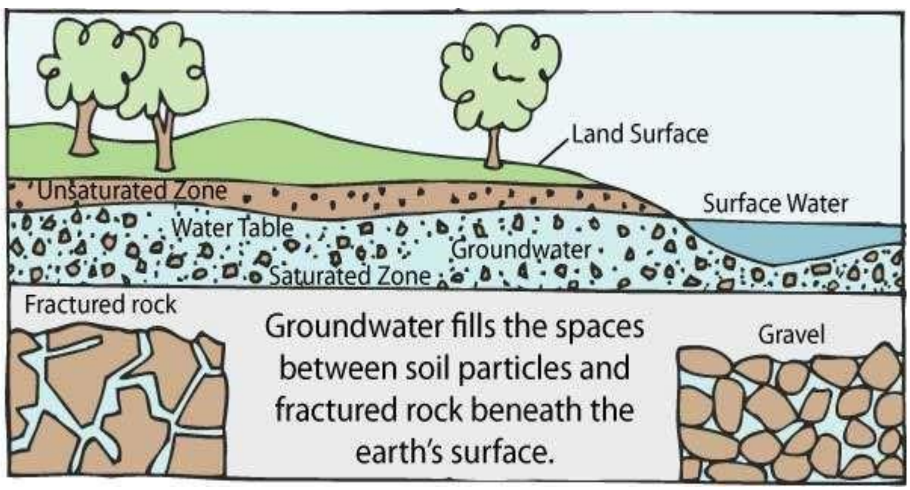
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Groundwater quality refers to the state of water that is located beneath Earth's surface. Groundwater can gather in cracks in subsurface rocks and in between soil particles. Since many compounds can dissolve in water and others can be suspended in water, there is a potential for contamination with toxic compounds. These include petroleum, hydrocarbons (oil), pesticides, minerals, and disease-causing (pathogenic) microorganisms. Groundwater tends to be less prone to contamination than surface waters such as streams, rivers, and lakes because the contaminants have to pass down through the ground to reach the water. Nevertheless, contamination can occur, especially if there are cracks in overlying soil and rock through which the toxic compounds can more easily flow. In recent years, the growth of industry, technology, population, and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes and chemical fertilizers, herbicides, and pesticides not properly contained have entered the soil, infiltrated some aquifers, and degraded the ground-water quality. Other pollution problems include sewer leakage, faulty septic-tank operation, and landfill leachates.



Sample- collection

Water typically is not considered desirable for drinking if the quantity of dissolved minerals exceeds 1,000 mg/L (milligrams per liter). Water with a few thousand mg/L of dissolved minerals is classed as slightly saline, but it is sometimes used in areas where lessmineralized water is not available. Water from some wells and springs contains very

large concentrations of dissolved minerals and cannot be tolerated by humans and other animals or plants. Many parts of the Nation are underlain at depth by highly saline ground water that has only very limited uses. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Krishna dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Vadlamudi Krishna river. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our area and changes in climatic conditions river water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Krishna river water and I would like to analyze and submit the report on Krishna river water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200
pH	pH metric method	pH	pH metric method	6.5-8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	----
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	----

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes withEDTA. Certain dyestuffs like EBT which form weak colored complexes with cationscan serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[M\text{-}EBT]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA.Once all the metal ions formed EDTA complex, finally the indicator is displaced frommetalindicator (M-In) complex leaving free indicator. The color change accompanyingthis progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[M\text{-}EBT]\ \text{complex}} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[M\text{-}EDTA]\ \text{complex}} + \underset{\text{(Blue)}}{EBT\ \text{indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

Un Boiled:

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.6 ml	7.6 ml
2	20 ml	7.6 ml	21.2 ml	14.6 ml
3	20 ml	21.2 ml	31.6 ml	10.4 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 10.8 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 10.8}{20} = 0.0054\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0054 X 100 x 1000 = 540 mg/l or 540 ppm

Result: Total Hardness of given water sample before boiling process is 540 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator,Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, inconditioning the boiler feed water (internally), for calculating the amounts of lime andsoda needed for water softening and also in neutralizing the acidic solution produced bythe hydrolysis of salts. In boilers for steam generation, high alkalinity of water may notonly lead to caustic embrittlement but also to the precipitation of sludges and depositionof scales.The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonateion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimatedseparately by titration against standard acid, using phenolphthalein and methyl orange asindicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops ofphenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	4.9 ml	4.9 ml
2	20 ml	4.9 ml	9.6 ml	4.7 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.8 ml

N_2= Normality of hard water sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 4.8}{20} = 0.024N$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

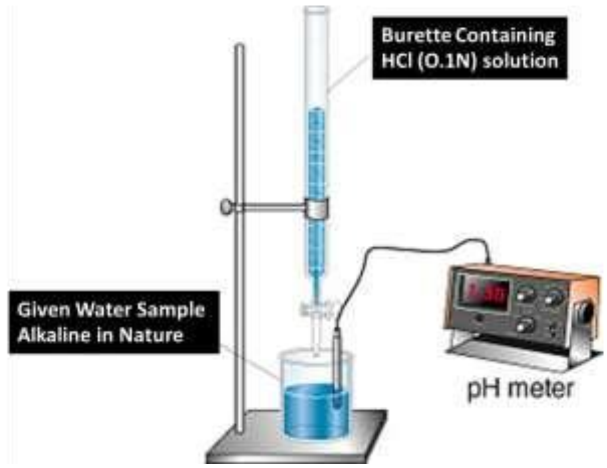
= 0.024 X 50 x 1000 = 1200 mg/l or 1200 ppm

Result: Total Alkalinity of given water sample before boiling process is 1200 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



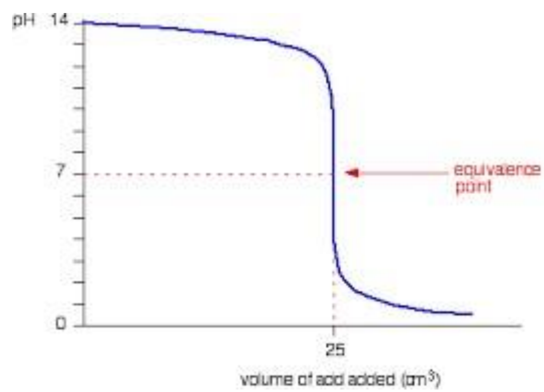
Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution .The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

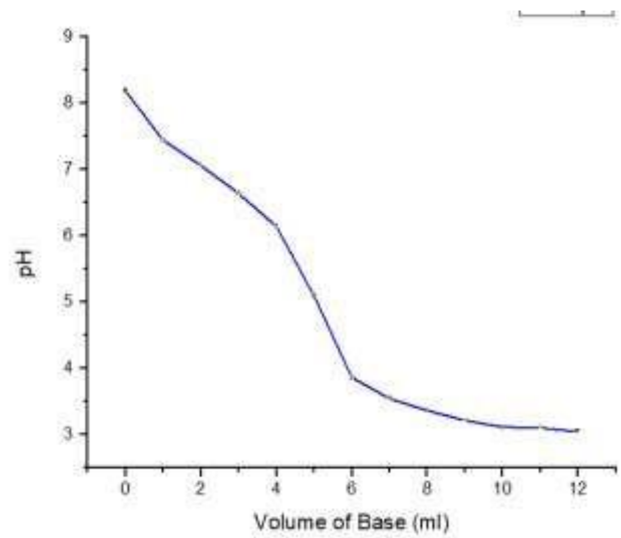
electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solutionproperly. Measure the temperature of the solution and set the temperature compensatecontrol accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put theselector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to theknown pH value of the buffer by burning the set buffer control. Put back the selector atzero position. Wash the electrode with distilled water and standardize the pH meter usingbasic buffer solution pH = 9.2. Same procedure to be followed except the selector switchis put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them withtissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conicaland immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time),shake the solution well and note the corresponding pH values. Near the endpoint, volumeof HCl added should be as small as possible because the base is neutralized and therewill a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decreasethe pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.



Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	10	0	8.19
2	10	1	7.44
3	10	2	7.06
4	10	3	6.64
5	10	4	6.14
6	10	5	5.09
7	10	6	3.86
8	10	7	3.54
9	10	8	3.36
10	10	9	3.21
11	10	10	3.11
12	10	11	3.10



13	10	12	3.04

Calculations:

Plot a graph between pH and volume of HCl added and find out the volume of HCl required (V_1 mL) for complete neutralization of alkaline water from the graph. Then find out thestrength of water (N_2).

$$20 \times N_1 = N_2 X V_2$$

Normality of Alkaline water sample (N_1) = (N_2 X V_2/20) = (---------N)

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_1 X 50 x 1000 mg/L

= ----------N X 50 x 1000 = -------- mg/l or -------- ppm

Result: Total Alkalinity of given water sample before boiling process is --------- ppm.

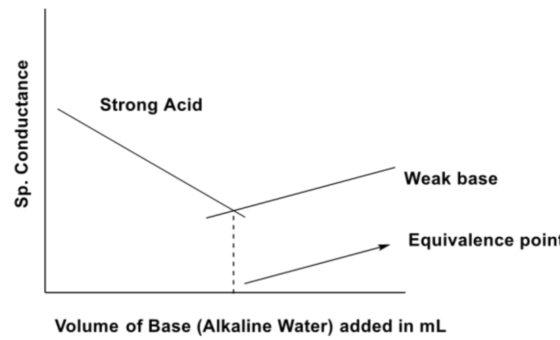
4. Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken** **(V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added** **(V_1 = mL)**	**Sp. Conductance**
1	10	0	1.3

Result: the electrical conductance of water sample before boiling process is ---1.3------

5. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon . c . l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

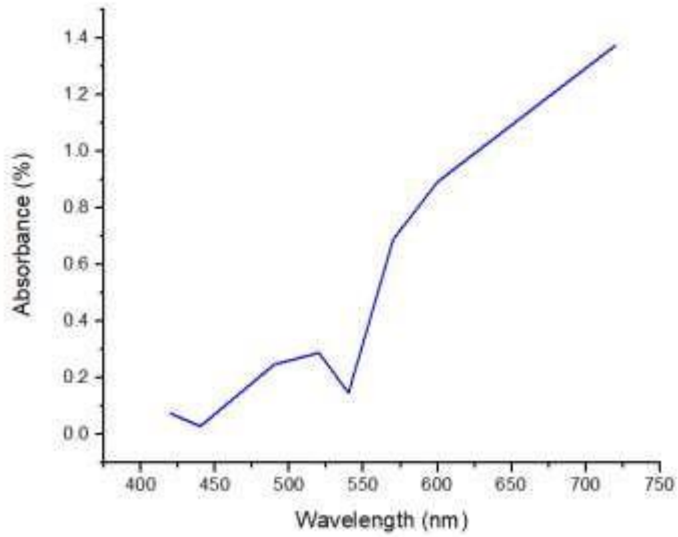
Determination $\lambda_{max}$for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graphis drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.073
2	440	0.028
3	490	0.247
4	520	0.288
5	540	0.146
6	570	0.688
7	600	0.893
8	720	1.375



Result: The graph shows maximum absorbanceat (□max) 520 nm (abs: 0.288) and another one at 720 nm (abs: 1.375).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	5.4 ml	5.4 ml
2	20 ml	5.4 ml	10.8 ml	5.4 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \;\; 5.4}{20} = \mathbf{0}.0027\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0027 X 100 x 1000 = 270 mg/l or 270 ppm

Result: Total Hardness of given water sample before boiling process is 270 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint .Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint.The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	0.8 ml	0.8 ml
2	20 ml	0.8 ml	3.4 ml	2.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.7 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 1.7}{20} = 0.0085$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0085 X 50 x 1000 = 425 mg/l or 425 ppm

Result: Total Alkalinity of given water sample before boiling process is 425 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	20	0	8.80

Result: pH of given water sample after boiling process is **8.80**

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1	10	0.13

Result: Electrical conductance of given water sample after boiling process is ---0.13------

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

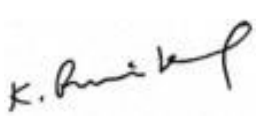
S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.112**
2	**440**	**0.071**

3	**490**	**0.301**
4	**520**	**0.351**
5	**540**	**0.215**
6	**570**	**0.751**
7	**600**	**0.934**
8	**720**	**1.410**

Result: Water Analysis Report 351) and another one at 720 nm (abs: 1.410).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method (540 ppm)	Hardness	EDTA Method (270 ppm)	574, 275 ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	1200, 425 ppm
pH	pH metric method	pH	pH metric method	8.8
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	1.3-0.13
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	1.375-1.41



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Vadlamudi Water Analysis

SUBMITTED BY

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MANAM ASWITHA (221FA01109)
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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Vadlamudi Water Analysis**" is submitted by **MOHAMMAD FARHEEN (221FA01108), MANAM ASWITHA (221FA01109) ,KALVATALA HEMALATHANJALI (221FA01110),BOYA VENKATA HEMA HARSHINI (221FA01112),CHERUKURI SAI TARUN (221FA01113), MANDAVA BALAJI (221FA01115),RAMISETTY HARSHITHA**

(221FA01118) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Vadlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Vadlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Y P A Prasad

పంచాయితీ కార్యదర్శి
గ్రామ పంచాయితీ, వడ్లమూడి
చేబ్రోలు మండలం, గుంటూరు జిల్లా

Objective:

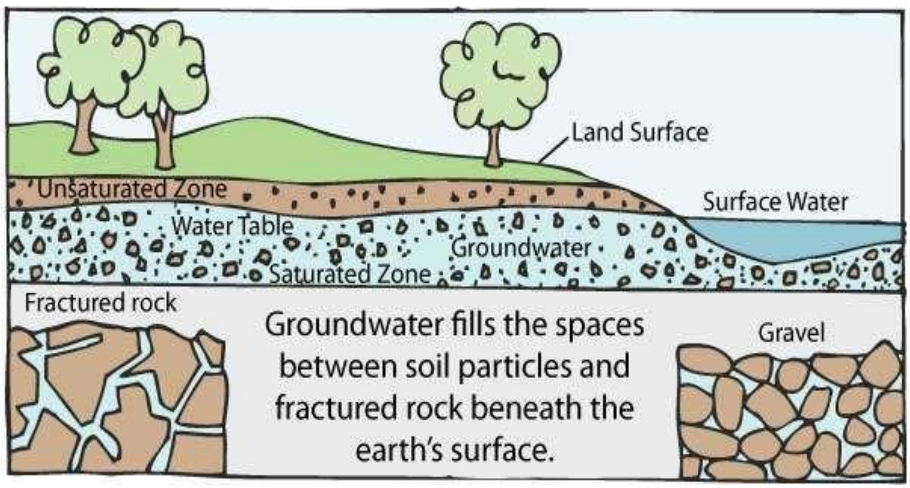
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Groundwater quality refers to the state of water that is located beneath Earth's surface. Groundwater can gather in cracks in subsurface rocks and in between soil particles. Since many compounds can dissolve in water and others can be suspended in water, there is a potential for contamination with toxic compounds. These include petroleum, hydrocarbons (oil), pesticides, minerals, and disease-causing (pathogenic) microorganisms. Groundwater tends to be less prone to contamination than surface waters such as streams, rivers, and lakes because the contaminants have to pass down through the ground to reach the water. Nevertheless, contamination can occur, especially if there are cracks in overlying soil and rock through which the toxic compounds can more easily flow. In recent years, the growth of industry, technology, population, and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes and chemical



fertilizers, herbicides, and pesticides not properly contained have entered the soil, infiltrated some aquifers, and degraded the ground-water quality. Other pollution problems include sewer leakage, faulty septic-tank operation, and landfill leachates.

Sample- collection

Water typically is not considered desirable for drinking if the quantity of dissolved minerals exceeds 1,000 mg/L (milligrams per liter). Water with a few thousand mg/L of dissolved minerals is classed as slightly saline, but it is sometimes used in areas where lessmineralized water is not available. Water from some wells and springs contains very

large concentrations of dissolved minerals and cannot be tolerated by humans and other animals or plants. Many parts of the Nation are underlain at depth by highly saline ground water that has only very limited uses. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Krishna dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Vadlamudi Krishna river. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our area and changes in climatic conditions river water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Krishna river water and I would like to analyze and submit the report on Krishna river water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200
pH	pH metric method	pH	pH metric method	6.5-8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	----
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	----

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes withEDTA. Certain dyestuffs like EBT which form weak colored complexes with cationscan serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA.Once all the metal ions formed EDTA complex, finally the indicator is displaced frommetalindicator (M-In) complex leaving free indicator. The color change accompanyingthis progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

Un Boiled:

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	7.6 ml	7.6 ml
2	20 ml	7.6 ml	21.2 ml	14.6 ml
3	20 ml	21.2 ml	31.6 ml	10.4 ml

$$\boldsymbol{M_1 X V_1 = M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 10.8 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ \ 10.8}{20} = 0.0054\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0054 X 100 x 1000 = 540 mg/l or 540 ppm

Result: Total Hardness of given water sample before boiling process is 540 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator,Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, inconditioning the boiler feed water (internally), for calculating the amounts of lime andsoda needed for water softening and also in neutralizing the acidic solution produced bythe hydrolysis of salts. In boilers for steam generation, high alkalinity of water may notonly lead to caustic embrittlement but also to the precipitation of sludges and depositionof scales.The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonateion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimatedseparately by titration against standard acid, using phenolphthalein and methyl orange asindicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops ofphenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	4.9 ml	4.9 ml
2	20 ml	4.9 ml	9.6 ml	4.7 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.8 ml

N_2= Normality of hard water sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $of Hardwater = N_2 = \frac{N_1 X V_1}{V_2} = \frac{0.1 X 4.8}{20} = 0.024N$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

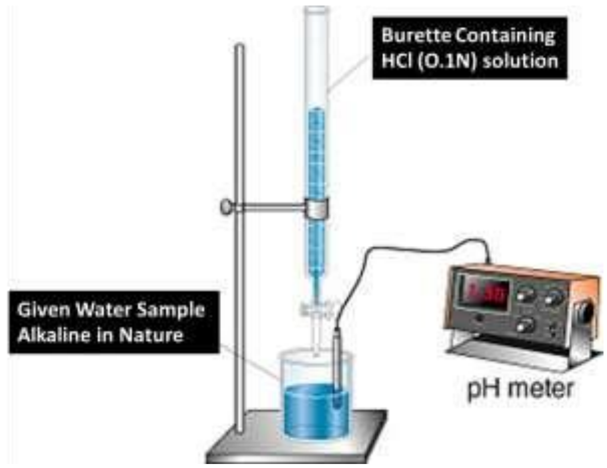
= 0.024 X 50 x 1000 = 1200 mg/l or 1200 ppm

Result: Total Alkalinity of given water sample before boiling process is 1200 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



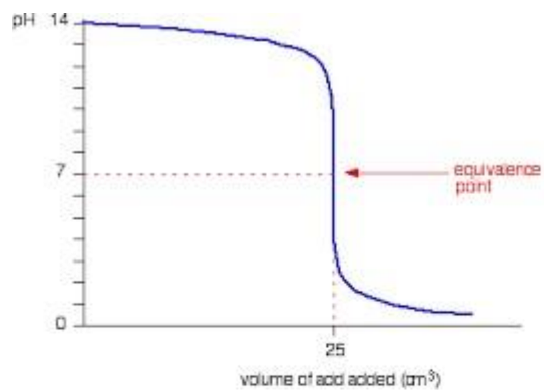
Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution .The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

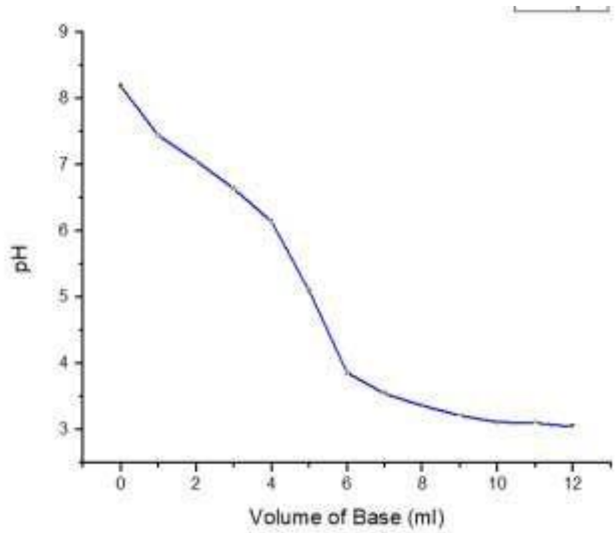
electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solutionproperly. Measure the temperature of the solution and set the temperature compensatecontrol accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put theselector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to theknown pH value of the buffer by burning the set buffer control. Put back the selector atzero position. Wash the electrode with distilled water and standardize the pH meter usingbasic buffer solution pH = 9.2. Same procedure to be followed except the selector switchis put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them withtissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conicaland immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time),shake the solution well and note the corresponding pH values. Near the endpoint, volumeof HCl added should be as small as possible because the base is neutralized and therewill a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decreasethe pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.



Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	10	0	8.19
2	10	1	7.44
3	10	2	7.06
4	10	3	6.64
5	10	4	6.14
6	10	5	5.09
7	10	6	3.86
8	10	7	3.54
9	10	8	3.36
10	10	9	3.21
11	10	10	3.11
12	10	11	3.10



13	10	12	3.04

Calculations:

Plot a graph between pH and volume of HCl added and find out the volume of HCl required (V_1 mL) for complete neutralization of alkaline water from the graph. Then find out thestrength of water (N_2).

$$20 \times N_1 = N_2 X V_2$$

Normality of Alkaline water sample (N_1) = (N_2 X V_2/20) = (---------N)

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_1 X 50 x 1000 mg/L

= ----------N X 50 x 1000 = -------- mg/l or -------- ppm

Result: Total Alkalinity of given water sample before boiling process is --------- ppm.

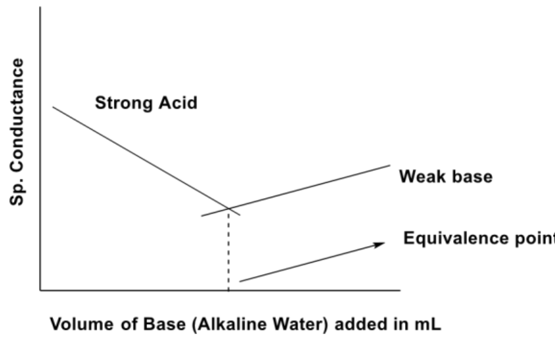
4. Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^-ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.

2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.

4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.

5. Connect the conductivity cell to the conductometer.

6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.

7. Put the function switch to cell constant and set the value of cell constant.

8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = mL)**	**Sp. Conductance**
1	10	0	1.3

Result: the electrical conductance of water sample before boiling process is ---1.3------

5. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon . c . l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

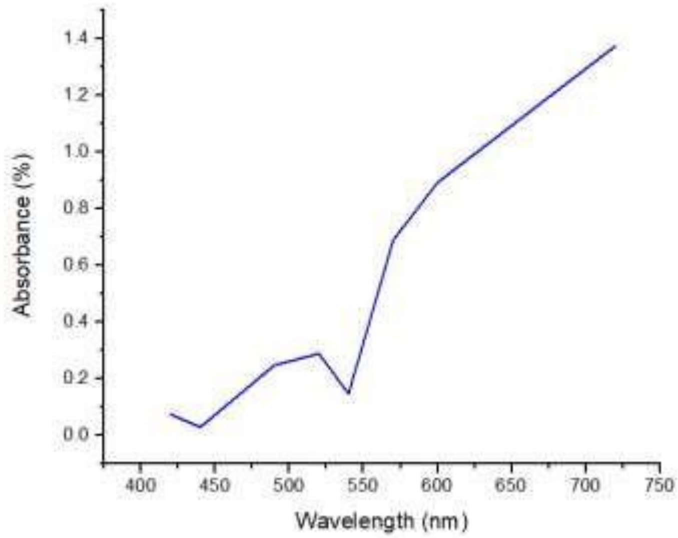
Determination $\lambda_{max}$for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graphis drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.073**
2	**440**	**0.028**
3	**490**	**0.247**
4	**520**	**0.288**
5	**540**	**0.146**
6	**570**	**0.688**
7	**600**	**0.893**
8	**720**	**1.375**



Result: The graph shows maximum absorbanceat (□max) 520 nm (abs: 0.288) and another one at 720 nm (abs: 1.375).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.4 ml	5.4 ml
2	20 ml	5.4 ml	10.8 ml	5.4 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 5.4}{20} = \mathbf{0}.0027\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0027 X 100 x 1000 = 270 mg/l or 270 ppm

Result: Total Hardness of given water sample before boiling process is 270 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint .Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint.The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	0.8 ml	0.8 ml
2	20 ml	0.8 ml	3.4 ml	2.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.7 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 1.7}{20} = 0.0085$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0085 X 50 x 1000 = 425 mg/l or 425 ppm

Result: Total Alkalinity of given water sample before boiling process is 425 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 20 mL)	Volume of HCL added (V_1 = mL)	pH values
1	20	0	8.80

Result: pH of given water sample after boiling process is **8.80**

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1	10	0.13

Result: Electrical conductance of given water sample after boiling process is ---0.13------

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbanceat (□max) 720 nm.

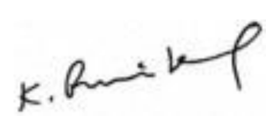
S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.112**
2	**440**	**0.071**

3	**490**	**0.301**
4	**520**	**0.351**
5	**540**	**0.215**
6	**570**	**0.751**
7	**600**	**0.934**
8	**720**	**1.410**

Result: Water Analysis Report 351) and another one at 720 nm (abs: 1.410).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method (540 ppm)	Hardness	EDTA Method (270 ppm)	270
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	425
pH	pH metric method	pH	pH metric method	8.8
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	0.13
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	1.41



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sangam Jagrlamudi Water Analysis

SUBMITTED BY

CHERUKURI CHARAN KUMAR (221FA01009)
MALLADI PRAVALLIKA (221FA01010)
KALLURI SIVA REDDY (221FA01011)
YADALA AKHILA (221FA01012)
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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

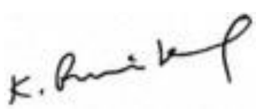
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sangam Jagarlamudi Water Analysis**" is submitted by **CHERUKURI CHARAN KUMAR (221FA01009),MALLADI PRAVALLIKA (221FA01010),KALLURI SIVA REDDY (221FA01011),YADALA AKHILA (221FA01012) ,MADDINA RUPA (221FA01013),TENALI VASUNDARA (221FA01014),TIYYAGURA TEJASWINI**

(221FA01015),MAMILLAPALLI TEJASWI (221FA01016) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Sangam Jagarlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to provide the necessary permission to the students to collect water samples from various places of **Sangam Jagarlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

permitted to collect water samples in Sangam Jagarlamudi GP
K. Sreedevi
Panchayat Secretary
Gram Panchayat, Sangamjagarlamudi
Tenali Mdl., Guntur (Dt.) A.P

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

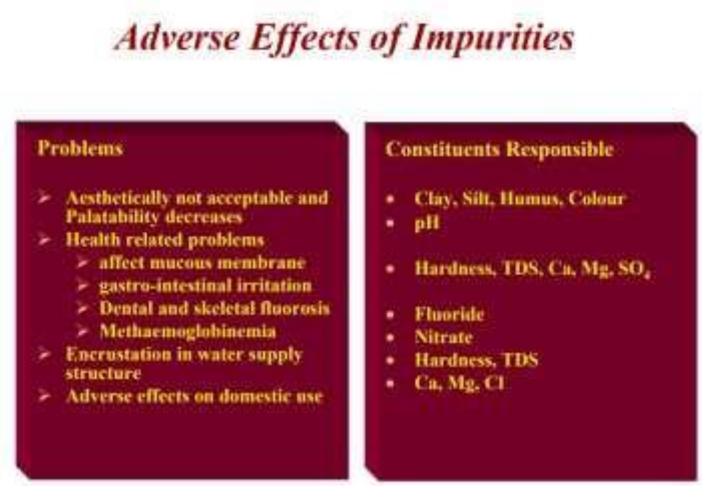
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 13.0}{20} = 0.0065 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

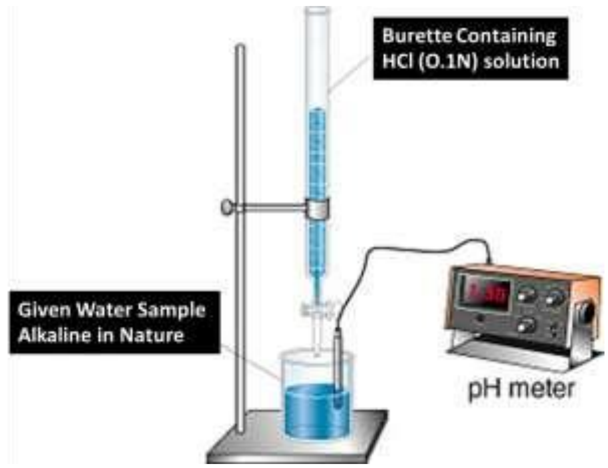
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) **pH-metric Titration:** Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

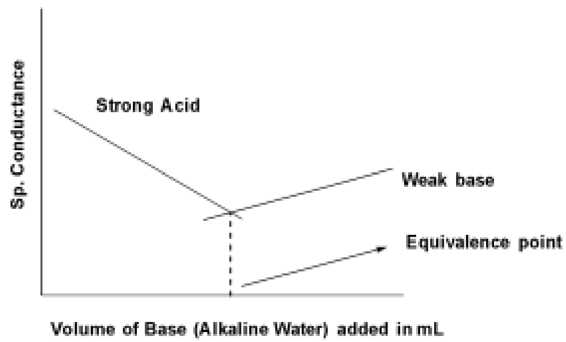
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon . c . l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

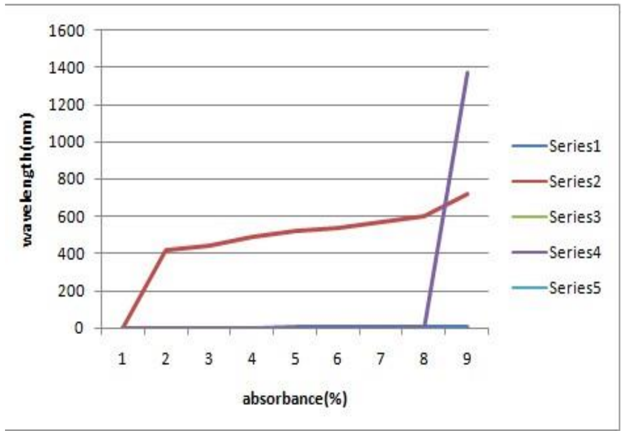
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$M_1 \ X \ V_1 = M_2 \ X \ V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHardwater} = \boldsymbol{M}_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 5.0}{20} = 0.0025 \ \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $of Hard\ water$ $= N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

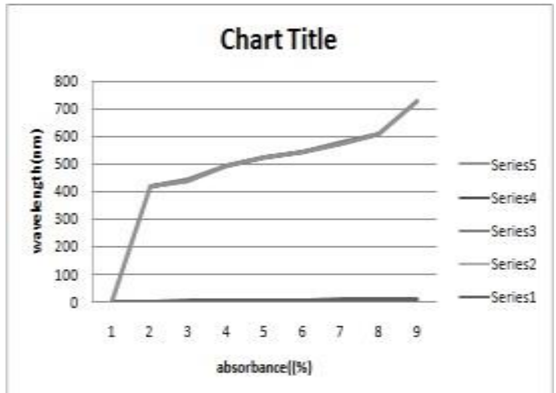
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430

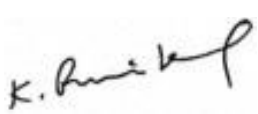


Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	....
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	....

By this analysis we should know that this sample has more hardness and more alkalinity. This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru Water Analysis

SUBMITTED

BY

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ANAPARTHI HAVEELA (221FA01190) DIKSHA KUMARI (221FA01191)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

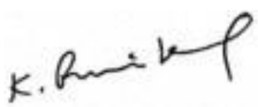
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sekuru Water Analysis**" issubmitted by **JANJANAM BHUVITHA (221FA01188), ANAPARTHI HAVEELA (221FA01190), DIKSHA KUMARI (221FA01191),MAVULURI HARSHITH (221FA01193) ,NANNEBOINA AKHILA (221FA01194),BATHULA RAJYA LAKSHMI (221FA01195),CHALLA JAYA SREE (221FA01196),K**

PRAVEENA (221FA01198) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

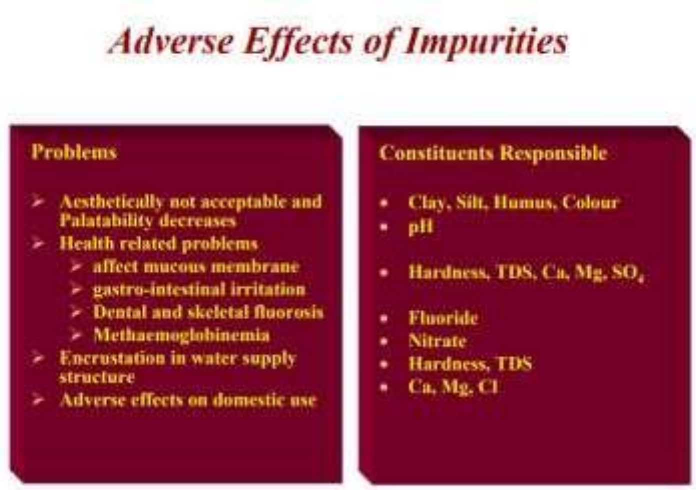
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

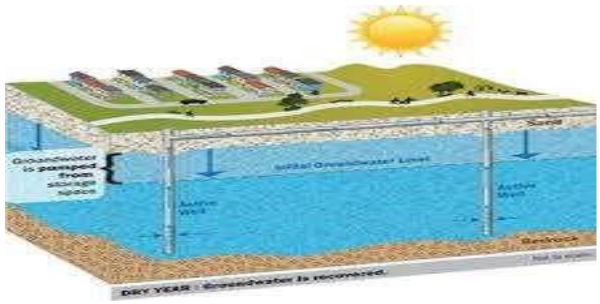
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$\mathbf{M^{2+} + EBT \xrightarrow{pH\,=\,10} \underset{(Wine\ Red)}{[M\text{-}EBT]\ complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\mathbf{\underset{(Wine\ Red)}{[M\text{-}EBT]\ complex} + EDTA \xrightarrow{pH\,=\,10} \underset{(Colorless)}{[M\text{-}EDTA]\ complex} + \underset{(Blue)}{EBT\ indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$\boldsymbol{M_1 \ X \ V_1 = M_2 \ X \ V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 13.0}{20} = 0.0065 \text{ M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \, 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

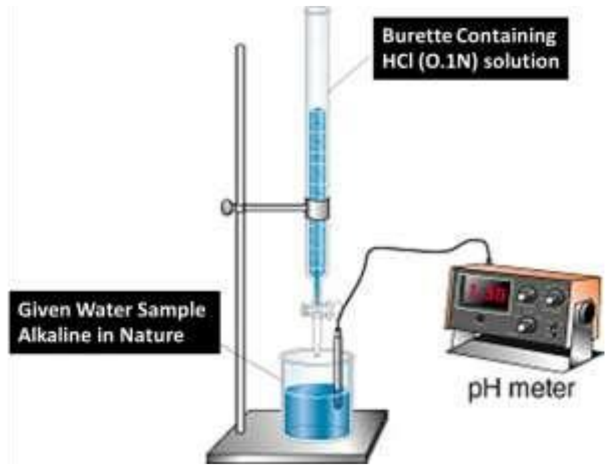
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

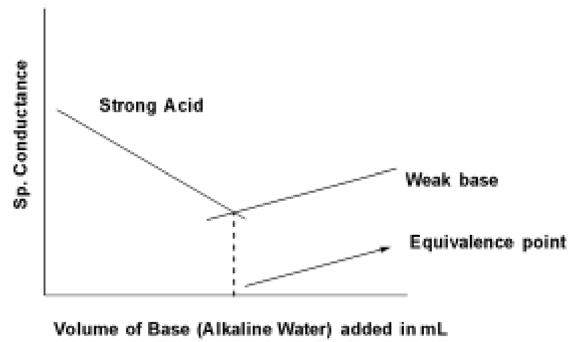
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution ($NH_4Cl + NH_4OH$ solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon . c . l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

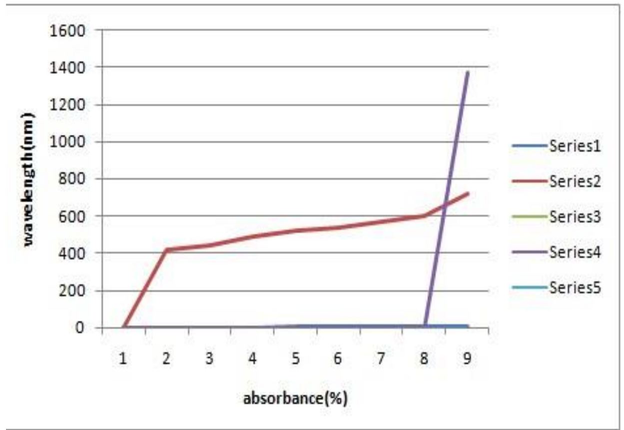
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \; X \; 5.0}{20} = 0.0025 \; \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $of Hard\ water$ $= N_2 = \dfrac{N_1 \, X \, V_1}{V_2} = \dfrac{0.1 \, X \, 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

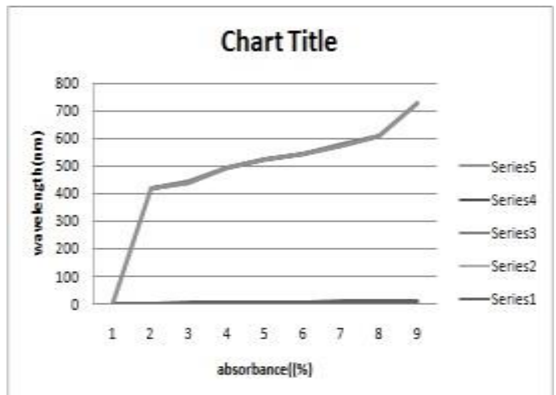
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



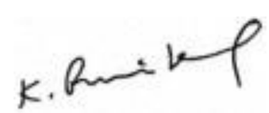
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Narakoduru Water Analysis

SUBMITTED

BY

THUNUGUNTLA HARI NAGA KAVYA SRI (221FA01119)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

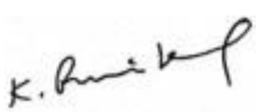
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Narakoduru Water Analysis**" is submitted by **THUNUGUNTLA HARI NAGA KAVYA SRI (221FA01119), KAKOLLU SRI HARSHINI (221FA01120),GOLLAPALLI SRI KIRAN (221FA01121), MINNA GRISHMA (221FA01122)**

,RAMISETTY LAHARI (221FA01124),THARINI CHALLA (221FA01125),MUNNELLI LAHARI

(221FA01128),JINKA GEETHANJALI (221FA01129) in partial fulfilment for the 1st B.Tech to the Vignan'sFoundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Narakoduru,
Andhra Pradesh-522212

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.
In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of**Narakoduru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.
Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. R. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

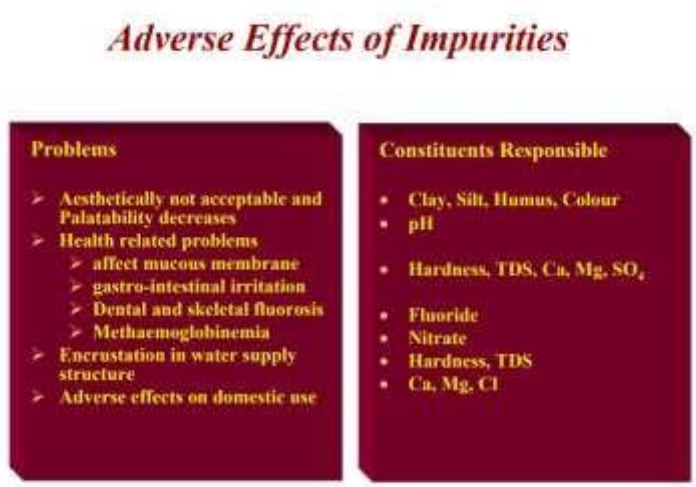
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

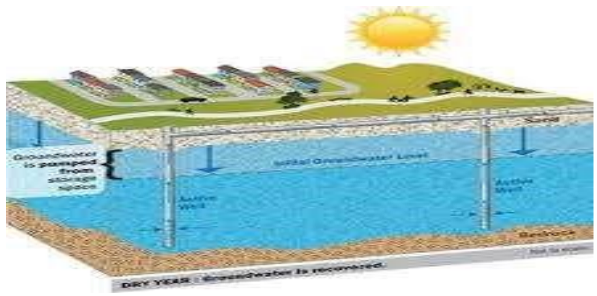
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$\boldsymbol{M_1 \ X \ V_1 = M_2 \ X \ V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 13.0}{20} = 0.0065 \ M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \, 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

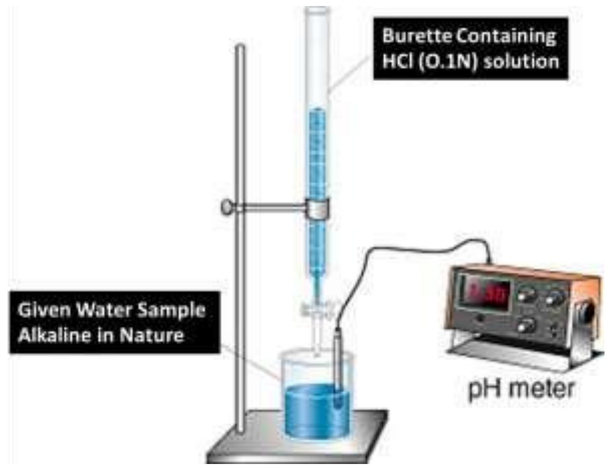
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

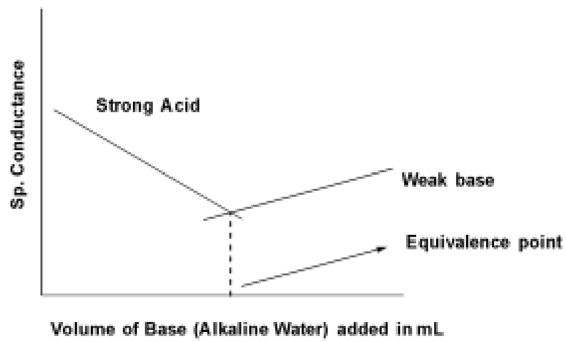
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution ($NH_4Cl + NH_4OH$ solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

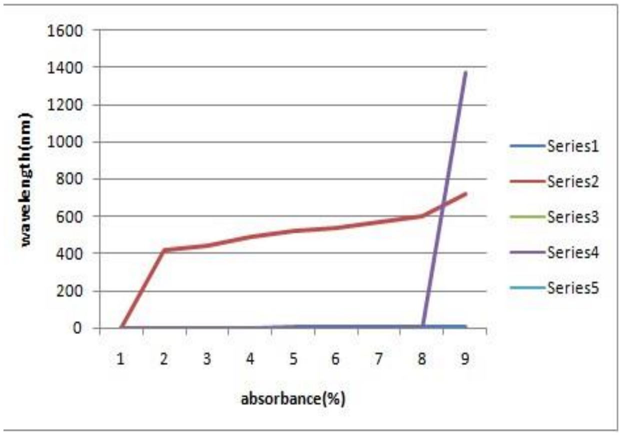
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$M_1 \, X \, V_1 = M_2 \, X \, V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \, X \, 5.0}{20} = 0.0025 \, \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \boldsymbol{X} \boldsymbol{V_1} = N_2 \boldsymbol{X} \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \text{ X } V_1}{V_2} = \frac{0.1 \text{ X } 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	**Volume of Water sample taken (V_2 = 10 mL)**	**Volume of HCL added (V_1 =1 mL)**	**pH values**
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Sp. Conductance**
1.	10 ml	1.2

Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**. Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
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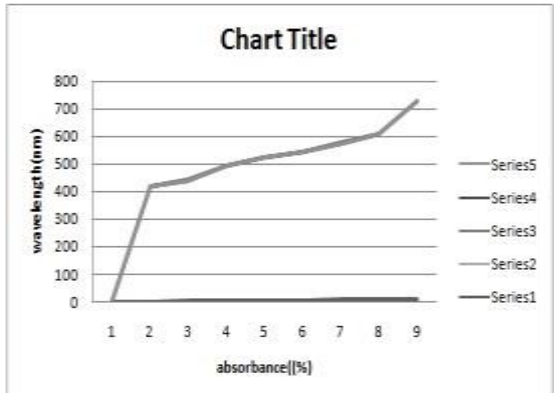
8	720	1.430



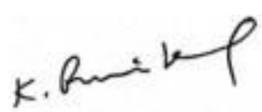
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED
BY

VELAGA LIKHITHA GAYATHRI (221FA01017)
GANDHAM MAYUKHA SAI (221FA01018)
BATHULA SHARANYA (221FA01019)
SUNNY KUMAR (221FA01020)
JANAPANENI GAYATRI SOWMYA (221FA01021)
MUTHYALAMPALLI PRANEETHA (221FA01022)
TALLA SWATHI (221FA01023)
KOPPIREDDY NAGA SAIRAM (221FA01024)
GUNTUPALLI PHANEENDRA (221FA01025)

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

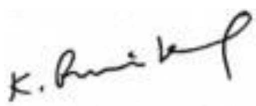
Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **VELAGA LIKHITHA GAYATHRI (221FA01017), GANDHAM MAYUKHA SAI (221FA01018),ATHULA SHARANYA (221FA01019), SUNNY KUMAR (221FA01020)JANAPANENI GAYATRI SOWMYA (221FA01021), MUTHYALAMPALLI PRANEETHA (221FA01022),TALLA SWATHI (221FA01023) , KOPPIREDDY NAGA SAIRAM (221FA01024) ,GUNTUPALLI PHANEENDRA (221FA01025)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Anifa

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

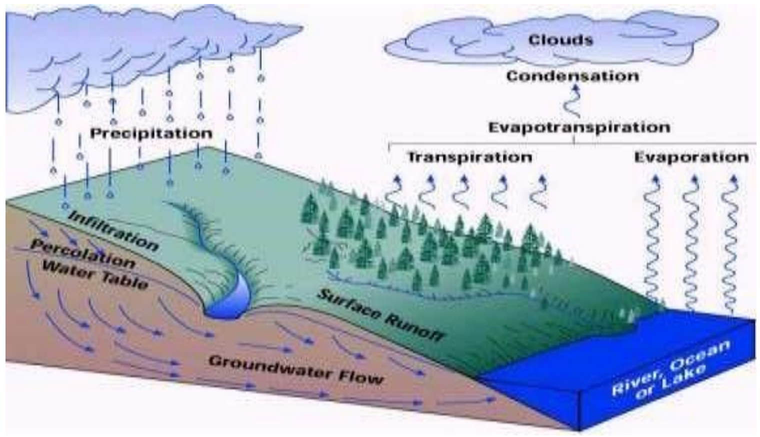
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, $etc.$, and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		

1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

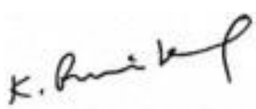
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED
BY

YERRAGUNTA DIVITHA (221FA01172)
BANDI HEMANTH BHARGAV (221FA01175)
MOHAMMAD SOHAIL (221FA01176)
BANDARU SAI KIRAN (221FA01177)
GONDI SRI LIKHITA (221FA01179)
BILLA HARSHAVARDHAN (221FA01181)
GUMMADI VIGNA NAGA SANTHOSHI (221FA01183)
KONDISETTY JAYA SAI VENKATA RATNADEEP (221FA01184)
MANDAPATI HARIKA (221FA01185)
DASARI BHUVANESWARI (221FA01187)

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Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **YERRAGUNTA DIVITHA (221FA01172), BANDI HEMANTH BHARGAV (221FA01175),MOHAMMAD SOHAIL (221FA01176),BANDARU SAI KIRAN (221FA01177),GONDI SRI LIKHITA (221FA01179),BILLA HARSHAVARDHAN (221FA01181),GUMMADI VIGNA NAGA SANTHOSHI (221FA01183) ,KONDISETTY JAYA SAI VENKATA RATNADEEP (221FA01184) ,MANDAPATI HARIKA (221FA01185) ,DASARI BHUVANESWARI (221FA01187)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S

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NAAC Accredited A

Date: 02-02-2023

To

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Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) * Govt. of Andhra Pradesh

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

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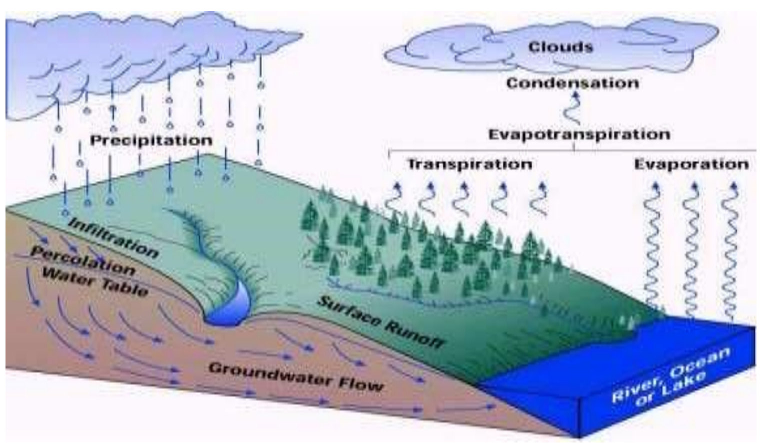

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	ChemicalParameters		
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$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

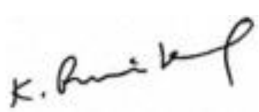
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED
BY

MORLA SAI VENKATA LAKSHMI DURGA MEGHANA (221FA01026)
NITISH KUMAR (221FA01027)
AASHRITHA MAROUTHU (221FA01029)
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NAMBULA NISHANTH (221FA01034)

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **MORLA SAI VENKATA LAKSHMI DURGA MEGHANA (221FA01026) ,NITISH KUMAR (221FA01027),AASHRITHA MAROUTHU (221FA01029), MANNAVA SINDU PRIYA (221FA01030), RAVEENA KATURI (221FA01031),SHAMILA AFREEN (221FA01032) SHAIK RIZWAN AHMAD**

(221FA01033) NAMBULA NISHANTH (221FA01034) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956
NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

Head, Department of Chemistry

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) *
Govt. of Andhra Pradesh

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

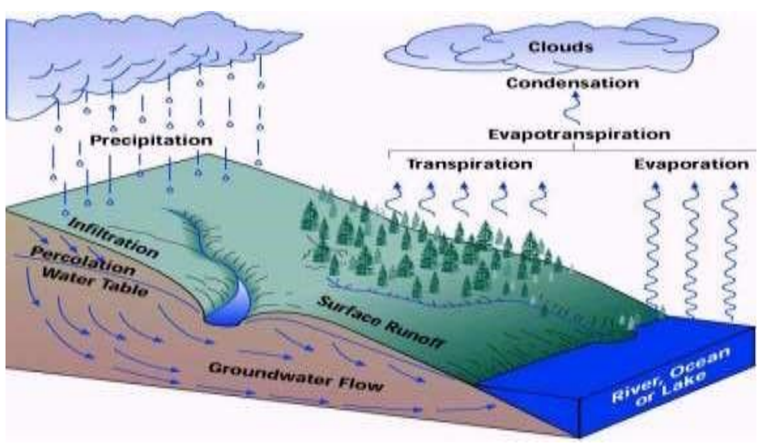
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.

- It should be free from dissolved gases like CO_2,H_2S,NH_3, $etc.$, and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

 When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	Compounds	WHOStandards	BISStandards
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.		**Burette reading**	

	Volume of given sample water (in ml) (V_2)	Initial	Final	Volume of EDTA consumed (in ml) (V_1)
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	**Final**	
	(V_2)			**(V_1)**
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

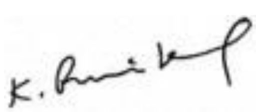
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED
BY

MUPPARAJU GNANESWARI (221FA01161)
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GARAPATI SRI RAM (221FA01165)
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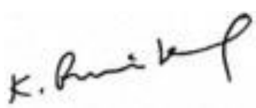
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

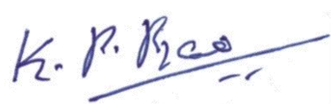
CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **MUPPARAJU GNANESWARI (221FA01161) ,SHAIK HARSHAD (221FA01163), SYED NAZIYA (221FA01164),GARAPATI SRI RAM (221FA01165),DASARI MADHAVI (221FA01167)VITTA DAKSHAYANI (221FA01168),PAVULURI RAVICHANDRA (221FA01169) ,CHANDOLU CHINNA BABU**

(221FA01170) NAIDU NIKHIL (221FA01171) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Anifa

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

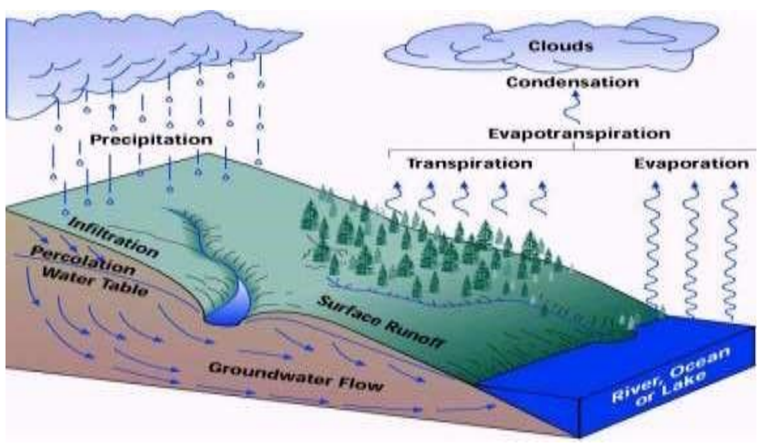
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.

- It should be free from dissolved gases like CO_2,H_2S,NH_3, $etc.$, and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}{=}{=}{=}{=}{=}{=}{>}(C_{17}H_{35}COO)_2Ca + 2Na^+$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

 When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$\mathbf{M^{2+} + EBT \xrightarrow{pH\,=\,10} \underset{(Wine\ Red)}{[M\text{-}EBT]\ complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\mathbf{\underset{(Wine\ Red)}{[M\text{-}EBT]\ complex} + EDTA \xrightarrow{pH\,=\,10} \underset{(Colorless)}{[M\text{-}EDTA]\ complex} + \underset{(Blue)}{EBT\ indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha dwater = M_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027N$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012N$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

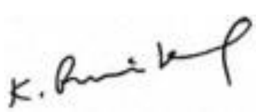
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY

KODURU JAHNAVI SAI DURGA (221FA01043)

GOGASANI SAI MOUNIKA (221FA01044)

PANEM POOJITHA (221FA01045)

GORREPATI PRAVALLI (221FA01046)

BIKKI NAGA VYSHNAVI (221FA01047)

KOPPARTHI THARUNMAI (221FA01048)

SAFIYA SHAIK (221FA01049)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **KODURU JAHNAVI SAI DURGA (221FA01043), GOGASANI SAI MOUNIKA (221FA01044),PANEM POOJITHA (221FA01045),GORREPATI PRAVALLI (221FA01046),BIKKI NAGA VYSHNAVI (221FA01047),KOPPARTHI THARUNMAI (221FA01048) SAFIYA SHAIK (221FA01049)** in partial

fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
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NAAC Accredited A

Date: 02-02-2023

To

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Gram Panchayat Office,
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Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

Head, Department of Chemistry

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) *
Govt. of Andhra Pradesh

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

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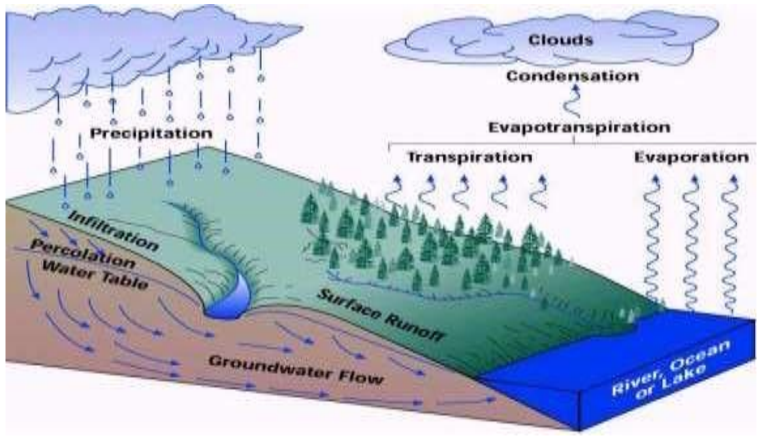

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- It should be free from dissolved gases like $CO_2, H_2S, NH_3, etc.,$ and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

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How to detect hardness?

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- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		

1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \;\; 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

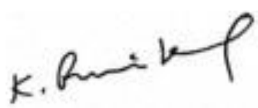
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY
PALLAPU VEENA MADHURI (221FA01154)
NAGIDI VANI VENKATA JYOTHSNA (221FA01155)
SHAIK SAMEEHA (221FA01156)
BYREDDY HEMANTH REDDY (221FA01157)
BOMMANABOYINA LEELAVATHI (221FA01158)
SHAIK NUSHRATH ANJUM (221FA01159)
GOTTIMUKKALA SITA REDDY (221FA01160)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **PALLAPU VEENA MADHURI (221FA01154), NAGIDI VANI VENKATA JYOTHSNA (221FA01155),SHAIK SAMEEHA (221FA01156), BYREDDY HEMANTH REDDY (221FA01157),BOMMANABOYINA LEELAVATHI (221FA01158), SHAIK NUSHRATH ANJUM**

(221FA01159) ,GOTTIMUKKALA SITA REDDY (221FA01160) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) * Govt. of Andhra Pradesh

Objective:

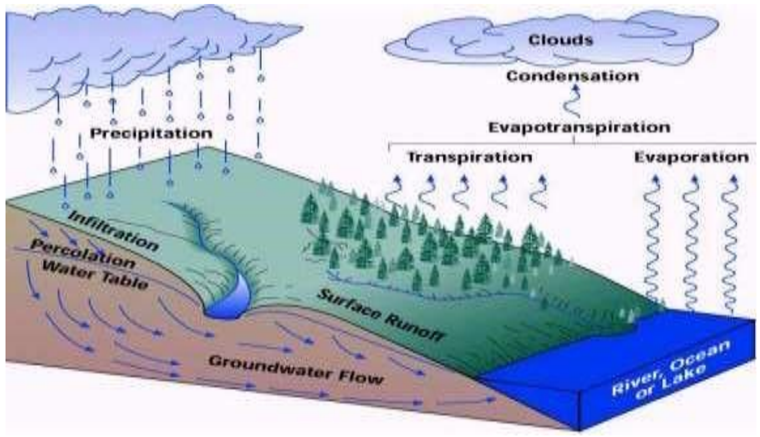
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like $CO_2, H_2S, NH_3, etc.,$ and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		

1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$\underset{}{M^{2+}} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$MolarityofHa\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

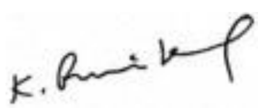
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

Sangam Jagrlamudi WATER ANALYSIS

SUBMITTED
BY
MURALI PRADEEP YADLA (221FA01058)
POTHUGANTI GULNAZ MABUNNI (221FA01059)
MATLURU SAI DHANUSH (221FA01062)
NADIKATTU SUCHITA SHARON (221FA01063)
ALLAMSETTI CHARITHA SRI (221FA01066)
IKKURTHI BHAVYA SRI (221FA01067)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SANGAM JAGARLAMUDI WATER ANALYSIS**" is submitted by **MURALI PRADEEP YADLA (221FA01058), POTHUGANTI GULNAZ MABUNNI (221FA01059), MATLURU SAI DHANUSH (221FA01062), NADIKATTU SUCHITA SHARON (221FA01063), ALLAMSETTI CHARITHA SRI (221FA01066), IKKURTHI BHAVYA SRI (221FA01067)** in partial fulfilment

for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Sangam Jagarlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to provide the necessary permission to the students to collect water samples from various places of **Sangam Jagarlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

permitted to collect water samples in Sangam Jagarlamudi GP
K. Sreedevi
Panchayat Secretary
Gram Panchayat, Sangamjagarlamudi
Tenali Md., Guntur (Dt.) A.P

Objective:

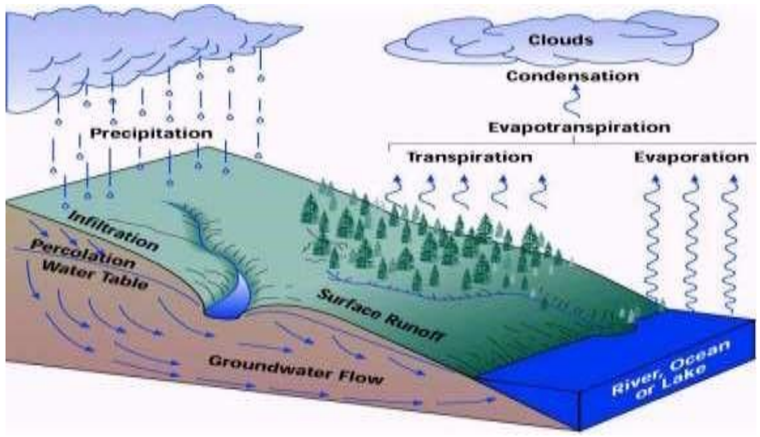
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



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Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in vejendla pond water. The main water source of surface water used in vejendla pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of vejendla pond water.

Water samples are collected from vejendla pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions vejendla pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on vejendla pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like $CO_2, H_2S, NH_3, etc.,$ and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++} ======> (C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless

	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.0 ml	8.0 ml
2	20 ml	0 ml	8.0 ml	8.0 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.0 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 8.0}{20} = 0.004M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.004 X 100.09 x 1000 = 400.36 mg/l or 400 ppm

Result: Total Hardness of given water sample before boiling process is 400ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			**(V_1)**
1	20 ml	0 ml	5.1ml	5.1 ml
2	20 ml	0 ml	5.1ml	5.1 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.1ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.1}{20} = 0.0255\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0255X 50 x 1000 = 1275mg/l or 1275 ppm

Result: Total Alkalinity of given water sample before boiling process is 1275 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	3.5 ml	3.5 ml
2	20 ml	0 ml	3.5 ml	3.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 3.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 3.5}{20} = 0.00175\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00175 X 100 x 1000 = 175 mg/l or 175 ppm

Result: Total Hardness of given water sample before boiling process is 175 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	4.1 ml	4.1 ml
2	20 ml	0 ml	4.1 ml	4.1 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.1 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0205M$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

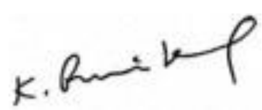
= 0.0205 X 50 x 1000 = 1025 mg/l or 1025 ppm

Result: Total Alkalinity of given water sample before boiling process is 1025 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(8.0)**		**WHO/BIS Standards**
Hardness	EDTA Method (400 ppm)	Hardness	EDTA Method (175 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1275 ppm)	Alkalinity	Acid – Base Titration (1025 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

Sangam Jagrlamudi POND WATER ANALYSIS

SUBMITTED
BY

ATTAR MAHABOOB HUSSAIN (221FA01146)
CHENNUPALLI LALITHA DEVI (221FA01148)
NUNNA LIKHITHA SAI (221FA01150)
KODAMAGULLA SUHRUTHA (221FA01151)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

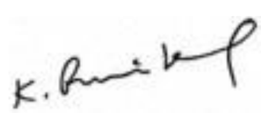
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

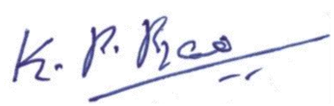
CERTIFICATE

This is to certify that the field project entitled "**SANGAM JAGARLAMUDI POND WATER ANALYSIS**" is submitted by **ATTAR MAHABOOB HUSSAIN (221FA01146), CHENNUPALLI LALITHA DEVI (221FA01148), NUNNA LIKHITHA SAI (221FA01150), KODAMAGULLA SUHRUTHA (221FA01151), PUPPALA**

MOKSHITHA (221FA01152), GOUTUKATLA VENKAT (221FA01153) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Sangam Jagarlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to provide the necessary permission to the students to collect water samples from various places of **Sangam Jagarlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

permitted to collect water samples in Sangam Jagarlamudi GP
K. Sree [signature]
Panchaya Secretary
Gram Panchayat, Sangamjagarlamudi
Tenali Md'., Guntur (Dt.) A.P

Objective:

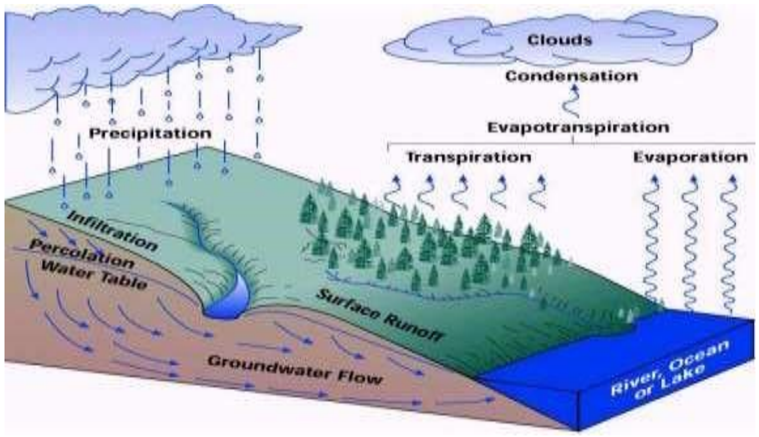
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in vejendla pond water. The main water source of surface water used in vejendla pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of vejendla pond water.

Water samples are collected from vejendla pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions vejendla pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on vejendla pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, $etc.$, and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless

3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[M\text{-}EBT]\ complex}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[M\text{-}EBT]\ complex} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[M\text{-}EDTA]\ complex} + \underset{\text{(Blue)}}{EBT\ indicator}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	8.0 ml	8.0 ml
2	20 ml	0 ml	8.0 ml	8.0 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.0 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 8.0}{20} = 0.004M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.004 X 100.09 x 1000 = 400.36 mg/l or 400 ppm

Result: Total Hardness of given water sample before boiling process is 400ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.1ml	5.1 ml
2	20 ml	0 ml	5.1ml	5.1 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.1ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 5.1}{20} = 0.0255\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0255X 50 x 1000 = 1275mg/l or 1275 ppm

Result: Total Alkalinity of given water sample before boiling process is 1275 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	3.5 ml	3.5 ml
2	20 ml	0 ml	3.5 ml	3.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 3.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\textbf{Molarity of Ha dwater} = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \;\; 3.5}{20} = 0.00175 \textbf{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

$= 0.00175 \times 100 \times 1000 = 175$ mg/l or 175 ppm

Result: Total Hardness of given water sample before boiling process is 175 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.1 ml	4.1 ml
2	20 ml	0 ml	4.1 ml	4.1 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.1 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0205\text{M}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

$= \text{Normality of Water sample X Equivalent weight of } CaCO_3 \text{ x } 1000 \text{ mg/L}$

$= N_2 \text{ X } 50 \text{ x } 1000 \text{ mg/L}$

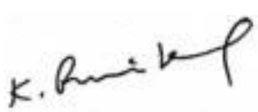
$= 0.0205 \text{ X } 50 \text{ x } 1000 = 1025 \text{ mg/l or } 1025 \text{ ppm}$

Result: Total Alkalinity of given water sample before boiling process is 1025 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(8.0)**		**WHO/BIS Standards**
Hardness	EDTA Method (400 ppm)	Hardness	EDTA Method (175 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1275 ppm)	Alkalinity	Acid – Base Titration (1025 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru Water Analysis

SUBMITTED

BY

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SETTI ANANYA (221FA01069)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SEKURU Water Analysis**" issubmitted by **UMMADI RAMYA (221FA01068), SETTI ANANYA (221FA01069), GODAVARTHY LAKSHMI VARDHANI (221FA01070), MEENISETTI GEETA KRISHNAMANAIDU (221FA01071) CHENNUPATI PRUDVI RAJ (221FA01072), YARLAGADDA AANATHI (221FA01073)** in partial

fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

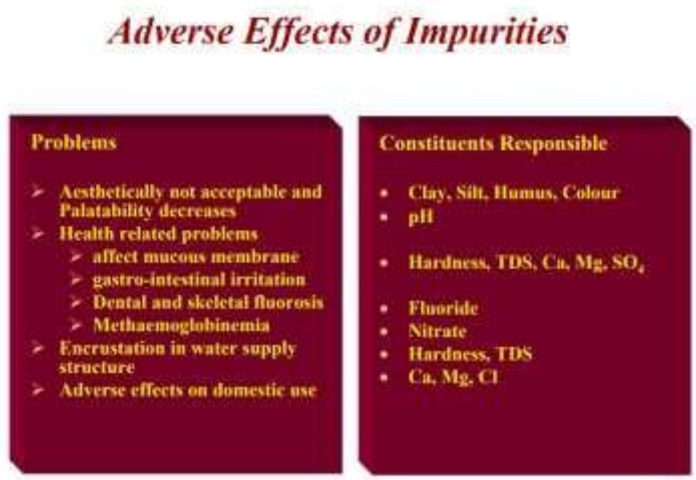
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 13.0}{20} = 0.0065 \text{ M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

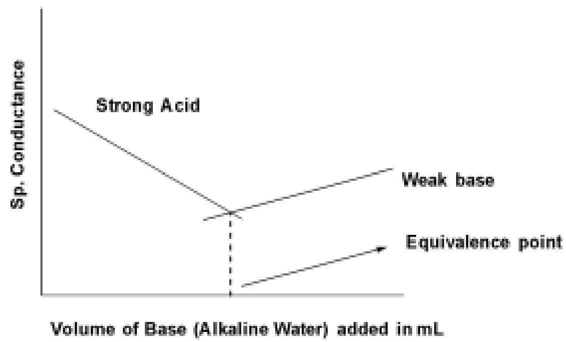
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.

2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.

4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.

5. Connect the conductivity cell to the conductometer.

6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.

7. Put the function switch to cell constant and set the value of cell constant.

8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

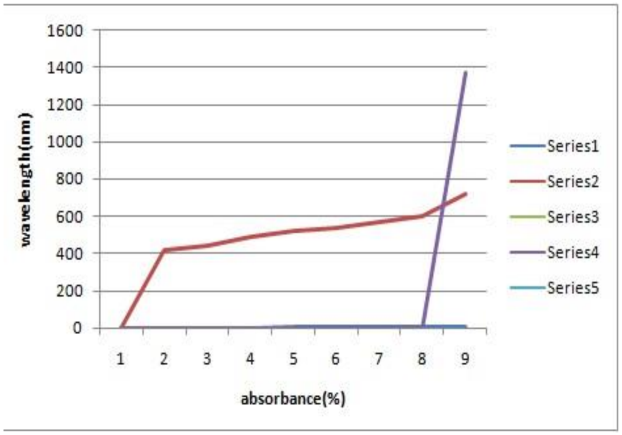
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \; X \; 5.0}{20} = 0.0025 \; \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \boldsymbol{X} \boldsymbol{V_1} = N_2 \boldsymbol{X} \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water} = N_2 = \frac{N_1 X V_1}{V_2} = \frac{0.1 X\ 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

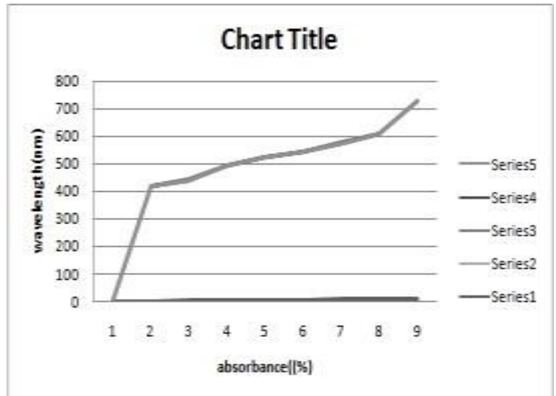
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430

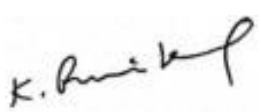


Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity. This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Narakoduru Water Analysis

SUBMITTED

BY

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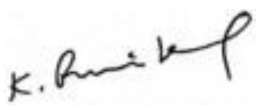
February 2023

CERTIFICATE

This is to certify that the field project entitled "**NARAKODURU Water Analysis**" is submitted by **MURAKONDA PRASANTH CHOWDARY (221FA01130)**, **SANGIREDDY DEEKSHITHA VYSHNAVI (221FA01132)**, **SYED FAIZA SADAF (221FA01133)**, **TALARI VENKATA VYSHNAVI (221FA01134)** ,**THIRUGAMALLA BHAVYA (221FA01135)**, **AMULOTHU VENKATA UDAYA CHANDRIKA (221FA01136)**, **KAKANURU ARUN KUMAR REDDY (221FA01137)** in partial fulfilment for

the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Narakoduru,
Andhra Pradesh-522212

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of**Narakoduru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report. Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

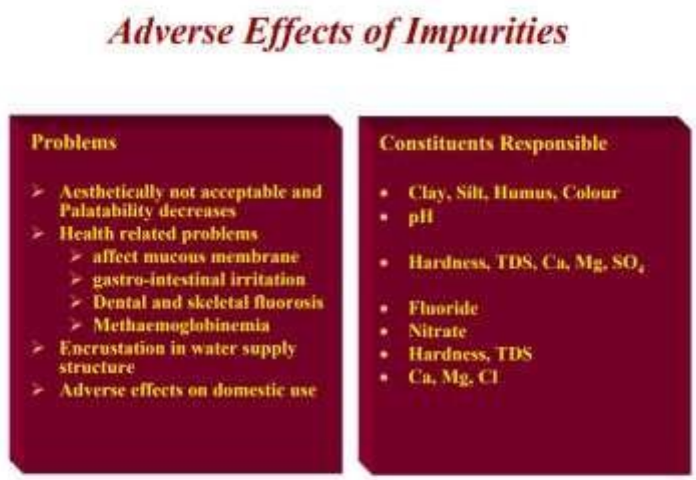
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$\boldsymbol{M_1\ X\ V_1 = M_2\ X\ V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 13.0}{20} = 0.0065\ M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

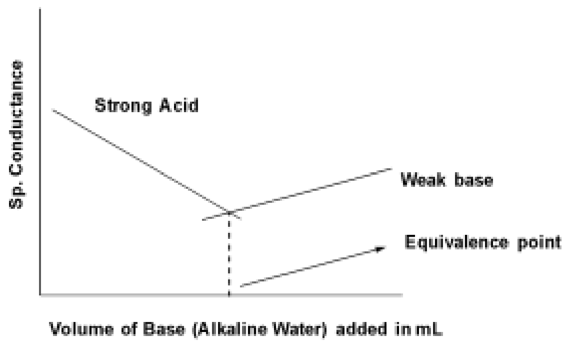
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.

2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.

4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.

5. Connect the conductivity cell to the conductometer.

6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.

7. Put the function switch to cell constant and set the value of cell constant.

8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

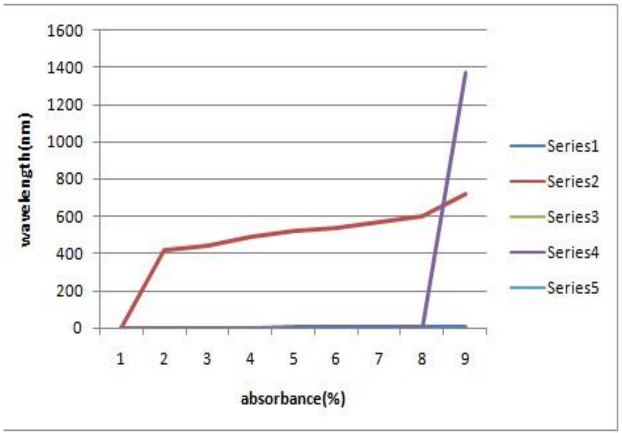
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \; X \;\; 5.0}{20} = 0.0025 \; \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \boldsymbol{X} \boldsymbol{V_1} = N_2 \boldsymbol{X} \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ $= N_2 = \frac{N_1 \text{ X } V_1}{V_2} = \frac{0.1 \text{ X } 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

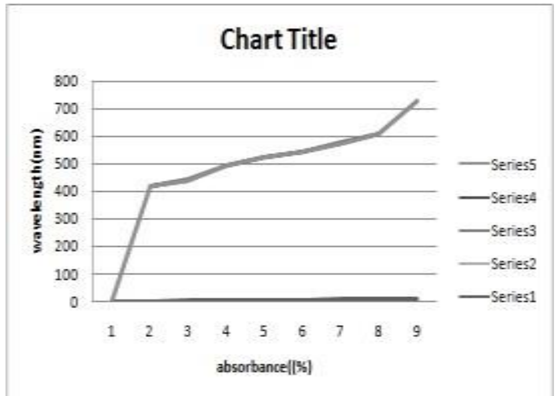
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



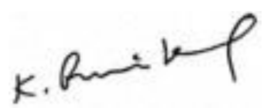
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report
Selapadu (venugopalaswami temple)
Water Analysis

Submitted by

SAMIMOON SHAIK (221FA01050)
JANAPATI VENKATA LAKSHMI PADMAVATHI (221FA01051)
NANDAGARI MEGHANA (221FA01052)
VARANASI TULASI PRAVARANWITHA (221FA01053)
MANDRU TEJA SRI (221FA01054)
GUNDEPUDI KARTHIKEYA (221FA01055)
BACHINA DHARANI (221FA01056)
JAGARLAMUDI SOHITH CHAITANYA (221FA01057)

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

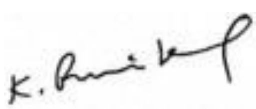
Department of Chemistry

School of Applied Sciences and Humanities

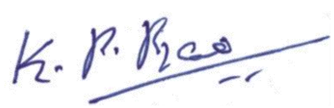
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled “**Selapadu (venugopalaswami temple) Water Analysis**” is submitted by **SAMIMOON SHAIK (221FA01050),JANAPATI VENKATA LAKSHMI PADMAVATHI (221FA01051),NANDAGARI MEGHANA (221FA01052) ,VARANASI TULASI PRAVARANWITHA (221FA01053) ,MANDRU TEJA SRI (221FA01054),GUNDEPUDI KARTHIKEYA (221FA01055),BACHINA DHARANI (221FA01056), JAGARLAMUDI SOHITH CHAITANYA (221FA01057)** in partial fulfilment for the 1st B.Tech to the Vignan’s Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Arif
SELAPADU GRAMA PANCHAYAT
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Chebrolu (Mdl.), Guntur (Dt.)

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

There is no other planet like Earth in our solar system: no other planet is both rocky and has flowing water at its surface. Without water, life as we know it could not exist. Although our planet is covered by seemingly vast oceans, only a small fraction of the water on Earth is fresh, and even less is readily accessible. As the population grows, it becomes more important to understand how to manage and protect our fresh water supply. Water is very useful. It generates electricity and waters the grains, fruits and vegetables that people and animals eat. It can also be very dangerous, causing much destruction from flooding and landslides. Concern about the purity of both surface and groundwater is a growing issue. If we misuse chemicals on our crops, lawns, or industry both surface and groundwater supplies may be contaminated. Some scientists study water in streams, rivers, and underground. They measure rain and snowfall, how much runs off into streams, [taking soil and water samples]and how much filters through the soil and rocks into the underground water system. These scientists work with biologists, chemists, public health specialists, physicists, geologists and atmospheric scientists, who also have a personal and professional concern about water. What do we call these scientists? Hydrologists

1. Did you know? The Antarctic ice sheet is up to 3 miles thick.

Some scientists study oceans. They investigate how biology, geology, meteorology, physics, and chemistry interact to shape the marine environment. They have discovered that the floor of Earth's oceans has high mountains, deep valleys, shelves and slopes, and is as varied as the surface of the land. Some of these scientists study how tides and storms move sand to and from beaches. Because a large percentage of Earth's population lives within 50 miles of a coast, understanding these processes is very important. They also investigate how the oceans move heat around our planet, and they work with meteorologists to predict changes in weather and climate. This team is now better able to predict and monitor El Niño and La Niña events, which are warm and cold ocean currents that have a big impact on weather. Ocean Submersible

2. Did you know? Water covers 71% of the Earth.

Many scientists concentrate their attention on the chemical composition of ocean water. Most of the substances in seawater come from the land, where they have been dissolved and then carried by rivers to the oceans. Some of these substances are pesticides, herbicides, and other waste products from human activities. These scientists work with marine biologists to understand the impact that toxic chemicals are having on marine plants and animals. They use ships, deep submersibles, fixed platforms, underwater laboratories, aircraft, and Earth-orbiting satellites to learn about our environment. What do we call all these scientists? Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds are formed from suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor. Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Water covers 71% of the Earth's surface, mostly in seas and oceans. Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation (0.001%). Water plays an important role in the world economy.

Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of longdistance trade of commodities (such as oil and natural gas) and manufactured products is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing. Water is also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, and diving. Earth is known as the "Blue Planet" because 71 percent of the Earth's surface is covered with water. Water also exists below land surface and as water vapor in the air. Water is a finite source. The bottled water that is consumed today might possibly be the same water that once trickled down the back of a wooly mammoth. The Earth is a closed system, meaning that very little matter, including water, ever leaves or enters the atmosphere; the water that was here billions of years ago is still here now. But, the Earth cleans and replenishes the water supply through the hydrologic cycle. The earth has an abundance of water, but unfortunately, only a small percentage (about 0.3 percent), is even usable by humans. The other 99.7 percent is in the oceans, soils, icecaps, and floating in the atmosphere. Still, much of the 0.3 percent that is useable is unattainable.

Most of the water used by humans comes from rivers. The visible bodies of water are referred to as surface water. The majority of fresh water is actually found underground as soil moisture and in aquifers. Groundwater can feed the s

- ★ Ocean water: 97.2 percent
- ★ Glaciers and other ice: 2.15 percent
- ★ Ground Water: 0.61 percent
- ★ Fresh water lakes: 0.009 percent
- ★ Inland seas: 0.008 percent
- ★ Soil Moisture: 0.005 percent
- ★ Atmosphere: 0.001 percent
- ★ Rivers: 0.0001 percent. (Source: Nace, USGS, 1967 and The Hydrologic Cycle (Pamphlet), USGS, 1984)

Surface water is far easier to reach, so this becomes the most common source of potable water. About 321 billion gallons per day of surface water is used by humans. About 77 billion gallons of groundwater are used each day. Problems also exist in contamination of the water supplies. This further limits the amount of water available for human consumption. Water is found in many different forms and in many different places. While the amounts of water that exist seem to be plentiful, the availability of the water for human consumption is limited.

SURFACE WATERS

Surface waters can be simply described as the water that is on the surface of the Earth. This includes the oceans, rivers and streams, lakes, and reservoirs. Surface waters are very important. They constitute approximately 80 percent of the water used on a daily basis. In 1990, the United States alone used approximately 327,000 billion gallons of surface water a day. Surface waters make up the majority of the water used for public supply and irrigation. It plays less of a role in mining and livestock industries. Oceans, which are the largest source of surface water, comprise approximately 97 percent of the Earth's surface water. However, since the oceans have high salinity, the water is not useful as drinking water. Efforts have been made to remove the salt from the water (desalination), but this is a very costly endeavor. Salt water is used in the mining process, in industry, and in power generation. The oceans also play a vital role in the hydrologic cycle, in regulating the global climate, and in providing habitats for thousands of marine species.

Rivers and streams constitute the flowing surface waters. The force of gravity naturally draws water from a higher altitude to a lower altitude. Rivers obtain their water from two sources: groundwater, and runoff. Rivers can obtain their water from the ground if they cut into the water table, the area in which the ground is saturated with water. This is known as base flow to the stream. Runoff flows downhill, first as small creeks, then gradually merging with other creeks and streams, increasing in size until a river has formed. These small creeks, or tributaries, where the river begins are known as the headwaters. Springs from confined aquifers also can contribute to rivers.

A river will eventually flow into an ocean. A river's length can be difficult to determine, especially if it has numerous tributaries. The USGS Web site defines a river's length as "the distance to the outflow point from the original headwaters where the name defines the complete length." In order for water to flow, there must be land upgradient of the river, that is land that is at a higher elevation than the river. The land that is upgradient of any point on the river is known as the drainage basin or watershed. Ridges of higher land, such as the Continental Divide, separate two drainage basins. Flowing water is extremely powerful and plays an important role in creating the landscape and in humans' lives. Flowing water is used for numerous reasons including irrigation and hydroelectric power production. Rivers erode the landscape and change the topography of the Earth by carving canyons and transporting soil and sediment to create fertile plains. Rivers carry soil and sediment that have been washed into the river when it rains or snow melts. The faster the water moves, the larger the particle size the river is capable of carrying. The USGS measures how much sediment a river carries by measuring the streamflow, or the amount of water flowing past a given site; and the sediment concentration. Sediment in the river can be helpful and harmful. Sediment, when deposited on the banks and in the flood plain, makes excellent farmlands. However, sediment can harm and even destroy dams, reservoirs and the life in the stream. Also, during floods, these sediments can be left behind as sticky, smelly mud in unwanted places.

Measuring the streamflow is accomplished by determining the stream stage and the stream discharge. The stream stage, or datum, is the height of the water surface, in feet, above an arbitrary reference point. The stream discharge is a measurement of the amount of water that is flowing at a particular point in time. It is measured in cubic feet per second. A

discharge measurement determines the amount of water that is flowing in the river at any given stream stage. In order to make this measurement, the width of the river, and the water's depth and velocity at various points must be measured at several different stream stages. A cross-section of the river is divided into intervals and the area of each interval is calculated. If the velocity was measured at different depths on the same vertical interval, then the velocity is averaged. To determine the discharge for the interval, the area is multiplied by the velocity. To find the entire stream's discharge, an average of all the intervals' discharges is calculated. It is important to take discharge measurements of the stream at various stream stages, even flood stage.

A river reaches flood stage when the river overflows its banks. The flood stage can be determined by measuring the gage height, or simply the height of the water in the stream measured from the river's bottom. The streamflow can increase exponentially as the gage height increases. Thus, a small increase in gage height may indicate that a river has reached its flood stage. Floods are a fairly common, yet dangerous, natural disaster.

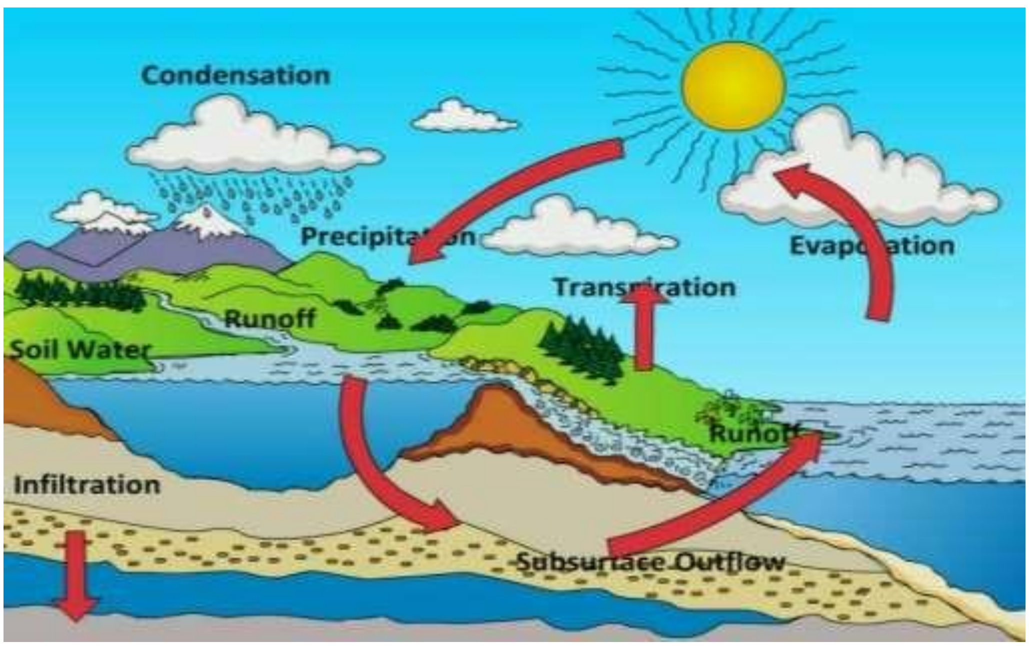
They normally occur because a storm or rapid snow melt has produced more runoff than a stream can carry. Dams failing, landslides blocking stream channels, and high tides are some other causes of flooding. Weather patterns can greatly influence when and where flooding will occur. By studying these patterns, geologists can determine the susceptibility of a region to having a flood at certain times of the year. The recurrence interval, measured in years, describes the magnitude of a flood. Changes in the drainage basin, such as harvesting timber or housing developments, can change the magnitude of a flood. The normally dry land that becomes covered with water during a flood is known as the flood plain. Restrictions on land use in flood plains is regulated by flood-plain zoning. Dams and levees have been built to help reduce damage caused by floods.

When flowing water travels to an area of land that is completely surrounded by higher land, a lake is formed. The water is not trapped .in this low area, the water just escapes at a slower rate than the rate of incoming water. Lakes can vary greatly in area, depth, and water type. Most lakes are fresh water, however some, such as the Great Salt Lake and the Dead Sea, are salt water. Contrary to common belief, a reservoir is not the same as a lake.

A reservoir is a manmade lake caused by a river being dammed. The water in a reservoir is very slow moving compared to the river. Therefore, the majority of the sediments that the river was carrying settle to the bottom of the reservoir. A reservoir will eventually fill up with sediment and mud and become unusable.

THE WATER CYCLE

The hydrologic cycle or water cycle is a graphic representation of how water is led through the environment. Water molecules remain constant, though they may change between solid, liquid, and gas forms. Drops of water in the ocean evaporate, which is the process of liquid water becoming water vapor. Evaporation can occur from water surfaces, land surfaces, and snow fields into the air as water vapor. Moisture in the air can condensate,



which is the process of water vapor in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water. Condensation is the opposite process of evaporation. Water vapor condenses on tiny particles of dust, smoke, and salt crystals to become part of a cloud. After a while, the water droplets combine with other droplets and fall to Earth in the form of precipitation (rain, snow, hail, sleet, dew, and frost). Once the precipitation has fallen to Earth, it may go into an aquifer as groundwater or the drop may stay above ground as surface water. The hydrologic cycle is an important concept to

understand. Water has so many uses on Earth, such as human and animal consumption, power production, and industrial and agricultural needs. Precipitation—in the form of rain and snow—also is an important thing to understand. It is the main way that the water in the skies comes down to Earth, where it fills the lakes and rivers, recharges the underground aquifers, and provides drinks to plants and animals. Different amounts of precipitation fall on different areas of the Earth at different rates and at various times of the year.

One problem facing the cycle of water on Earth is water contamination. Chemicals that go into the water often are very difficult, if not impossible, to remove. One potential source of contamination of water is runoff, the overland flow of water. While precipitation causes the runoff to occur, stripping vegetation from land can add to the runoff in a particular area. The sediment and soil from these areas, not to mention any pesticides or fertilizers that are present, are washed into the streams, oceans, and lakes. What happens to the rain after it falls depends on many factors, such as the intensity and duration of rainfall, the topography of the land, soil conditions, amount of urbanization, and density of vegetation. A common misconception about rain that it is tear-shaped, when in actuality it is shaped more like a hamburger bun. Rain drops also are different sizes, due to the initial difference in particle size and the different rate of coalescence.

GLACIERS AND ICE CAPS

Glaciers and icecaps are referred to as storehouses for fresh water. They cover 10 percent of the world's land mass. These glaciers are primarily located in Greenland and Antarctica. The glaciers in Greenland almost cover the entire land mass. Glaciers begin forming

because of snowfall accumulation. When snowfall exceeds the rate of melting in a certain area,

Glacier, Landform

begin to form. This melting occurs in the summer. The weight of snow accumulating compresses the snow to form ice. Because these glaciers are so heavy, they can slowly move their way down hills.

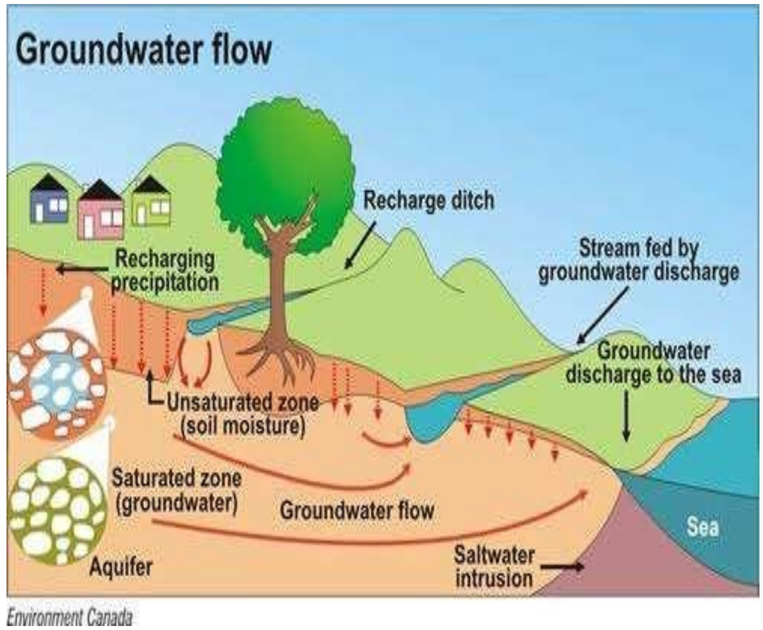
Glaciers affect the topography of the land in some areas. Ancient glaciers formed lakes and valleys. The Great Lakes are an example of this. Glaciers range in length from less than the size of a football field to hundreds of miles long. They also can reach up to 2 miles thick. Glaciers melting can have a tremendous effect on the sea level. If all of the glaciers were to melt today, the sea would rise an estimated 260 feet, according to the USGS. Glaciers have had a tremendous effect on the formation of the Earth's surface and are still influencing the topography everyday.

GROUNDWATER

Groundwater is defined as water that is found beneath the surface of the Earth in conditions of 100 percent saturation (if it is less than 100 percent saturation, then the water is considered soil moisture). Ninety-eight percent of Earth's available fresh water is groundwater. It is about 60 times as plentiful as the fresh water found in lakes and streams. Water in the ground travels through pores in soil and rock, and in fractures and weathered areas of bedrock. The amount of pore space present in rock and soil is known as porosity. The ability to travel through the rock or soil is known as permeability. The permeability and porosity measurements in rock and/or soil can determine the amount of water that can

flow through that particular medium. A "high" permeability and porosity value means that the water can travel quickly.

Groundwater can be found in aquifers. An aquifer is a body of water-saturated sediment or rock in which water can move readily. There are two main types of aquifers: unconfined and confined. An unconfined aquifer is a partially or fully filled aquifer that is exposed to the surface of the land. Because this aquifer is in contact with the atmosphere, it is impacted by meteoric water and any kind of surface



contamination. There is not an impermeable layer to protect this aquifer. In contrast, a confined aquifer is an aquifer that has a confining layer that separates it from the land surface. This aquifer is filled with pressurized water (due to the confining layer). If the water is pressurized at a high enough value, when a well is drilled into the confining aquifer, water rises above the surface of the ground. This is known as a flowing water well. The pressure of the water is called the hydraulic head. Groundwater movement, or velocity, is measured in feet (or meters) per second.

In some areas, the bedrock has low permeability and porosity levels, yet groundwater can still travel in the aquifers. Groundwater can travel through fractures in the rock or through areas that are weathered. Limestone, for example, weathers in solution, creating underground cavities and cavern systems. At the land surface, these areas are known as "karst". The voids in the rock, created as limestone goes into solution, can cause collapses at the land surface. These collapses are known as sinkholes. Sinkholes are often a direct

conduit to the groundwater and areas where contamination can easily infiltrate the aquifers. Sinkhole areas also can have land subsidence as mass wasting occurs in areas with a sudden change in slope and contact with water. Land subsidence may or may not be noticeable in some areas because it appears as hills and valleys (due to the very large size). As groundwater becomes more of a source for drinking water, the problem of sinkholes and land subsidence could increase.

Porosity and permeability of the sediment, soil, and bedrock in the area also affects the recharge rate of the groundwater. This means that in some areas, the groundwater can be pumped out faster than it can replenish itself. This creates a number of problems. One of these problems is called "drawdown," a lowering of the aquifer near a pumping well. This can occur in areas where the well is pumping faster than the groundwater aquifer is recharged. Drawdown creates voids in the bedrock and can lead to additional land subsidence or sinkholes (as there is no longer water present and the void cannot hold the weight of the material above and collapses)

"Decreasing water levels" illustrates drawdown and overpumping problems. Because groundwater is a very plentiful source of fresh water, it must be a protected resource. In many areas, however, groundwater is not protected. Once an aquifer is contaminated with chemicals or petroleum, it is difficult, if not impossible, to clean up. Therefore, prevention of contamination is paramount. Karst areas pose a difficult problem because anything spilled on the surface travels quickly and easily into the aquifer. Many times, surface water also is in direct contact with undergroundwater, and depending on if the stream is feeding the groundwater (a losing stream) or if the groundwater is feeding the stream (a gaining stream) this can create a problem with contamination of the groundwater.

There is also the problem of saltwater intrusion (present in coastal regions, such as Florida) where over-pumping of the groundwater draws the denser saltwater up into the aquifer. A cross-section illustrates the problem of salt water intrusion on So, protection of the groundwater should be a high priority as the population on Earth continues to rise and potable water becomes a valuable resource. Protecting groundwater also means protecting

surface water, rain water, and all forms of water, because water continues to cycle and recycle. Once the water is contaminated, it is difficult to ever remediate.

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Globally, the most prevalent water quality problem is eutrophication, a result of highnutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is a phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Nagarjuna sager dam and its branches. The present

study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Selapadu(Venugopalaswami Temple) village. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our village and changes in climatic conditions Selapadu(Venugopalaswami Temple) village ground water was highly effected. Therefore, as part of my engineering chemistry field project, I have chosen Selapadu(Venugopalaswami Temple) village ground water and I would like to analyze and submit the report on Selapadu(Venugopalaswami Temple) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\text{[M-EBT] complex} + \text{EDTA} \xrightarrow{pH = 10} \text{[M-EDTA] complex} + \text{EBT indicator}$$

(Wine Red) (Colorless) (Blue)

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml

M_2 = Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 4.5}{20} = 0.002 \ M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.002 X 100.09 x 1000 = 200.18 mg/l or 200.18 ppm

Result: Total Hardness of given water sample before boiling process is 200.18 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.0 ml	2.0 ml
2	20 ml	0 ml	2.0 ml	2.0 ml

$$N_1 \; X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.0 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 2.0}{20} = 0.01\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

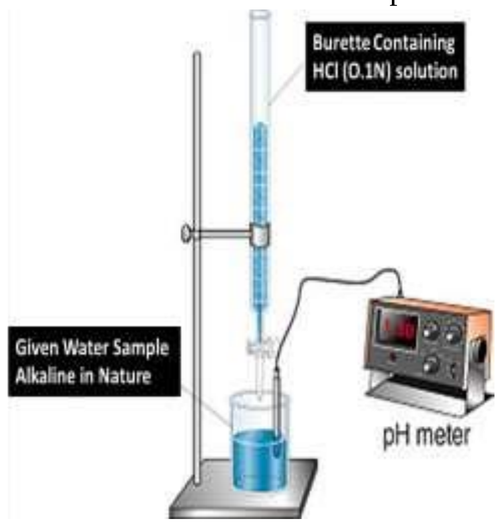
= 0.01 X 50 x 1000 = 500 mg/l or 500 ppm

Result: Total Alkalinity of given water sample before boiling process is 500 ppm

Determination of pH of Water - pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (- log H^+) and has values between 0-14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid-base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The pH value of the water before boiling - **7.25**

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	16.5 ml	16.5 ml
2	20 ml	0 ml	33.0 ml	16.5 ml

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 16.5 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 16.5}{20} = \mathbf{0.00825\ M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00825 X 100 x 1000 = 825 mg/l or 825 ppm

Result: Total Hardness of given water sample before boiling process is 825 ppm

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.5 ml	2.5 ml
2	20 ml	2.5 ml	5.0 ml	2.5 ml

$$N_1 \; X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 2.5}{20} = 0.0125 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L = N_2 X 50 x 1000 mg/L

= 0.0125 X 50 x 1000 = 625 mg/l or 625 ppm

Result: Total Alkalinity of given water sample before boiling process is 625 ppm.

3. Determination of pH of Water ‑ pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

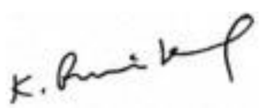
Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (‑ log H^+) and has values between 0‑14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid‑base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The PH value of the water After boiling **– 7.2**

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	500
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	300
pH	pH metric method(7.25)	pH	pH metric method(9.96)	6.5-8.5



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report
Selapadu (venugopalaswami temple)
Water Analysis

Submitted by

KROVI VENKATADATTASAI MADHUNANDHANAABHIRAM (221FA01138)
CHINNI MANIKANTA (221FA01139)
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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

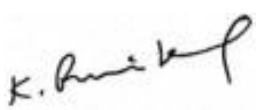
Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Selapadu (venugopalaswami temple) Water Analysis**" is submitted by **KROVI VENKATADATTASAI MADHUNANDHANAABHIRAM (221FA01138), CHINNI MANIKANTA (221FA01139),YEMINENI HEMANADH (221FA01140), ATHOTA SUNANDA (221FA01141) , BOLLINENI PAVANI (221FA01142), PANDITI LAKSHMI PURNIMA (221FA01143),KATTA KAVYA SRI (221FA01144), CHAVVA THARUNI (221FA01145)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Ansifa

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

There is no other planet like Earth in our solar system: no other planet is both rocky and has flowing water at its surface. Without water, life as we know it could not exist. Although our planet is covered by seemingly vast oceans, only a small fraction of the water on Earth is fresh, and even less is readily accessible. As the population grows, it becomes more important to understand how to manage and protect our fresh water supply. Water is very useful. It generates electricity and waters the grains, fruits and vegetables that people and animals eat. It can also be very dangerous, causing much destruction from flooding and landslides. Concern about the purity of both surface and groundwater is a growing issue. If we misuse chemicals on our crops, lawns, or industry both surface and groundwater supplies may be contaminated. Some scientists study water in streams, rivers, and underground. They measure rain and snowfall, how much runs off into streams, [taking soil and water samples]and how much filters through the soil and rocks into the underground water system. These scientists work with biologists, chemists, public health specialists, physicists, geologists and atmospheric scientists, who also have a personal and professional concern about water. What do we call these scientists? Hydrologists

1. Did you know? The Antarctic ice sheet is up to 3 miles thick.

Some scientists study oceans. They investigate how biology, geology, meteorology, physics, and chemistry interact to shape the marine environment. They have discovered that the floor of Earth's oceans has high mountains, deep valleys, shelves and slopes, and is as varied as the surface of the land. Some of these scientists study how tides and storms move sand to and from beaches. Because a large percentage of Earth's population lives within 50 miles of a coast, understanding these processes is very important. They also investigate how the oceans move heat around our planet, and they work with meteorologists to predict changes in weather and climate. This team is now better able to predict and monitor El Niño and La Niña events, which are warm and cold ocean currents that have a big impact on weather. Ocean Submersible

2. Did you know? Water covers 71% of the Earth.

Many scientists concentrate their attention on the chemical composition of ocean water. Most of the substances in seawater come from the land, where they have been dissolved and then carried by rivers to the oceans. Some of these substances are pesticides, herbicides, and other waste products from human activities. These scientists work with marine biologists to understand the impact that toxic chemicals are having on marine plants and animals. They use ships, deep submersibles, fixed platforms, underwater laboratories, aircraft, and Earth-orbiting satellites to learn about our environment. What do we call all these scientists? Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds are formed from suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor. Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Water covers 71% of the Earth's surface, mostly in seas and oceans. Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation (0.001%). Water plays an important role in the world economy.

Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of longdistance trade of commodities (such as oil and natural gas) and manufactured products is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing. Water is also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, and diving. Earth is known as the "Blue Planet" because 71 percent of the Earth's surface is covered with water. Water also exists below land surface and as water vapor in the air. Water is a finite source. The bottled water that is consumed today might possibly be the same water that once trickled down the back of a wooly mammoth. The Earth is a closed system, meaning that very little matter, including water, ever leaves or enters the atmosphere; the water that was here billions of years ago is still here now. But, the Earth cleans and replenishes the water supply through the hydrologic cycle. The earth has an abundance of water, but unfortunately, only a small percentage (about 0.3 percent), is even usable by humans. The other 99.7 percent is in the oceans, soils, icecaps, and floating in the atmosphere. Still, much of the 0.3 percent that is useable is unattainable.

Most of the water used by humans comes from rivers. The visible bodies of water are referred to as surface water. The majority of fresh water is actually found underground as soil moisture and in aquifers. Groundwater can feed the s

- ★ Ocean water: 97.2 percent
- ★ Glaciers and other ice: 2.15 percent
- ★ Ground Water: 0.61 percent
- ★ Fresh water lakes: 0.009 percent
- ★ Inland seas: 0.008 percent
- ★ Soil Moisture: 0.005 percent
- ★ Atmosphere: 0.001 percent
- ★ Rivers: 0.0001 percent. (Source: Nace, USGS, 1967 and The Hydrologic Cycle (Pamphlet), USGS, 1984)

Surface water is far easier to reach, so this becomes the most common source of potable water. About 321 billion gallons per day of surface water is used by humans. About 77 billion gallons of groundwater are used each day. Problems also exist in contamination of the water supplies. This further limits the amount of water available for human consumption. Water is found in many different forms and in many different places. While the amounts of water that exist seem to be plentiful, the availability of the water for human consumption is limited.

SURFACE WATERS

Surface waters can be simply described as the water that is on the surface of the Earth. This includes the oceans, rivers and streams, lakes, and reservoirs. Surface waters are very important. They constitute approximately 80 percent of the water used on a daily basis. In 1990, the United States alone used approximately 327,000 billion gallons of surface water a day. Surface waters make up the majority of the water used for public supply and irrigation. It plays less of a role in mining and livestock industries. Oceans, which are the largest source of surface water, comprise approximately 97 percent of the Earth's surface water. However, since the oceans have high salinity, the water is not useful as drinking water. Efforts have been made to remove the salt from the water (desalination), but this is a very costly endeavor. Salt water is used in the mining process, in industry, and in power generation. The oceans also play a vital role in the hydrologic cycle, in regulating the global climate, and in providing habitats for thousands of marine species.

Rivers and streams constitute the flowing surface waters. The force of gravity naturally draws water from a higher altitude to a lower altitude. Rivers obtain their water from two sources: groundwater, and runoff. Rivers can obtain their water from the ground if they cut into the water table, the area in which the ground is saturated with water. This is known as base flow to the stream. Runoff flows downhill, first as small creeks, then gradually merging with other creeks and streams, increasing in size until a river has formed. These small creeks, or tributaries, where the river begins are known as the headwaters. Springs from confined aquifers also can contribute to rivers.

A river will eventually flow into an ocean. A river's length can be difficult to determine, especially if it has numerous tributaries. The USGS Web site defines a river's length as "the distance to the outflow point from the original headwaters where the name defines the complete length." In order for water to flow, there must be land upgradient of the river, that is land that is at a higher elevation than the river. The land that is upgradient of any point on the river is known as the drainage basin or watershed. Ridges of higher land, such as the Continental Divide, separate two drainage basins. Flowing water is extremely powerful and plays an important role in creating the landscape and in humans' lives. Flowing water is used for numerous reasons including irrigation and hydroelectric power production. Rivers erode the landscape and change the topography of the Earth by carving canyons and transporting soil and sediment to create fertile plains. Rivers carry soil and sediment that have been washed into the river when it rains or snow melts. The faster the water moves, the larger the particle size the river is capable of carrying. The USGS measures how much sediment a river carries by measuring the streamflow, or the amount of water flowing past a given site; and the sediment concentration. Sediment in the river can be helpful and harmful. Sediment, when deposited on the banks and in the flood plain, makes excellent farmlands. However, sediment can harm and even destroy dams, reservoirs and the life in the stream. Also, during floods, these sediments can be left behind as sticky, smelly mud in unwanted places.

Measuring the streamflow is accomplished by determining the stream stage and the stream discharge. The stream stage, or datum, is the height of the water surface, in feet, above an arbitrary reference point. The stream discharge is a measurement of the amount of water that is flowing at a particular point in time. It is measured in cubic feet per second. A

discharge measurement determines the amount of water that is flowing in the river at any given stream stage. In order to make this measurement, the width of the river, and the water's depth and velocity at various points must be measured at several different stream stages. A cross-section of the river is divided into intervals and the area of each interval is calculated. If the velocity was measured at different depths on the same vertical interval, then the velocity is averaged. To determine the discharge for the interval, the area is multiplied by the velocity. To find the entire stream's discharge, an average of all the intervals' discharges is calculated. It is important to take discharge measurements of the stream at various stream stages, even flood stage.

A river reaches flood stage when the river overflows its banks. The flood stage can be determined by measuring the gage height, or simply the height of the water in the stream measured from the river's bottom. The streamflow can increase exponentially as the gage height increases. Thus, a small increase in gage height may indicate that a river has reached its flood stage. Floods are a fairly common, yet dangerous, natural disaster.

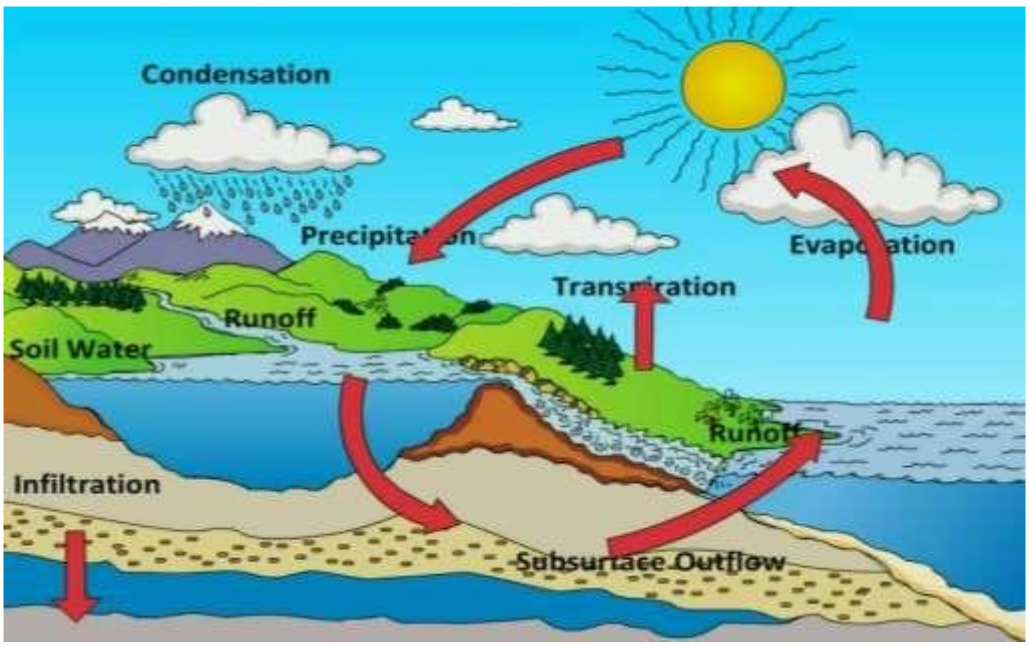
They normally occur because a storm or rapid snow melt has produced more runoff than a stream can carry. Dams failing, landslides blocking stream channels, and high tides are some other causes of flooding. Weather patterns can greatly influence when and where flooding will occur. By studying these patterns, geologists can determine the susceptibility of a region to having a flood at certain times of the year. The recurrence interval, measured in years, describes the magnitude of a flood. Changes in the drainage basin, such as harvesting timber or housing developments, can change the magnitude of a flood. The normally dry land that becomes covered with water during a flood is known as the flood plain. Restrictions on land use in flood plains is regulated by flood-plain zoning. Dams and levees have been built to help reduce damage caused by floods.

When flowing water travels to an area of land that is completely surrounded by higher land, a lake is formed. The water is not trapped .in this low area, the water just escapes at a slower rate than the rate of incoming water. Lakes can vary greatly in area, depth, and water type. Most lakes are fresh water, however some, such as the Great Salt Lake and the Dead Sea, are salt water. Contrary to common belief, a reservoir is not the same as a lake.

A reservoir is a manmade lake caused by a river being dammed. The water in a reservoir is very slow moving compared to the river. Therefore, the majority of the sediments that the river was carrying settle to the bottom of the reservoir. A reservoir will eventually fill up with sediment and mud and become unusable.

THE WATER CYCLE

The hydrologic cycle or water cycle is a graphic representation of how water is led through the environment. Water molecules remain constant, though they may change between solid, liquid, and gas forms. Drops of water in the ocean evaporate, which is the process of liquid water becoming water vapor. Evaporation can occur from water surfaces, land surfaces, and snow fields into the air as water vapor. Moisture in the air can condensate,



which is the process of water vapor in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water. Condensation is the opposite process of evaporation. Water vapor condenses on tiny particles of dust, smoke, and salt crystals to become part of a cloud. After a while, the water droplets combine with other droplets and fall to Earth in the form of precipitation (rain, snow, hail, sleet, dew, and frost). Once the precipitation has fallen to Earth, it may go into an aquifer as groundwater or the drop may stay above ground as surface water. The hydrologic cycle is an important concept to

understand. Water has so many uses on Earth, such as human and animal consumption, power production, and industrial and agricultural needs. Precipitation—in the form of rain and snow—also is an important thing to understand. It is the main way that the water in the skies comes down to Earth, where it fills the lakes and rivers, recharges the underground aquifers, and provides drinks to plants and animals. Different amounts of precipitation fall on different areas of the Earth at different rates and at various times of the year.

One problem facing the cycle of water on Earth is water contamination. Chemicals that go into the water often are very difficult, if not impossible, to remove. One potential source of contamination of water is runoff, the overland flow of water. While precipitation causes the runoff to occur, stripping vegetation from land can add to the runoff in a particular area. The sediment and soil from these areas, not to mention any pesticides or fertilizers that are present, are washed into the streams, oceans, and lakes. What happens to the rain after it falls depends on many factors, such as the intensity and duration of rainfall, the topography of the land, soil conditions, amount of urbanization, and density of vegetation. A common misconception about rain that it is tear-shaped, when in actuality it is shaped more like a hamburger bun. Rain drops also are different sizes, due to the initial difference in particle size and the different rate of coalescence.

GLACIERS AND ICE CAPS

Glaciers and icecaps are referred to as storehouses for fresh water. They cover 10 percent of the world's land mass. These glaciers are primarily located in Greenland and Antarctica. The glaciers in Greenland almost cover the entire land mass. Glaciers begin forming

because of snowfall accumulation. When snowfall exceeds the rate of melting in a certain area,

Glacier, Landform

begin to form. This melting occurs in the summer. The weight of snow accumulating compresses the snow to form ice. Because these glaciers are so heavy, they can slowly move their way down hills.

Glaciers affect the topography of the land in some areas. Ancient glaciers formed lakes and valleys. The Great Lakes are an example of this. Glaciers range in length from less than the size of a football field to hundreds of miles long. They also can reach up to 2 miles thick. Glaciers melting can have a tremendous effect on the sea level. If all of the glaciers were to melt today, the sea would rise an estimated 260 feet, according to the USGS. Glaciers have had a tremendous effect on the formation of the Earth's surface and are still influencing the topography everyday.

GROUNDWATER

Groundwater is defined as water that is found beneath the surface of the Earth in conditions of 100 percent saturation (if it is less than 100 percent saturation, then the water is considered soil moisture). Ninety-eight percent of Earth's available fresh water is groundwater. It is about 60 times as plentiful as the fresh water found in lakes and streams. Water in the ground travels through pores in soil and rock, and in fractures and weathered areas of bedrock. The amount of pore space present in rock and soil is known as porosity. The ability to travel through the rock or soil is known as permeability. The permeability and porosity measurements in rock and/or soil can determine the amount of water that can

flow through that particular medium. A "high" permeability and porosity value means that the water can travel quickly.

Groundwater can be found in aquifers. An aquifer is a body of water-saturated sediment or rock in which water can move readily. There are two main types of aquifers: unconfined and confined. An unconfined aquifer is a partially or fully filled aquifer that is exposed to the surface of the land. Because this aquifer is in contact with the atmosphere, it is impacted by meteoric water and any kind of surface

contamination. There is not an impermeable layer to protect this aquifer. In contrast, a confined aquifer is an aquifer that has a confining layer that separates it from the land surface. This aquifer is filled with pressurized water (due to the confining layer). If the water is pressurized at a high enough value, when a well is drilled into the confining aquifer, water rises above the surface of the ground. This is known as a flowing water well. The pressure of the water is called the hydraulic head. Groundwater movement, or velocity, is measured in feet (or meters) per second.

In some areas, the bedrock has low permeability and porosity levels, yet groundwater can still travel in the aquifers. Groundwater can travel through fractures in the rock or through areas that are weathered. Limestone, for example, weathers in solution, creating underground cavities and cavern systems. At the land surface, these areas are known as "karst". The voids in the rock, created as limestone goes into solution, can cause collapses at the land surface. These collapses are known as sinkholes. Sinkholes are often a direct

conduit to the groundwater and areas where contamination can easily infiltrate the aquifers. Sinkhole areas also can have land subsidence as mass wasting occurs in areas with a sudden change in slope and contact with water. Land subsidence may or may not be noticeable in some areas because it appears as hills and valleys (due to the very large size). As groundwater becomes more of a source for drinking water, the problem of sinkholes and land subsidence could increase.

Porosity and permeability of the sediment, soil, and bedrock in the area also affects the recharge rate of the groundwater. This means that in some areas, the groundwater can be pumped out faster than it can replenish itself. This creates a number of problems. One of these problems is called "drawdown," a lowering of the aquifer near a pumping well. This can occur in areas where the well is pumping faster than the groundwater aquifer is recharged. Drawdown creates voids in the bedrock and can lead to additional land subsidence or sinkholes (as there is no longer water present and the void cannot hold the weight of the material above and collapses)

"Decreasing water levels" illustrates drawdown and overpumping problems. Because groundwater is a very plentiful source of fresh water, it must be a protected resource. In many areas, however, groundwater is not protected. Once an aquifer is contaminated with chemicals or petroleum, it is difficult, if not impossible, to clean up. Therefore, prevention of contamination is paramount. Karst areas pose a difficult problem because anything spilled on the surface travels quickly and easily into the aquifer. Many times, surface water also is in direct contact with undergroundwater, and depending on if the stream is feeding the groundwater (a losing stream) or if the groundwater is feeding the stream (a gaining stream) this can create a problem with contamination of the groundwater.

There is also the problem of saltwater intrusion (present in coastal regions, such as Florida) where over-pumping of the groundwater draws the denser saltwater up into the aquifer. A cross-section illustrates the problem of salt water intrusion on So, protection of the groundwater should be a high priority as the population on Earth continues to rise and potable water becomes a valuable resource. Protecting groundwater also means protecting

surface water, rain water, and all forms of water, because water continues to cycle and recycle. Once the water is contaminated, it is difficult to ever remediate.

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Globally, the most prevalent water quality problem is eutrophication, a result of highnutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is a phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Nagarjuna sager dam and its branches. The present

study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Selapadu(Venugopalaswami Temple) village. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our village and changes in climatic conditions Selapadu(Venugopalaswami Temple) village ground water was highly effected. Therefore, as part of my engineering chemistry field project, I have chosen Selapadu(Venugopalaswami Temple) village ground water and I would like to analyze and submit the report on Selapadu(Venugopalaswami Temple) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$[\text{M-EBT}]\ \text{complex} + \text{EDTA} \xrightarrow{\text{pH} = 10} [\text{M-EDTA}]\ \text{complex} + \text{EBT indicator}$$

(Wine Red) (Colorless) (Blue)

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml

M_2 = Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = \mathbf{0.00}2\ \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.002 X 100.09 x 1000 = 200.18 mg/l or 200.18 ppm

Result: Total Hardness of given water sample before boiling process is 200.18 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.0 ml	2.0 ml
2	20 ml	0 ml	2.0 ml	2.0 ml

$$N_1 \ X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.0 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 2.0}{20} = 0.01\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

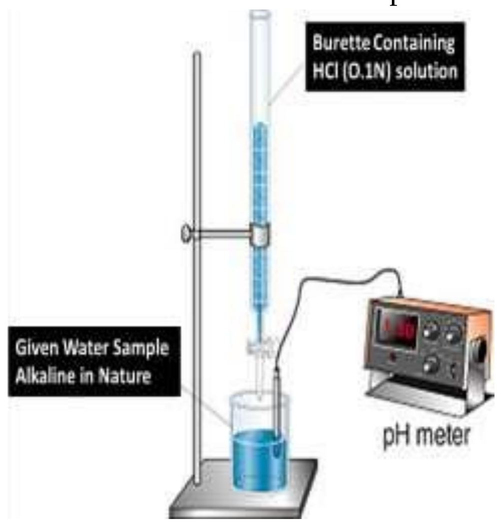
= 0.01 X 50 x 1000 = 500 mg/l or 500 ppm

Result: Total Alkalinity of given water sample before boiling process is 500 ppm

Determination of pH of Water ‑ pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (‑ log H^+) and has values between 0‑14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid‑base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The pH value of the water before boiling - **7.25**

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	16.5 ml	16.5 ml
2	20 ml	0 ml	33.0 ml	16.5 ml

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 16.5 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 16.5}{20} = \mathbf{0.00825}\ \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00825 X 100 x 1000 = 825 mg/l or 825 ppm

Result: Total Hardness of given water sample before boiling process is 825 ppm

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.5 ml	2.5 ml
2	20 ml	2.5 ml	5.0 ml	2.5 ml

$$N_1 \; X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 2.5}{20} = 0.0125 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L =

N_2 X 50 x 1000 mg/L

= 0.0125 X 50 x 1000 = 625 mg/l or 625 ppm

Result: Total Alkalinity of given water sample before boiling process is 625 ppm.

3. Determination of pH of Water - pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

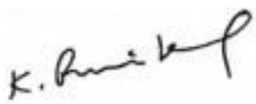
Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (- log H^+) and has values between 0-14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid-base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The PH value of the water After boiling **– 7.2**

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	500
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	300
pH	pH metric method(7.25)	pH	pH metric method(9.96)	6.5-8.5



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY
ANNAPUREDDY NIRMITHA JYOSTHNA (221FA01098)
UPPALA VARSHITHA (221FA01099)
YAKKATI PRANITHA (221FA01100)
TAYYIB RAZA KHAN (221FA01101)
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TANNIRU CHAITANYA SAI (221FA01107)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

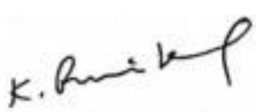
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **ANNAPUREDDY NIRMITHA JYOSTHNA (221FA01098), UPPALA VARSHITHA (221FA01099),YAKKATI PRANITHA (221FA01100), TAYYIB RAZA KHAN (221FA01101), VADLAMANNATI AKSHAYA (221FA01102), GUNTURU PHANI SAHITHI (221FA01103),JAMMULA TRIVENI (221FA01104) ,MANEPALLI SRISURYANAGAVEERA VENKATALALITHA (221FA01105)**
TANNIRU CHAITANYA SAI (221FA01107) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956
NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) * Govt. of Andhra Pradesh

Objective:

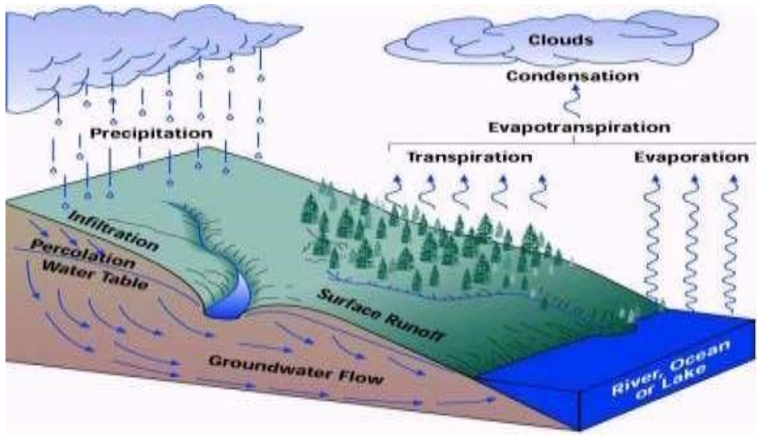
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, *etc.,* and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless

3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml)**	**Burette reading**		**Volume of HCl consumed (in ml)**
		Initial	**Final**	
	(V_2)			**(V_1)**
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha dwater} = \boldsymbol{M}_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $of Ha\ dwater$ = $N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ 2.4}{20}$ = 0.012N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

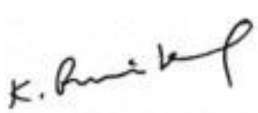
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY
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VARADA AKASH SAIRAM GANGADHAR (221FA01097)

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **PEDALANKA VENKATA MANI KUMAR (221FA01089) ,MOKHAMATAM SRAVANTHI (221FA01090), MATHIREDDI POOJITHA (221FA01091), POLISETTY GAYATHRI (221FA01092),MUKKU LAKSHMI VENKATA KARTHIK (221FA01093), VITTA DAKSHAYANI (221FA01094), VELDURTHI MOKSHA MADHUMINA (221FA01095) ,PASAPU PRANATHI LAKSHMI (221FA01096) ,VARADA AKASH SAIRAM GANGADHAR (221FA01097)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator **Head of the Department**

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Anifa

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

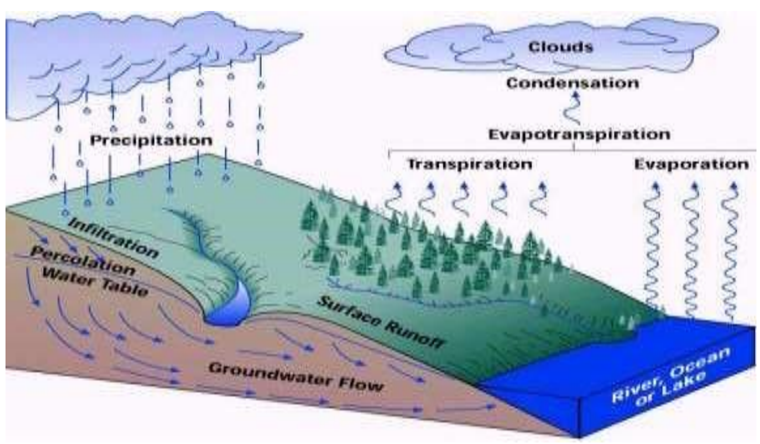
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.

- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2, H_2S, NH_3, *etc.*, and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^+$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

 When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

$= 0.00225 \times 100 \times 1000 = 225.2025$ mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 \times V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

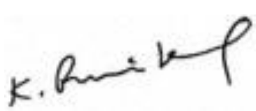
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Selapadu (venugopalaswami temple)

Water Analysis

Submitted by

NAROTTAM KUMAR (221FA01081)
MATTA DOLA SAI NAGA DIVYA SRI (221FA01082)
POLAROWTHU SRI SWARNA LAKSHMI (221FA01083)
RAVIPATI SAI VYSHNAVI (221FA01084)
YADLAPALLI RISHITHA (221FA01085)
RAMALAKSHMI TEJASWI MADDI (221FA01086)
SURE LAKSHMI SAI SREE (221FA0107)
SHAIK ASIF (221FA01088)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Selapadu (venugopalaswami temple) Water Analysis**" is submitted by **NAROTTAM KUMAR (221FA01081), MATTA DOLA SAI NAGA DIVYA SRI (221FA01082), POLAROWTHU SRI SWARNA LAKSHMI (221FA01083) , RAVIPATI SAI VYSHNAVI (221FA01084) ,YADLAPALLI RISHITHA (221FA01085), RAMALAKSHMI TEJASWI MADDI (221FA01086),SURE LAKSHMI SAI SREE (221FA0107),SHAIK ASIF (221FA01088)** in partial fulfilment

for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

There is no other planet like Earth in our solar system: no other planet is both rocky and has flowing water at its surface. Without water, life as we know it could not exist. Although our planet is covered by seemingly vast oceans, only a small fraction of the water on Earth is fresh, and even less is readily accessible. As the population grows, it becomes more important to understand how to manage and protect our fresh water supply. Water is very useful. It generates electricity and waters the grains, fruits and vegetables that people and animals eat. It can also be very dangerous, causing much destruction from flooding and landslides. Concern about the purity of both surface and groundwater is a growing issue. If we misuse chemicals on our crops, lawns, or industry both surface and groundwater supplies may be contaminated. Some scientists study water in streams, rivers, and underground. They measure rain and snowfall, how much runs off into streams, [taking soil and water samples]and how much filters through the soil and rocks into the underground water system. These scientists work with biologists, chemists, public health specialists, physicists, geologists and atmospheric scientists, who also have a personal and professional concern about water. What do we call these scientists? Hydrologists

1. Did you know? The Antarctic ice sheet is up to 3 miles thick.

Some scientists study oceans. They investigate how biology, geology, meteorology, physics, and chemistry interact to shape the marine environment. They have discovered that the floor of Earth's oceans has high mountains, deep valleys, shelves and slopes, and is as varied as the surface of the land. Some of these scientists study how tides and storms move sand to and from beaches. Because a large percentage of Earth's population lives within 50 miles of a coast, understanding these processes is very important. They also investigate how the oceans move heat around our planet, and they work with meteorologists to predict changes in weather and climate. This team is now better able to predict and monitor El Niño and La Niña events, which are warm and cold ocean currents that have a big impact on weather. Ocean Submersible

2. Did you know? Water covers 71% of the Earth.

Many scientists concentrate their attention on the chemical composition of ocean water. Most of the substances in seawater come from the land, where they have been dissolved and then carried by rivers to the oceans. Some of these substances are pesticides, herbicides, and other waste products from human activities. These scientists work with marine biologists to understand the impact that toxic chemicals are having on marine plants and animals. They use ships, deep submersibles, fixed platforms, underwater laboratories, aircraft, and Earth-orbiting satellites to learn about our environment. What do we call all these scientists? Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds are formed from suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor. Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Water covers 71% of the Earth's surface, mostly in seas and oceans. Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation (0.001%). Water plays an important role in the world economy.

Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of longdistance trade of commodities (such as oil and natural gas) and manufactured products is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing. Water is also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, and diving. Earth is known as the "Blue Planet" because 71 percent of the Earth's surface is covered with water. Water also exists below land surface and as water vapor in the air. Water is a finite source. The bottled water that is consumed today might possibly be the same water that once trickled down the back of a wooly mammoth. The Earth is a closed system, meaning that very little matter, including water, ever leaves or enters the atmosphere; the water that was here billions of years ago is still here now. But, the Earth cleans and replenishes the water supply through the hydrologic cycle. The earth has an abundance of water, but unfortunately, only a small percentage (about 0.3 percent), is even usable by humans. The other 99.7 percent is in the oceans, soils, icecaps, and floating in the atmosphere. Still, much of the 0.3 percent that is useable is unattainable. Most of the water used by humans comes from rivers. The visible bodies of water are referred to as surface water. The majority of fresh water is actually found underground as soil moisture and in aquifers. Groundwater can feed the s

- ★ Ocean water: 97.2 percent
- ★ Glaciers and other ice: 2.15 percent
- ★ Ground Water: 0.61 percent
- ★ Fresh water lakes: 0.009 percent
- ★ Inland seas: 0.008 percent
- ★ Soil Moisture: 0.005 percent
- ★ Atmosphere: 0.001 percent
- ★ Rivers: 0.0001 percent. (Source: Nace, USGS, 1967 and The Hydrologic Cycle (Pamphlet), USGS, 1984)

Surface water is far easier to reach, so this becomes the most common source of potable water. About 321 billion gallons per day of surface water is used by humans. About 77 billion gallons of groundwater are used each day. Problems also exist in contamination of the water supplies. This further limits the amount of water available for human consumption. Water is found in many different forms and in many different places. While the amounts of water that exist seem to be plentiful, the availability of the water for human consumption is limited.

SURFACE WATERS

Surface waters can be simply described as the water that is on the surface of the Earth. This includes the oceans, rivers and streams, lakes, and reservoirs. Surface waters are very important. They constitute approximately 80 percent of the water used on a daily basis. In 1990, the United States alone used approximately 327,000 billion gallons of surface water a day. Surface waters make up the majority of the water used for public supply and irrigation. It plays less of a role in mining and livestock industries. Oceans, which are the largest source of surface water, comprise approximately 97 percent of the Earth's surface water. However, since the oceans have high salinity, the water is not useful as drinking water. Efforts have been made to remove the salt from the water (desalination), but this is a very costly endeavor. Salt water is used in the mining process, in industry, and in power generation. The oceans also play a vital role in the hydrologic cycle, in regulating the global climate, and in providing habitats for thousands of marine species.

Rivers and streams constitute the flowing surface waters. The force of gravity naturally draws water from a higher altitude to a lower altitude. Rivers obtain their water from two sources: groundwater, and runoff. Rivers can obtain their water from the ground if they cut into the water table, the area in which the ground is saturated with water. This is known as base flow to the stream. Runoff flows downhill, first as small creeks, then gradually merging with other creeks and streams, increasing in size until a river has formed. These small creeks, or tributaries, where the river begins are known as the headwaters. Springs from confined aquifers also can contribute to rivers.

A river will eventually flow into an ocean. A river's length can be difficult to determine, especially if it has numerous tributaries. The USGS Web site defines a river's length as "the distance to the outflow point from the original headwaters where the name defines the complete length." In order for water to flow, there must be land upgradient of the river, that is land that is at a higher elevation than the river. The land that is upgradient of any point on the river is known as the drainage basin or watershed. Ridges of higher land, such as the Continental Divide, separate two drainage basins. Flowing water is extremely powerful and plays an important role in creating the landscape and in humans' lives. Flowing water is used for numerous reasons including irrigation and hydroelectric power production. Rivers erode the landscape and change the topography of the Earth by carving canyons and transporting soil and sediment to create fertile plains. Rivers carry soil and sediment that have been washed into the river when it rains or snow melts. The faster the water moves, the larger the particle size the river is capable of carrying. The USGS measures how much sediment a river carries by measuring the streamflow, or the amount of water flowing past a given site; and the sediment concentration. Sediment in the river can be helpful and harmful. Sediment, when deposited on the banks and in the flood plain, makes excellent farmlands. However, sediment can harm and even destroy dams, reservoirs and the life in the stream. Also, during floods, these sediments can be left behind as sticky, smelly mud in unwanted places.

Measuring the streamflow is accomplished by determining the stream stage and the stream discharge. The stream stage, or datum, is the height of the water surface, in feet, above an arbitrary reference point. The stream discharge is a measurement of the amount of water that is flowing at a particular point in time. It is measured in cubic feet per second. A

discharge measurement determines the amount of water that is flowing in the river at any given stream stage. In order to make this measurement, the width of the river, and the water's depth and velocity at various points must be measured at several different stream stages. A cross-section of the river is divided into intervals and the area of each interval is calculated. If the velocity was measured at different depths on the same vertical interval, then the velocity is averaged. To determine the discharge for the interval, the area is multiplied by the velocity. To find the entire stream's discharge, an average of all the intervals' discharges is calculated. It is important to take discharge measurements of the stream at various stream stages, even flood stage.

A river reaches flood stage when the river overflows its banks. The flood stage can be determined by measuring the gage height, or simply the height of the water in the stream measured from the river's bottom. The streamflow can increase exponentially as the gage height increases. Thus, a small increase in gage height may indicate that a river has reached its flood stage. Floods are a fairly common, yet dangerous, natural disaster.

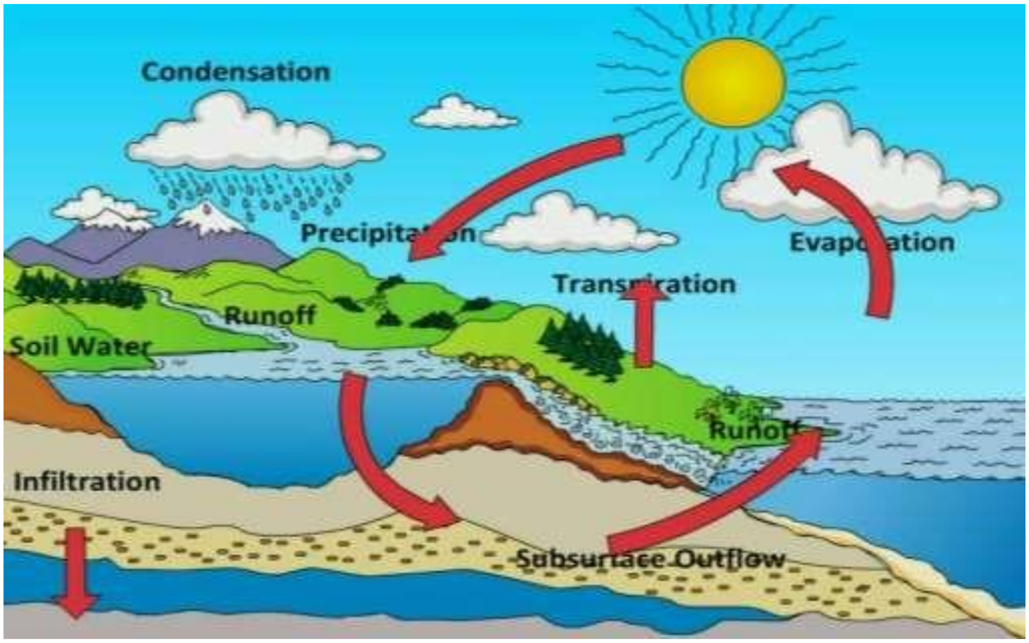
They normally occur because a storm or rapid snow melt has produced more runoff than a stream can carry. Dams failing, landslides blocking stream channels, and high tides are some other causes of flooding. Weather patterns can greatly influence when and where flooding will occur. By studying these patterns, geologists can determine the susceptibility of a region to having a flood at certain times of the year. The recurrence interval, measured in years, describes the magnitude of a flood. Changes in the drainage basin, such as harvesting timber or housing developments, can change the magnitude of a flood. The normally dry land that becomes covered with water during a flood is known as the flood plain. Restrictions on land use in flood plains is regulated by flood-plain zoning. Dams and levees have been built to help reduce damage caused by floods.

When flowing water travels to an area of land that is completely surrounded by higher land, a lake is formed. The water is not trapped .in this low area, the water just escapes at a slower rate than the rate of incoming water. Lakes can vary greatly in area, depth, and water type. Most lakes are fresh water, however some, such as the Great Salt Lake and the Dead Sea, are salt water. Contrary to common belief, a reservoir is not the same as a lake.

A reservoir is a manmade lake caused by a river being dammed. The water in a reservoir is very slow moving compared to the river. Therefore, the majority of the sediments that the river was carrying settle to the bottom of the reservoir. A reservoir will eventually fill up with sediment and mud and become unusable.

THE WATER CYCLE

The hydrologic cycle or water cycle is a graphic representation of how water is led through the environment. Water molecules remain constant, though they may change between solid, liquid, and gas forms. Drops of water in the ocean evaporate, which is the process of liquid water becoming water vapor. Evaporation can occur from water surfaces, land surfaces, and snow fields into the air as water vapor. Moisture in the air can condensate,



which is the process of water vapor in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water. Condensation is the opposite process of evaporation. Water vapor condenses on tiny particles of dust, smoke, and salt crystals to become part of a cloud. After a while, the water droplets combine with other droplets and fall to Earth in the form of precipitation (rain, snow, hail, sleet, dew, and frost). Once the precipitation has fallen to Earth, it may go into an aquifer as groundwater or the drop may stay above ground as surface water. The hydrologic cycle is an important concept to

understand. Water has so many uses on Earth, such as human and animal consumption, power production, and industrial and agricultural needs. Precipitation—in the form of rain and snow—also is an important thing to understand. It is the main way that the water in the skies comes down to Earth, where it fills the lakes and rivers, recharges the underground aquifers, and provides drinks to plants and animals. Different amounts of precipitation fall on different areas of the Earth at different rates and at various times of the year.

One problem facing the cycle of water on Earth is water contamination. Chemicals that go into the water often are very difficult, if not impossible, to remove. One potential source of contamination of water is runoff, the overland flow of water. While precipitation causes the runoff to occur, stripping vegetation from land can add to the runoff in a particular area. The sediment and soil from these areas, not to mention any pesticides or fertilizers that are present, are washed into the streams, oceans, and lakes. What happens to the rain after it falls depends on many factors, such as the intensity and duration of rainfall, the topography of the land, soil conditions, amount of urbanization, and density of vegetation. A common misconception about rain that it is tear-shaped, when in actuality it is shaped more like a hamburger bun. Rain drops also are different sizes, due to the initial difference in particle size and the different rate of coalescence.

GLACIERS AND ICE CAPS

Glaciers and icecaps are referred to as storehouses for fresh water. They cover 10 percent of the world's land mass. These glaciers are primarily located in Greenland and Antarctica. The glaciers in Greenland almost cover the entire land mass. Glaciers begin forming

because of snowfall accumulation. When snowfall exceeds the rate of melting in a certain area,

Glacier, Landform

begin to form. This melting occurs in the summer. The weight of snow accumulating compresses the snow to form ice. Because these glaciers are so heavy, they can slowly move their way down hills.

Glaciers affect the topography of the land in some areas. Ancient glaciers formed lakes and valleys. The Great Lakes are an example of this. Glaciers range in length from less than the size of a football field to hundreds of miles long. They also can reach up to 2 miles thick. Glaciers melting can have a tremendous effect on the sea level. If all of the glaciers were to melt today, the sea would rise an estimated 260 feet, according to the USGS. Glaciers have had a tremendous effect on the formation of the Earth's surface and are still influencing the topography everyday.

GROUNDWATER

Groundwater is defined as water that is found beneath the surface of the Earth in conditions of 100 percent saturation (if it is less than 100 percent saturation, then the water is considered soil moisture). Ninety-eight percent of Earth's available fresh water is groundwater. It is about 60 times as plentiful as the fresh water found in lakes and streams. Water in the ground travels through pores in soil and rock, and in fractures and weathered areas of bedrock. The amount of pore space present in rock and soil is known as porosity. The ability to travel through the rock or soil is known as permeability. The permeability and porosity measurements in rock and/or soil can determine the amount of water that can

flow through that particular medium. A "high" permeability and porosity value means that the water can travel quickly.

Groundwater can be found in aquifers. An aquifer is a body of water-saturated sediment or rock in which water can move readily. There are two main types of aquifers: unconfined and confined. An unconfined aquifer is a partially or fully filled aquifer that is exposed to the surface of the land. Because this aquifer is in contact with the atmosphere, it is impacted by meteoric water and any kind of surface

contamination. There is not an impermeable layer to protect this aquifer. In contrast, a confined aquifer is an aquifer that has a confining layer that separates it from the land surface. This aquifer is filled with pressurized water (due to the confining layer). If the water is pressurized at a high enough value, when a well is drilled into the confining aquifer, water rises above the surface of the ground. This is known as a flowing water well. The pressure of the water is called the hydraulic head. Groundwater movement, or velocity, is measured in feet (or meters) per second.

In some areas, the bedrock has low permeability and porosity levels, yet groundwater can still travel in the aquifers. Groundwater can travel through fractures in the rock or through areas that are weathered. Limestone, for example, weathers in solution, creating underground cavities and cavern systems. At the land surface, these areas are known as "karst". The voids in the rock, created as limestone goes into solution, can cause collapses at the land surface. These collapses are known as sinkholes. Sinkholes are often a direct

conduit to the groundwater and areas where contamination can easily infiltrate the aquifers. Sinkhole areas also can have land subsidence as mass wasting occurs in areas with a sudden change in slope and contact with water. Land subsidence may or may not be noticeable in some areas because it appears as hills and valleys (due to the very large size). As groundwater becomes more of a source for drinking water, the problem of sinkholes and land subsidence could increase.

Porosity and permeability of the sediment, soil, and bedrock in the area also affects the recharge rate of the groundwater. This means that in some areas, the groundwater can be pumped out faster than it can replenish itself. This creates a number of problems. One of these problems is called "drawdown," a lowering of the aquifer near a pumping well. This can occur in areas where the well is pumping faster than the groundwater aquifer is recharged. Drawdown creates voids in the bedrock and can lead to additional land subsidence or sinkholes (as there is no longer water present and the void cannot hold the weight of the material above and collapses)

"Decreasing water levels" illustrates drawdown and overpumping problems. Because groundwater is a very plentiful source of fresh water, it must be a protected resource. In many areas, however, groundwater is not protected. Once an aquifer is contaminated with chemicals or petroleum, it is difficult, if not impossible, to clean up. Therefore, prevention of contamination is paramount. Karst areas pose a difficult problem because anything spilled on the surface travels quickly and easily into the aquifer. Many times, surface water also is in direct contact with undergroundwater, and depending on if the stream is feeding the groundwater (a losing stream) or if the groundwater is feeding the stream (a gaining stream) this can create a problem with contamination of the groundwater.

There is also the problem of saltwater intrusion (present in coastal regions, such as Florida) where over-pumping of the groundwater draws the denser saltwater up into the aquifer. A cross-section illustrates the problem of salt water intrusion on So, protection of the groundwater should be a high priority as the population on Earth continues to rise and potable water becomes a valuable resource. Protecting groundwater also means protecting

surface water, rain water, and all forms of water, because water continues to cycle and recycle. Once the water is contaminated, it is difficult to ever remediate.

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Globally, the most prevalent water quality problem is eutrophication, a result of highnutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is a phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Nagarjuna sager dam and its branches. The present

study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Selapadu(Venugopalaswami Temple) village. The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our village and changes in climatic conditions Selapadu(Venugopalaswami Temple) village ground water was highly effected. Therefore, as part of my engineering chemistry field project, I have chosen Selapadu(Venugopalaswami Temple) village ground water and I would like to analyze and submit the report on Selapadu(Venugopalaswami Temple) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

VIGNAN'S

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml

M_2 = Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 4.5}{20} = \mathbf{0.002}\ \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.002 X 100.09 x 1000 = 200.18 mg/l or 200.18 ppm

Result: Total Hardness of given water sample before boiling process is 200.18 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.0 ml	2.0 ml
2	20 ml	0 ml	2.0 ml	2.0 ml

$$N_1 \ X \ V_1 = N_2 \ X \ V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.0 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ \ 2.0}{20} = 0.01N$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

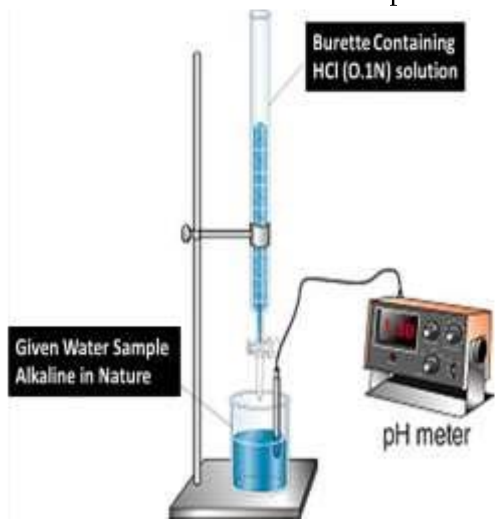
= 0.01 X 50 x 1000 = 500 mg/l or 500 ppm

Result: Total Alkalinity of given water sample before boiling process is 500 ppm

Determination of pH of Water ‑ pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (‑ log H^+) and has values between 0‑14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid‑base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The pH value of the water before boiling - **7.25**

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	16.5 ml	16.5 ml
2	20 ml	0 ml	33.0 ml	16.5 ml

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 16.5 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 16.5}{20} = \mathbf{0.00825}\ \boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00825 X 100 x 1000 = 825 mg/l or 825 ppm

Result: Total Hardness of given water sample before boiling process is 825 ppm

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.5 ml	2.5 ml
2	20 ml	2.5 ml	5.0 ml	2.5 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 2.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \;\; 2.5}{20} = 0.0125 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L =

N_2 X 50 x 1000 mg/L

= 0.0125 X 50 x 1000 = 625 mg/l or 625 ppm

Result: Total Alkalinity of given water sample before boiling process is 625 ppm.

3. Determination of pH of Water ‑ pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

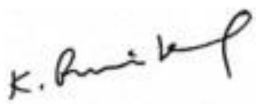
Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (‑ log H^+) and has values between 0‑14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid‑base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: The PH value of the water After boiling **– 7.2**

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	500
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	300
pH	pH metric method(7.25)	pH	pH metric method(9.96)	6.5-8.5



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

Vadlamudi WATER ANALYSIS

SUBMITTED BY

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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**VADLAMUDI WATER ANALYSIS**" is submitted by **MUDRABOYINA JAGADEESH (221FA01074),ABBURI NAGA BHARATH (221FA01075),KAMATHAM MISRITHA PRASANNA (221FA01076), AKKALA SRILATHA (221FA01077), ARJULA SRI**

SURYA KANTHI (221FA01079),PATTELA SAI MOUNIKA (221FA01080) in partial fulfilment for the 1stB.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Vadlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Vadlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Y P A Prasad
పంచాయితీ కార్యదర్శి
గ్రామ పంచాయితీ, వడ్లమూడి
చేబ్రోలు మండలం, గుంటూరు జిల్లా

Objective:

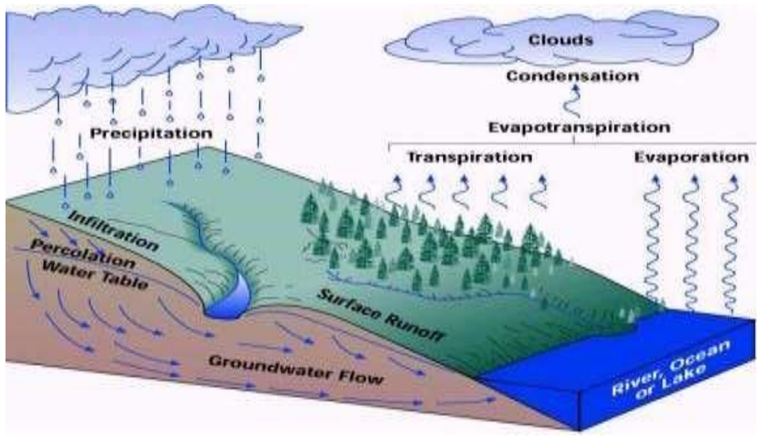
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in vejendla pond water. The main water source of surface water used in vejendla pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of vejendla pond water.

Water samples are collected from vejendla pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions vejendla pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on vejendla pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2, H_2S, NH_3, *etc.*, and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless

3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.0 ml	8.0 ml
2	20 ml	0 ml	8.0 ml	8.0 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.0 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.0}{20} = 0.004M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.004 X 100.09 x 1000 = 400.36 mg/l or 400 ppm

Result: Total Hardness of given water sample before boiling process is 400ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.1ml	5.1 ml
2	20 ml	0 ml	5.1ml	5.1 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.1ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.1}{20} = 0.0255\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0255X 50 x 1000 = 1275mg/l or 1275 ppm

Result: Total Alkalinity of given water sample before boiling process is 1275 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	3.5 ml	3.5 ml
2	20 ml	0 ml	3.5 ml	3.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 3.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 3.5}{20} = 0.00175\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00175 X 100 x 1000 = 175 mg/l or 175 ppm

Result: Total Hardness of given water sample before boiling process is 175 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.1 ml	4.1 ml
2	20 ml	0 ml	4.1 ml	4.1 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.1 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0205M$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

$= \text{Normality of Water sample X Equivalent weight of } CaCO_3 \text{ x } 1000 \text{ mg/L}$

$= N_2 \text{ X } 50 \text{ x } 1000 \text{ mg/L}$

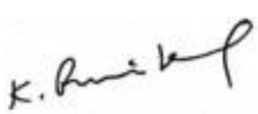
$= 0.0205 \text{ X } 50 \text{ x } 1000 = 1025 \text{ mg/l or } 1025 \text{ ppm}$

Result: Total Alkalinity of given water sample before boiling process is 1025 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(8.0)**		**WHO/BIS Standards**
Hardness	EDTA Method (400 ppm)	Hardness	EDTA Method (175 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1275 ppm)	Alkalinity	Acid – Base Titration (1025 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU(SAIBABA TEMPLE ROAD) WATER ANALYSIS

SUBMITTED BY

GUDAPATI KARTHIKEYA (221FA14001)
MUTHOJU SRIRAM (221FA14002)
MAYALURU SAMEERA (221FA14003)
SOMEPALLI BHARGAVI (221FA14004)
SHAIK NAZMA (221FA14005)

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU (SAIBABA TEMPLE ROAD) WATER ANALYSIS**" is submitted by **GUDAPATI KARTHIKEYA (221FA14001), MUTHOJU SRIRAM (221FA14002), MAYALURU SAMEERA (221FA14003), SOMEPALLI BHARGAVI (221FA14004), SHAIK NAZMA (221FA14005)** in partial fulfilment for the 1st B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Ajit ...
SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

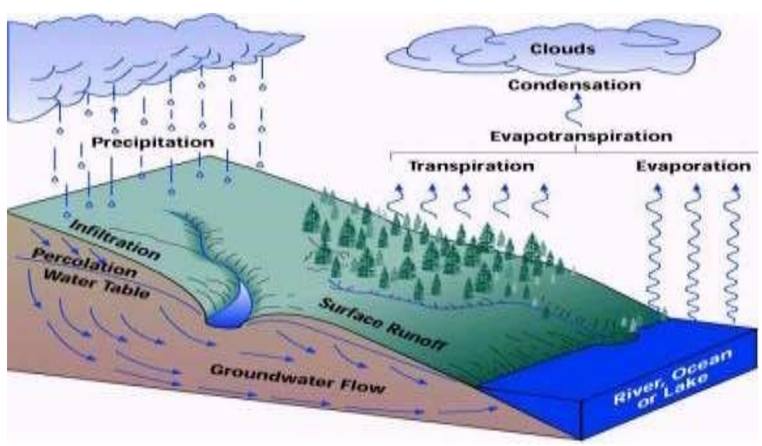
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



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Water samples are collected from Selapadu(Saibaba temple road) pond water. The collected water sample are generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu(Saibaba temple road) pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on Selapadu(Saibaba temple road) pond water.

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- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^+$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$\mathbf{M^{2+} + EBT \xrightarrow{pH\ =\ 10} \underset{(Wine\ Red)}{[M\text{-}EBT]\ complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\mathbf{\underset{(Wine\ Red)}{[M\text{-}EBT]\ complex} + EDTA \xrightarrow{pH\ =\ 10} \underset{(Colorless)}{[M\text{-}EDTA]\ complex} + \underset{(Blue)}{EBT\ indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.4 ml	8.4 ml
2	20 ml	0 ml	8.4 ml	8.4 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 4.5}{20} = 0.00435\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00435 X 100.09 x 1000 = 435.3915 mg/l or 435 ppm

Result: Total Hardness of given water sample before boiling process is 435ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	5.3ml	5.3 ml
2	20 ml	0 ml	5.3ml	5.3 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.3ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Ha\ dwater}$ = N_2 = $\frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.0}{20}$ = 0.0265N

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0265X 50 x 1000 = 1325mg/l or 1325 ppm

Result: Total Alkalinity of given water sample before boiling process is 1325 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = \boldsymbol{M_2} = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 2.6}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.5 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0225\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0225 X 50 x 1000 = 1125 mg/l or 1125 ppm

Result: Total Alkalinity of given water sample before boiling process is 1125 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (435 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (1125 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.

Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU(SAIBABA TEMPLE ROAD) WATER ANALYSIS

SUBMITTED BY

SOMU SAI SRUTHI (221FA14116)
BHASKARANI SHRADDHA (221FA14117)
PALUKURI VENKATA HARSHITHA (221FA14118)
ADAPA VIDHYA (221FA14120)
ALLA SWETHA (221FA14121)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

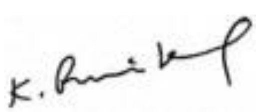
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU(SAIBABA TEMPLE ROAD) WATER ANALYSIS**" is submitted by **SOMU SAI SRUTHI (221FA14116),BHASKARANI SHRADDHA (221FA14117).PALUKURI VENKATA HARSHITHA (221FA14118),ADAPA**

VIDHYA (221FA14120) ,ALLA SWETHA (221FA14121)in partial fulfilment for the 1st B.Tech tothe Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Ainfulla

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

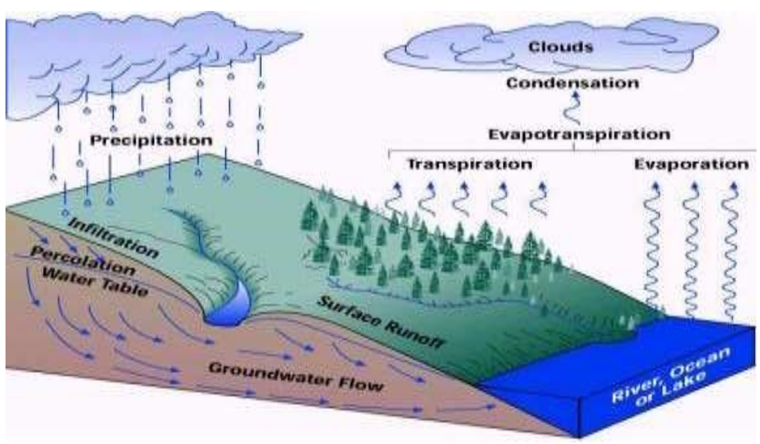
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu(Saibaba temple road) pond water. The main water source of surface water used in Selapadu(Saibaba temple road) pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu(Saibaba temple road) pond water.

Water samples are collected from Selapadu(Saibaba temple road) pond water. The collected water sample are generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu(Saibaba temple road) pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on Selapadu(Saibaba temple road) pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, *etc.,* and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++} ======> (C_{17}H_{35}COO)_2Ca + 2Na^+$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\text{ complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\text{ complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\text{ complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.4 ml	8.4 ml
2	20 ml	0 ml	8.4 ml	8.4 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00435\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00435 X 100.09 x 1000 = 435.3915 mg/l or 435 ppm

Result: Total Hardness of given water sample before boiling process is 435ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	5.3ml	5.3 ml
2	20 ml	0 ml	5.3ml	5.3 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.3ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.0}{20} = 0.0265\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0265X 50 x 1000 = 1325mg/l or 1325 ppm

Result: Total Alkalinity of given water sample before boiling process is 1325 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$MolarityofHa\,dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 2.6}{20} = 0.00225M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.5 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0225\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

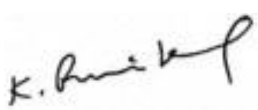
= 0.0225 X 50 x 1000 = 1125 mg/l or 1125 ppm

Result: Total Alkalinity of given water sample before boiling process is 1125 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (435 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (1125 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY
MADIREDDY HARSHITH SAI KRISHNA (221FA14006)
KURRA MAMATHA (221FA14007)
NALLAMOTHU SRIVALLI (221FA14008)
AKHIL YENDLURI (221FA14009)
SAKHAMURI NAGA SAMHITHA (221FA14010)

VIGNAN'S
Foundation for Science, Technology & Research
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-Estd. u/s 3 of UGC Act 1956

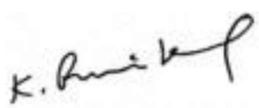
Department of Chemistry

School of Applied Sciences and Humanities

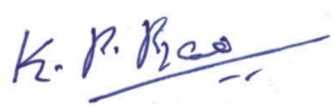
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **MADIREDDY HARSHITH SAI KRISHNA (221FA14006), KURRA MAMATHA (221FA14007), NALLAMOTHU SRIVALLI (221FA14008), AKHIL YENDLURI (221FA14009), SAKHAMURI NAGA SAMHITHA (221FA14010)** in partial fulfilment for the 1st B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956
NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
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Respected sir,

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Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao [illegible]

Head, Department of Chemistry

Md. [illegible]

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) *
Govt. of Andhra Pradesh

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

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Outcome:

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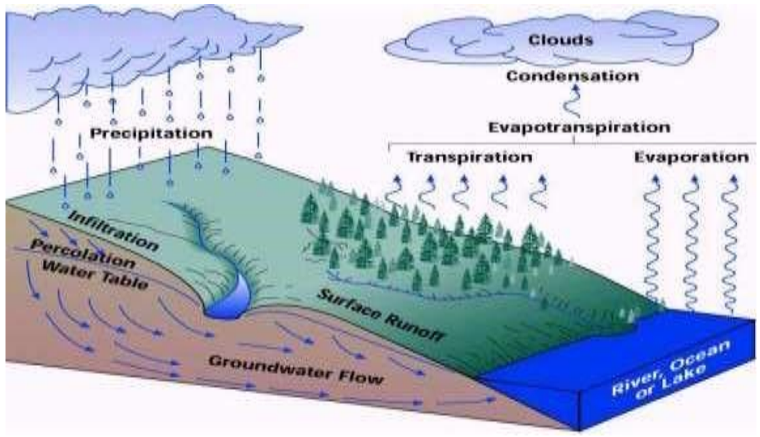

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- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}======>(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless

	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			**(V_1)**
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\,dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

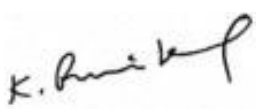
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED
BY

MADIREDDY HARSHITH SAI KRISHNA (221FA14110)
KURRA MAMATHA (221FA14111)
NALLAMOTHU SRIVALLI (221FA14112)
AKHIL YENDLURI (221FA14114)
SAKHAMURI NAGA SAMHITHA (221FA14115)

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submitted by **MADIREDDY HARSHITH SAI KRISHNA (221FA14110), KURRA MAMATHA (221FA14111), NALLAMOTHU SRIVALLI (221FA14112), AKHIL YENDLURI (221FA14114), SAKHAMURI NAGA SAMHITHA (221FA14115)** in partial fulfilment for the 1^{st} B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Aiufkha

SELAPADU GRAMA PANCHAYAT ★ Chebrolu (Mdl.), Guntur (Dt.) ★
Govt. of Andhra Pradesh

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

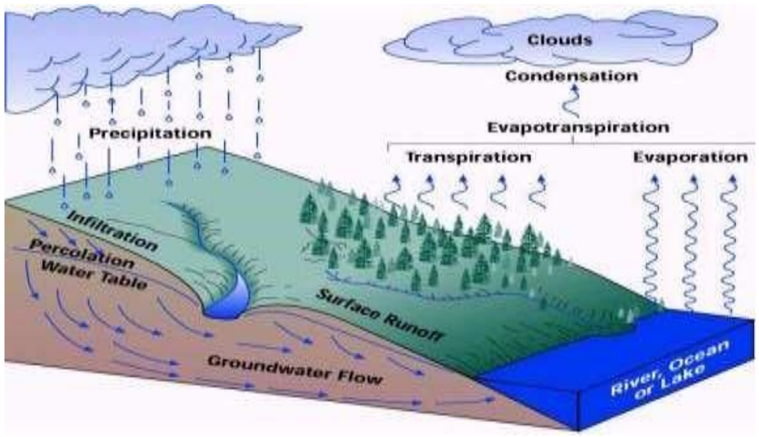
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, *etc.,* and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless

	ChemicalParameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha dwater = M_2 = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \, X \, 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20} = 0.027\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{ofHa\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

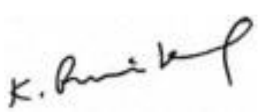
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		Water Sample after Boiling Process(4.5)		WHO/BIS Standards
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY

NEKKALAPU JHANSI CHOWDARY (221FA14011)

KILARI LAKSHMI NISHITHA (221FA14012)

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PALETI JAYAM JAMES (221FA14016)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

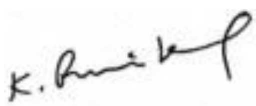
VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submittedby **NEKKALAPU JHANSI CHOWDARY (221FA14011), KILARI LAKSHMI NISHITHA (221FA14012), KURUVA VENKATA SRUTHI (221FA14013), MESA PREETHI ANULEKHA (221FA14014), OGIRALA YASWITHA (221FA14015), PALETI JAYAM JAMES (221FA14016)** in partial fulfilment for the1st B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT * Chebrolu (Mdl.), Guntur (Dt.) * Govt. of Andhra Pradesh

Objective:

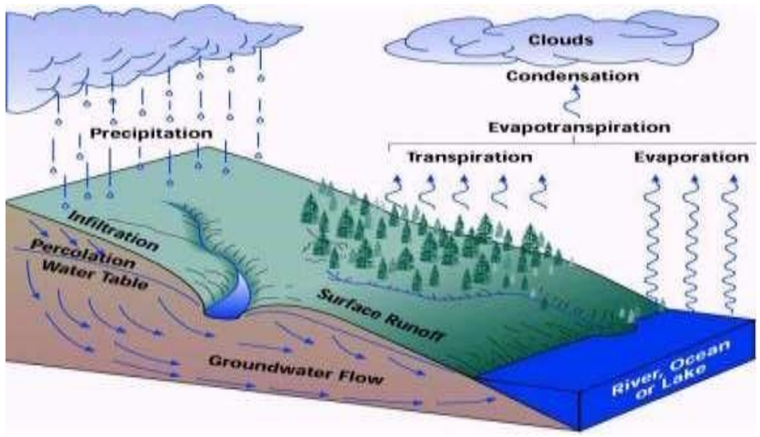
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu pond water. The main water source of surface water used in Selapadu pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu pond water.

Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2,H_2S,NH_3, *etc.,* and poisonous minerals like lead, arsenic, manganese etc., □ Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}\text{======>}(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		

1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} [M\text{-}EBT]\ complex$$

(Wine Red)

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$[M\text{-}EBT]\ complex + EDTA \xrightarrow{pH = 10} [M\text{-}EDTA]\ complex + EBT\ indicator$$

(Wine Red) (Colorless) (Blue)

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha dwater = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 8.3}{20} = 0.00415 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			**(V_1)**
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Ha\ dwater}$ = N_2 = $\frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20}$ = 0.027N

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{MolarityofHa\ dwater} = \boldsymbol{M}_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

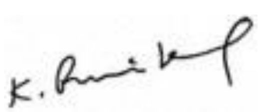
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU WATER ANALYSIS

SUBMITTED BY
NEKKALAPU JHANSI CHOWDARY (221FA14104)
KILARI LAKSHMI NISHITHA (221FA14105)
KURUVA VENKATA SRUTHI (221FA14106)
MESA PREETHI ANULEKHA (221FA14107)
OGIRALA YASWITHA (221FA14108)
PALETI JAYAM JAMES (221FA14109)

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU WATER ANALYSIS**" is submittedby **NEKKALAPU JHANSI CHOWDARY (221FA14104) ,KILARI LAKSHMI NISHITHA (221FA14105),KURUVA VENKATA SRUTHI (221FA14106),MESA PREETHI ANULEKHA (221FA14107),OGIRALA YASWITHA (221FA14108),PALETI JAYAM**

JAMES (221FA14109) in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science,Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

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In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. Ainfjkha

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

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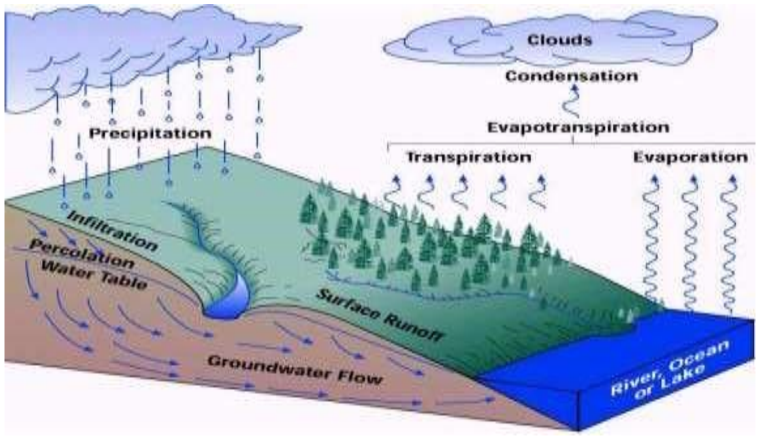

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Water samples are collected from Selapadu pond water. The collected water sample are

generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen Selapadu pond water and I would like to analyze and submit the report on Selapadu pond water.

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- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHOStandards**	**BISStandards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	ChemicalParameters		

1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.3 ml	8.3 ml
2	20 ml	0 ml	8.3 ml	8.3 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.3 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha\ dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ 8.3}{20} = 0.00415M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00415 X 100.09 x 1000 = 415.3715 mg/l or 415 ppm

Result: Total Hardness of given water sample before boiling process is 415ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml)	Burette reading		Volume of HCl consumed (in ml)
		Initial	Final	
	(V_2)			(V_1)
1	20 ml	0 ml	5.4ml	5.4 ml
2	20 ml	0 ml	5.4ml	5.4 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.4ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

Normality $\boldsymbol{of Ha\ dwater}$ = N_2 = $\frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 5.4}{20}$ = 0.027N

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.027X 50 x 1000 = 1350mg/l or 1350 ppm

Result: Total Alkalinity of given water sample before boiling process is 1350 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Ha\,dwater} = \boldsymbol{M}_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \;\; 4.5}{20} = 0.00225\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0 ml	2.4 ml	2.4 ml
2	20 ml	0 ml	2.4 ml	2.4 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.4 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ 2.4}{20} = 0.012\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

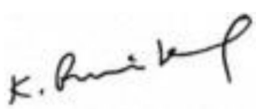
= 0.012 X 50 x 1000 = 600 mg/l or 600 ppm

Result: Total Alkalinity of given water sample before boiling process is 600 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (415 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (600 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru Water Analysis

SUBMITTED BY

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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sekuru Water Analysis**" is submitted by **PRAVALLIKA BHIMAVARAPU (221FA14017), DUDEKULA ZUBEDHA BEGUM(221FA14018), JONNALA NIHARIKA (221FA14019), RAJAVARAPU BHAVANA HARSHITHA (221FA14020), KOLLATI HONEY SANTOSH (221FA14021), ANNAPAREDDI HARSHA VARDHAN SAI (221FA14022), BELLAMKONDA SIRI SRAVANTHI (221FA14024)** in partial fulfilment for the 1st B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

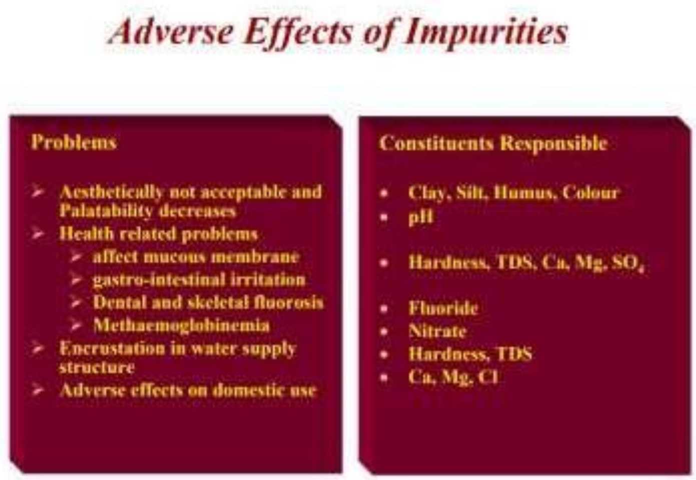
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \; X \; 12.0}{20} = 0.006M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality of Hard water $= N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 7.5}{20} = 0.0375$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

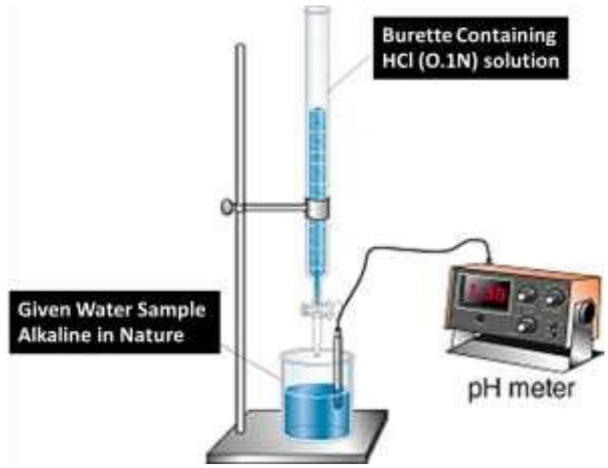
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

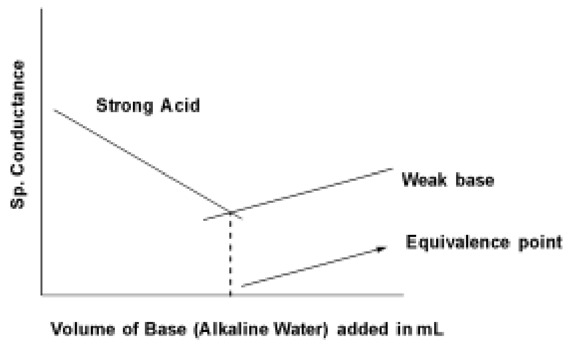
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.

2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.

4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.

5. Connect the conductivity cell to the conductometer.

6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.

7. Put the function switch to cell constant and set the value of cell constant.

8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon . c . l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

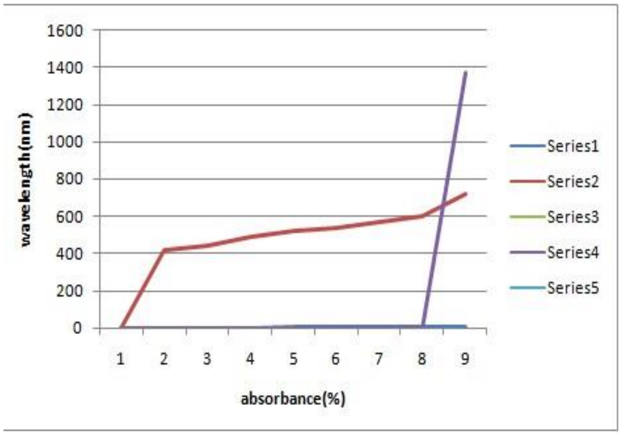
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ = N_2 = $\frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

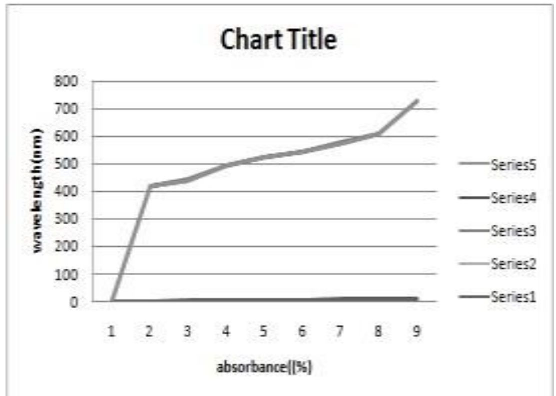
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



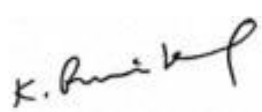
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 600ppm	Hardness	EDTA Method-260ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru Water Analysis

SUBMITTED BY

PRAVALLIKA BHIMAVARAPU (221FA14093)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

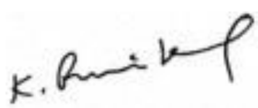
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

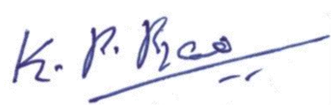
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sekuru Water Analysis**" is submitted by **PRAVALLIKA BHIMAVARAPU (221FA14093), DUDEKULA ZUBEDHA BEGUM (221FA14094) JONNALA NIHARIKA (221FA14095), RAJAVARAPU BHAVANA HARSHITHA (221FA14096), KOLLATI HONEY SANTOSH (221FA14097), ANNAPAREDDI HARSHA VARDHAN SAI (221FA14098), BELLAMKONDA SIRI SRAVANTHI (221FA14099)** in partial fulfilment for the 1st B.Tech. to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

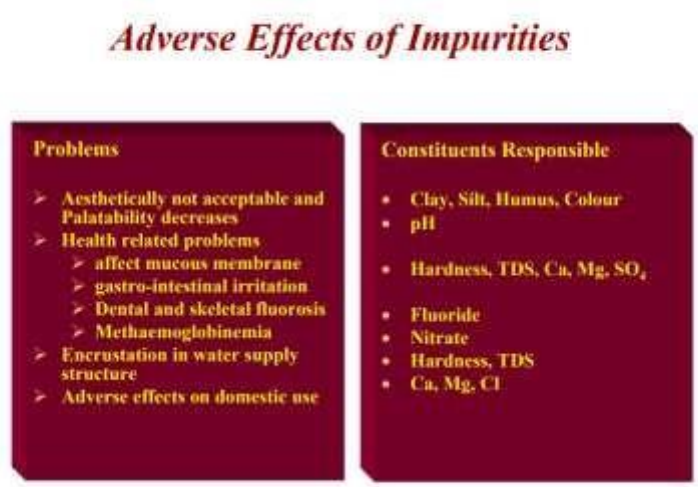
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

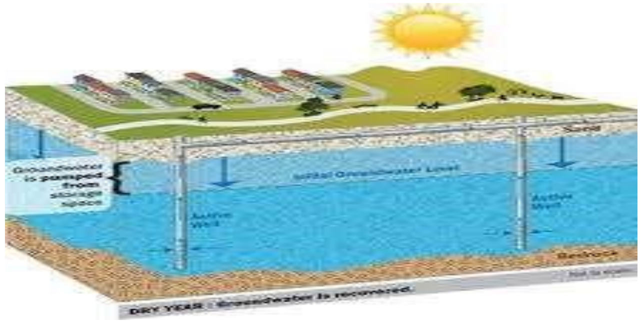
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	....
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	....

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \; X \; 12.0}{20} = 0.006M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $of Hard\ water = N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 7.5}{20} = 0.0375$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

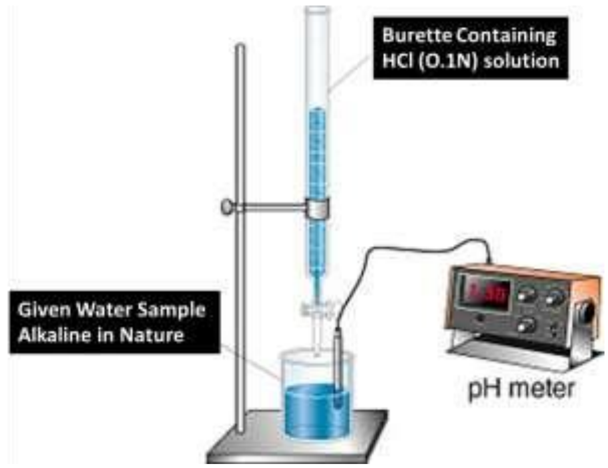
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	**Volume of Water sample taken (V_2 = 10 mL)**	**Volume of HCL added (V_1 = 1mL)**	**pH values**
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

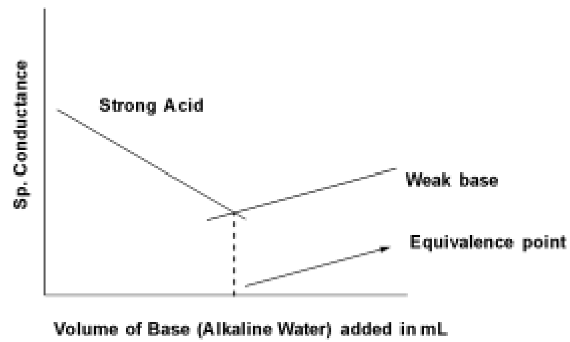
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

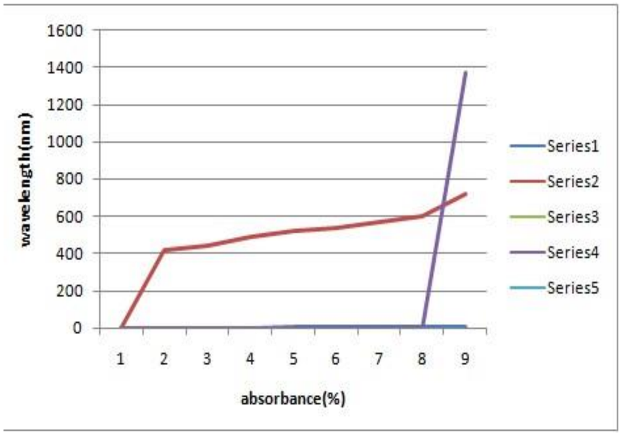
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality ***of Hard water*** = N_2 = $\frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

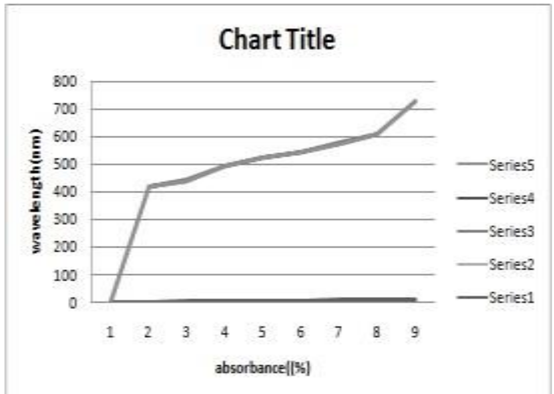
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



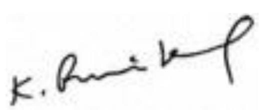
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 600ppm	Hardness	EDTA Method-260ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru(Ramalayam Bazar)
Water Analysis

Submitted by

PALUKURI SUSANNAH JOY (221FA14025) PASUPULETI PAVANI (221FA14026)

BANDI BHARGAVI (221FA14027)

SHAIK HABIB MUNISHA BEGUM (221FA14028)

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RAYAVARAPU LAKSHMI SOUMYA (221FA14033)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sekuru (Ramalayam Bazar)**" is submitted by **PALUKURI SUSANNAH JOY (221FA14025), PASUPULETI PAVANI (221FA14026) BANDI BHARGAVI (221FA14027), SHAIK HABIB MUNISHA BEGUM (221FA14028) MOTURI ANUPRETTY (221FA14030), SHRUTI KUMARI (221FA14031), ERUVASHOWRI KEERTHANA (221FA14032), RAYAVARAPU LAKSHMI SOUMYA (221FA14033)** in partial fulfilment for the 1st B.Tech. to the Vignan's Foundation for Science, Technologyand Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

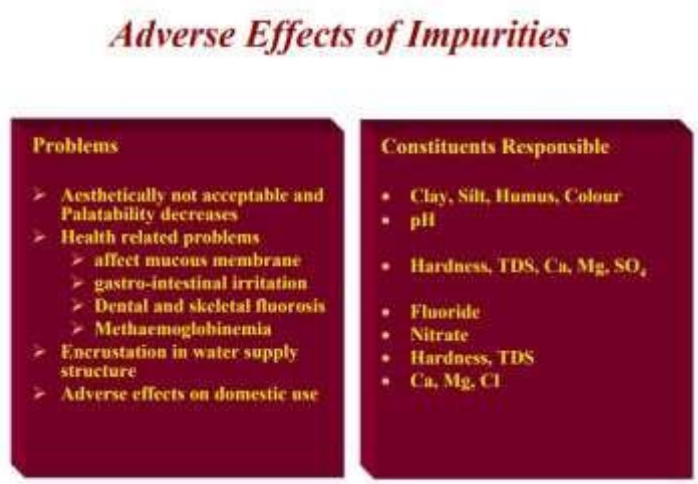
Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Globally, the most prevalent water quality problem is eutrophication, a result of high-nutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial



effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.

Irrigation through ground water

The largest component of ground water use is the water extracted for irrigation. The main means of irrigation in the country are canals, tanks and wells, including tube-wells. Of all these sources, ground water constitutes the largest share. Wells, including dug wells, shallow tube-wells and deep tube wells provide about 61.6% of water for irrigation, followed by canals with 24.5%.Over the years, there has been a decrease in surface water use and a continuous increase in ground water utilisation for irrigation. illustrates the pattern of use of the main sources of irrigation. As can be seen, the share of tube well has increased exponentially, indicating the increased usage of ground water for irrigation by farmers. The dependence of irrigation on ground water increased with the onset of the Green Revolution, which depended on intensive use of inputs such as water and fertilizers to boost farm production. Incentives such as credit for irrigation equipment and subsidies for electricity supply have further worsened the situation. Low power tariffs has led to excessive water usage, leading to a sharp fall in water tables.

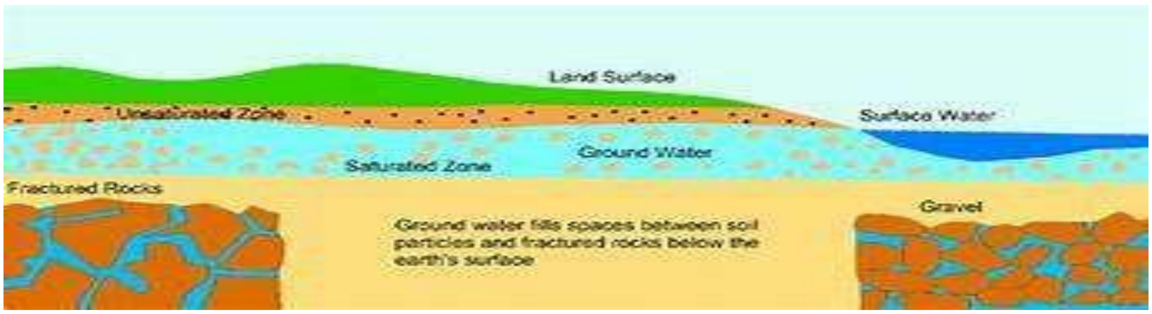
Ground water extraction and use

Experts believe that India is fast moving towards a crisis of ground water overuse and contamination. Ground water overuse or overexploitation is defined as a situation in which, over a period of time, average extraction rate from aquifers is greater than the average recharge rate. In India, the availability of surface water is greater than ground water. However, owing to the decentralised availability of groundwater, it is easily accessible and forms the largest share of India's agriculture and drinking water supply. 89% of ground water extracted is used in the irrigation sector, making it the highest category user in the country.6 This is followed by ground water for domestic use which is 9% of the extracted groundwater. Industrial use of ground water is 2%. 50% of urban

water requirements and 85% of rural domestic water requirements are also fulfilled by ground water.

Ground water availability

As of April 2015, the water resource potential or annual water availability of the country in terms of natural runoff (flow) in rivers is about 1,869 Billion Cubic Meter (BCM)/year.2 However the usable water resources of the country have been estimated as 1,123 BCM/year. This is due to constraints of topography and uneven distribution of the resource in various river basins, which makes it difficult to extract



the entire available 1,869 BCM/year.Out of the 1,123 BCM/year, the share of surface water and ground water is 690 BCM/year and 433 BCM/year respectively. Setting aside 35 BCM for natural discharge, the net annual ground water availability for the entire country is 398 BCM.The overall contribution of rainfall to the country's annual ground water resource is 68% and the share of other resources, such as canal seepage, return flow from irrigation, recharge from tanks,ponds and water conservation structures taken together is 32%.4 Due to the increasing population in the country, the national per capita annual availability of water has reduced from 1,816 cubic metre in 2001 to 1,544 cubic metre in 2011.2 This is a reduction of 15%.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is a phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district.

The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Nagarjuna sager dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Sekuru (Ramalayam Bazar). The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our village and changes in climatic conditions This ground water was highly effected. Therefore, as part of my engineering chemistry field project, I have chosen ground water sample and I would like to analyze and submit the report on Guntur ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	500
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	300
Ph	pH metric method	pH	pH metric method	6.5 to 8.5

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose

concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	0.0 ml	13.0 ml	13.0 ml

$$\boldsymbol{M_1 X V_1} = \boldsymbol{M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2=

Molarity of hardwater sample = ?

V_2 =volume of hard water sample =20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M}_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 13.0}{20} = \mathbf{0.0065}\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100.09 x 1000 mg/L

= 0.0065 X 100.09 x 1000 = 650.585 mg/l or 651 ppm

Result: Total Hardness of given water sample before boiling process is 651 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange end point. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.1 ml	2.1 ml
2	20 ml	0.0 ml	2.1 ml	2.1 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.1 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2 =volume of hard water sample =20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 \; X \; V_1}{V_2} = \frac{0.1 \; X \; 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

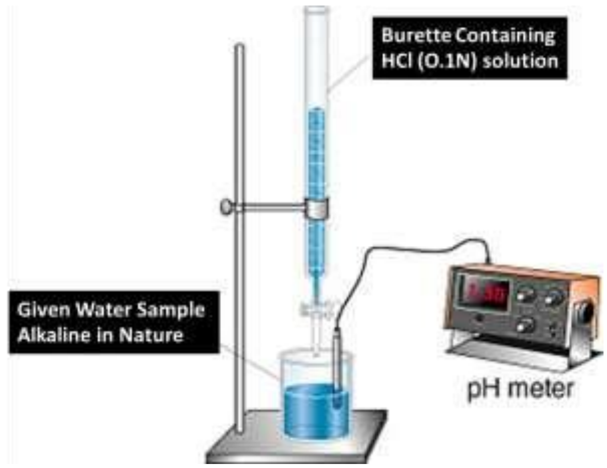
= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 500 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: the pH value of the water before boiling____8.0________

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	9.1 ml	9.1 ml
2	20 ml	0.0 ml	9.1 ml	9.1 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 9.1 ml M_2=

Molarity of hardwater sample = ?

V_2 =volume of hard water sample =20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.010 \; X \; 9.1}{20} = \mathbf{0.0045M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0045 X 100.09 x 1000 = 455.409 mg/l or 455 ppm

Result: Total Hardness of given water sample before boiling process is 455 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenol phthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange end point. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.6 ml	1.6 ml
2	20 ml	0.0 ml	1.6 ml	1.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.6 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2 =volume of hard water sample =20 ml

Normality $of Hardwater = N_2 = \frac{N_1 X V_1}{V_2} = \frac{0.1 X 1.6}{20} = 0.008$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.008 X 50 x 1000 = 400 mg/l or 400 ppm

Result: Total Alkalinity of given water sample before boiling process is 400 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

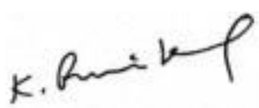
Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as ($-\log H^+$) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: the pH value of the water after boiling___7.0_________

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness (651)	EDTA Method	Hardness (455)	EDTA Method	500
Alkalinity (500)	Acid – Base Titration	Alkalinity (400)	Acid – Base Titration	300
pH (8.0)	pH metric method	pH (8.0)	pH metric method	6.5 to 8.5



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru(Ramalayam Bazar)
Water Analysis

Submitted by

PALUKURI SUSANNAH JOY (221FA14085)

PASUPULETI PAVANI (221FA14086)

BANDI BHARGAVI (221FA14087)

SHAIK HABIB MUNISHA BEGUM (221FA14088)

MOTURI ANUPRETTY (221FA14089)

SHRUTI KUMARI (221FA14090)

YERUVA SHOWRI KEERTHANA (221FA14091)

RAYAVARAPU LAKSHMI SOUMYA (221FA14092)

VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sekuru(Ramalayam Bazar)**" is submitted by **PALUKURI SUSANNAH JOY (221FA14085), PASUPULETI PAVANI (221FA14086) BANDI BHARGAVI (221FA14087), SHAIK HABIB MUNISHA BEGUM (221FA14088) MOTURI ANUPRETTY (221FA14089), SHRUTI KUMARI (221FA14090), ERUVASHOWRI KEERTHANA (221FA14091), RAYAVARAPU LAKSHMI SOUMYA (221FA14092)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technologyand Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

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In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

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The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

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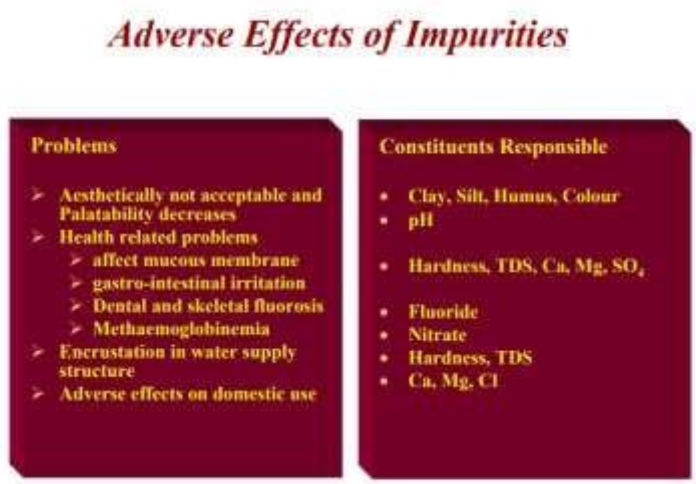
The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Globally, the most prevalent water quality problem is eutrophication, a result of high-nutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.

Irrigation through ground water

The largest component of ground water use is the water extracted for irrigation. The main means of irrigation in the country are canals, tanks and wells, including tube-wells. Of all these sources, ground water constitutes the largest share. Wells, including dug wells, shallow tube-wells and deep tube wells provide about 61.6% of water for irrigation, followed by canals with 24.5%.Over the years, there has been a decrease in surface water use and a continuous increase in ground water utilisation for irrigation. illustrates the pattern of use of the main sources of irrigation. As can be seen, the share of tube well has increased exponentially, indicating the increased usage of ground water for irrigation by farmers. The dependence of irrigation on ground water increased with the onset of the Green Revolution, which depended on intensive use of inputs such as water and fertilizers to boost farm production. Incentives such as credit for irrigation equipment and subsidies for electricity supply have further worsened the situation. Low power tariffs has led to excessive water usage, leading to a sharp fall in water tables.

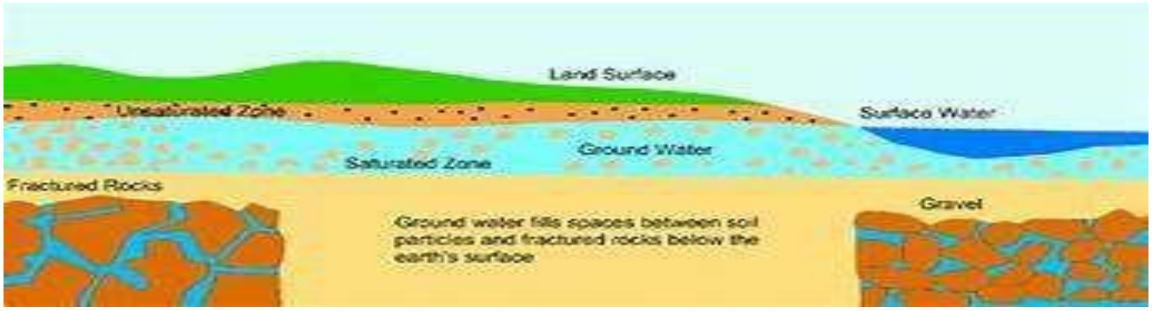
Ground water extraction and use

Experts believe that India is fast moving towards a crisis of ground water overuse and contamination. Ground water overuse or overexploitation is defined as a situation in which, over a period of time, average extraction rate from aquifers is greater than the average recharge rate. In India, the availability of surface water is greater than ground water. However, owing to the decentralised availability of groundwater, it is easily accessible and forms the largest share of India's agriculture and drinking water supply. 89% of ground water extracted is used in the irrigation sector, making it the highest category user in the country.6 This is followed by ground water for domestic use which is 9% of the extracted groundwater. Industrial use of ground water is 2%. 50% of urban water requirements and 85% of rural domestic water requirements are also fulfilled by ground water.

Ground water availability

As of April 2015, the water resource potential or annual water availability of the country in terms of natural runoff (flow) in rivers is about 1,869 Billion Cubic Meter (BCM)/year.2 However the usable water resources of the country have been estimated as 1,123

BCM/year. This is due to constraints of topography and uneven distribution of the resource in various river basins, which makes it difficult to extract



the entire available 1,869 BCM/year.Out of the 1,123 BCM/year, the share of surface water and ground water is 690 BCM/year and 433 BCM/year respectively. Setting aside 35 BCM for natural discharge, the net annual ground water availability for the entire country is 398 BCM.The overall contribution of rainfall to the country's annual ground water resource is 68% and the share of other resources, such as canal seepage, return flow from irrigation, recharge from tanks,ponds and water conservation structures taken together is 32%.4 Due to the increasing population in the country, the national per capita annual availability of water has reduced from 1,816 cubic metre in 2001 to 1,544 cubic metre in 2011.2 This is a reduction of 15%.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is a phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district.

The main water source of surface water used in Guntur District Municipalities is from the River Krishna water through Right canal of Nagarjuna sager dam and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Sekuru (Ramalayam Bazar). The collected water samples are generally used for agriculture and house hold purpose. Due to recent developments in our village and changes in climatic conditions This ground water was highly effected. Therefore, as part of my engineering chemistry field project, I have chosen ground water sample and I would like to analyze and submit the report on Guntur ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	500
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	300
Ph	pH metric method	pH	pH metric method	6.5 to 8.5

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + EBT \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{[M\text{-}EBT]\ complex}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[M\text{-}EBT]\ complex} + EDTA \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{[M\text{-}EDTA]\ complex} + \underset{\text{(Blue)}}{EBT\ indicator}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	0.0 ml	13.0 ml	13.0 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2=

Molarity of hardwater sample = ?

V_2 =volume of hard water sample =20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 13.0}{20} = \mathbf{0.0065M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100.09 x 1000 mg/L

= 0.0065 X 100.09 x 1000 = 650.585 mg/l or 651 ppm

Result: Total Hardness of given water sample before boiling process is 651 ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange end point. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	2.1 ml	2.1 ml
2	20 ml	0.0 ml	2.1 ml	2.1 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 2.1 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2 =volume of hard water sample =20 ml

Normality $\boldsymbol{of Hardwater}$ = $N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \, 2.1}{20}$ = 0.0105 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

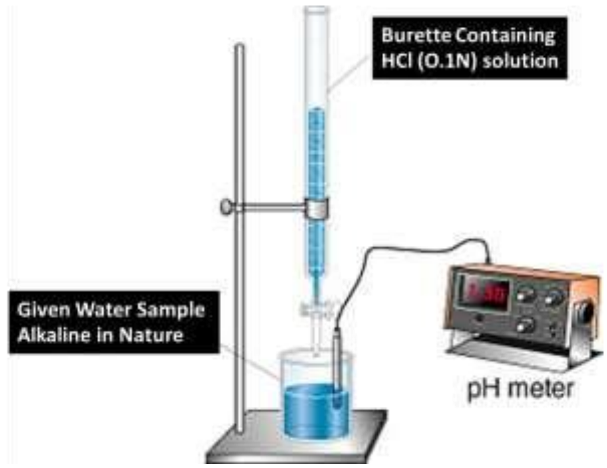
= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 500 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: the pH value of the water before boiling____8.0________

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	9.1 ml	9.1 ml
2	20 ml	0.0 ml	9.1 ml	9.1 ml

$$\boldsymbol{M_1 X V_1 = M_2 X V_2}$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 9.1 ml M_2=

Molarity of hardwater sample = ?

V_2 =volume of hard water sample =20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.010 \; X \;\; 9.1}{20} = \mathbf{0.0045}\boldsymbol{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0045 X 100.09 x 1000 = 455.409 mg/l or 455 ppm

Result: Total Hardness of given water sample before boiling process is 455 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenol phthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange end point. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	1.6 ml	1.6 ml
2	20 ml	0.0 ml	1.6 ml	1.6 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 1.6 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2 =volume of hard water sample =20 ml

Normality $\boldsymbol{of Hardwater} = N_2 = \frac{N_1 X V_1}{V_2} = \frac{0.1 X 1.6}{20} = 0.008$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.008 X 50 x 1000 = 400 mg/l or 400 ppm

Result: Total Alkalinity of given water sample before boiling process is 400 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

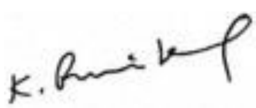
Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.

Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (–log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Result: the pH value of the water after boiling___7.0_________

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness (651)	EDTA Method	Hardness (455)	EDTA Method	500
Alkalinity (500)	Acid – Base Titration	Alkalinity (400)	Acid – Base Titration	300
pH (8.0)	pH metric method	pH (8.0)	pH metric method	6.5 to 8.5



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sangam Jagarlamudi Water Analysis

SUBMITTED BY

JASTI SIVA GANESH (221FA14034)
GRANDHI MINUSHA KOWSALYA (221FA14035)
DODDA SWARNA CHARITHA (221FA14036)
VEMULAPALLI SRI VARSHA (221FA14037)
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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

Department of Chemistry

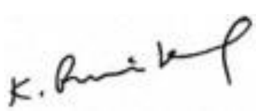
School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sangam Jagarlamudi Water Analysis**" is submitted by **JASTI SIVA GANESH (221FA14034),GRANDHI MINUSHA KOWSALYA (221FA14035) DODDA SWARNA CHARITHA (221FA14036),VEMULAPALLI SRI VARSHA (221FA14037),CHALLA GAYATRI (221FA14038),ITAM RAKESH**

(221FA14039),KARANAM NANDA KOUSHIKANJUM (221FA14040) in partial fulfilment forthe 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Sangam Jagarlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to provide the necessary permission to the students to collect water samples from various places of **Sangam Jagarlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Permitted to collect water samples in Sangam Jagarlamudi GP
K. Sreedevi
Panchayat Secretary
Gram Panchayat, Sangamjagarlamudi
Tenali Md'., Guntur (Dt.) A.P

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

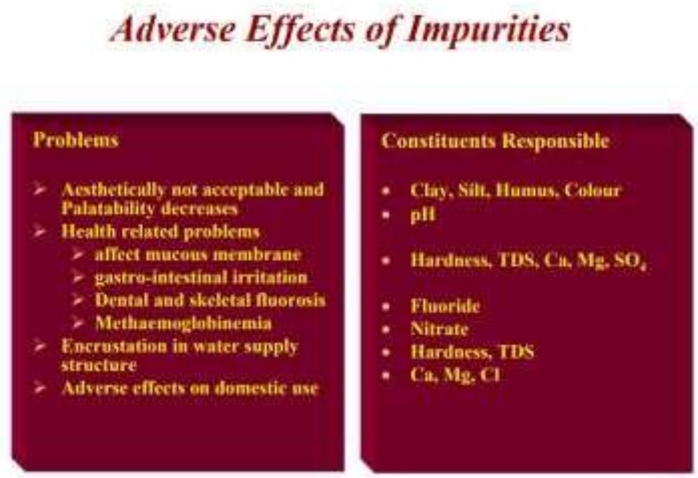
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

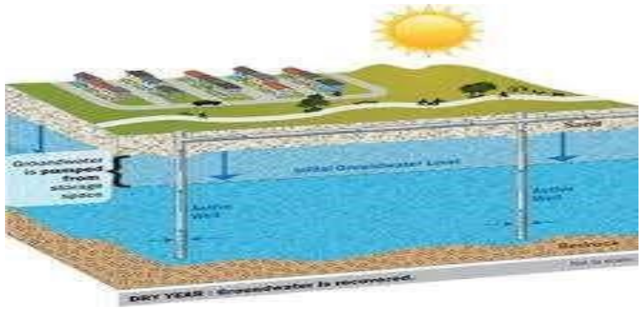
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$M_1 \, X \, V_1 = M_2 \, X \, V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \text{ X } 12.0}{20} = 0.006M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \boldsymbol{X} \boldsymbol{V_1} = N_2 \boldsymbol{X} \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ $= N_2 = \frac{N_1 X V_1}{V_2} = \frac{0.1 X \ 7.5}{20} = 0.0375$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

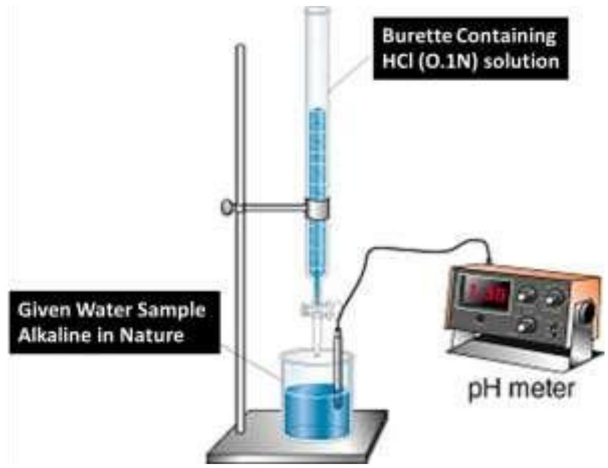
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	**Volume of Water sample taken (V_2 = 10 mL)**	**Volume of HCL added (V_1 = 1mL)**	**pH values**
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

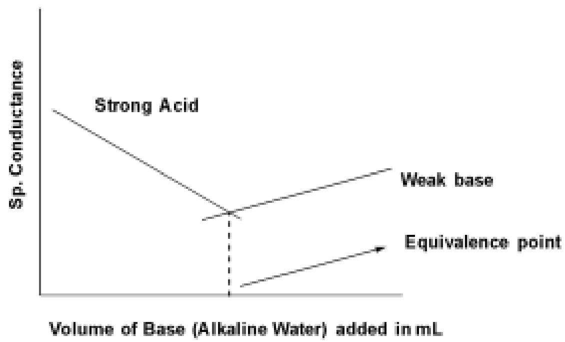
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

Beer Lambert's law :

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution (path length) is proportional to the intensity of incident radiation as well as the concentration of the solution.

$$A = \log (I_O/I) = \epsilon.c.l$$

Absorption α Concentration

- A = Absorbance (optical density)
- I_O = Intensity of light before entering the sample cell
- I = Intensity of light after passing the sample cell
- c = molar concentration of solute
- l = length of sample cell (cm)
- ϵ = molar absorptivity (molar extinction coefficient)

Permanganate is pink colored and the colour produced is proportional to the Mn^{7+} present.

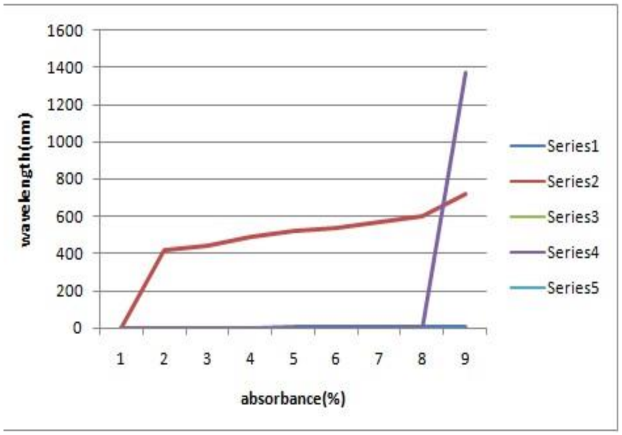
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of EDTA consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\textbf{Molarity of Hardwater} = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality ***of Hard water*** = $N_2 = \frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

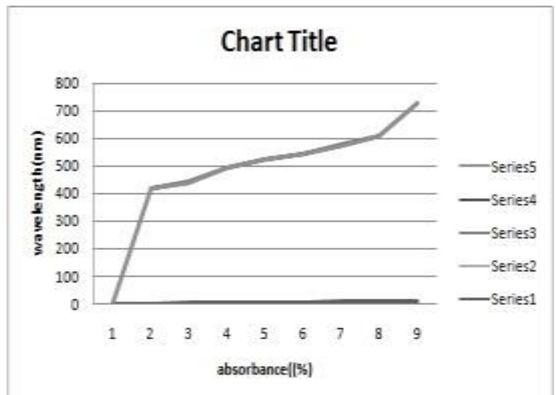
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**. Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



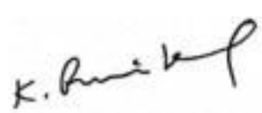
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 600ppm	Hardness	EDTA Method-260ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sangam Jagarlamudi Water Analysis

SUBMITTED BY

BODDU SOWMYA SREE (221FA14077)
JAJULA PRANATHI MALYA (221FA14078)
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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Sangam Jagarlamudi Water Analysis**" is submitted **by BODDU SOWMYA SREE (221FA14077),JAJULA PRANATHI MALYA (221FA14078) T PUJITHA (221FA14079),MODEPALLI SESIREK (221FA14080),GUDAVALLI BHAVYASRI (221FA14081),POTTURI DURGA SARIKA (221FA14082),YARLAGADDA LAKSHMI SLOHITHA (221FA14083)** in partial fulfilment for the 1st B.Tech to the Vignan'sFoundation for Science, Technology and Research, Deemed to be University.

K. Ramakrishna — K. P. Rao

Coordinator — **Head of the Department**

Dept. of Chemistry

Date: 02-02-2023

To
The Panchayat Secretary,
Gram Panchayat Office,
Sangam Jagarlamudi,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to provide the necessary permission to the students to collect water samples from various places of **Sangam Jagarlamudi Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

permitted to collect water samples in Sangam Jagarlamudi GP
K. Sreedevi
Panchayat Secretary
Gram Panchayat, Sangamjagarlamudi
Tenali Md., Guntur (Dt.) A.P

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

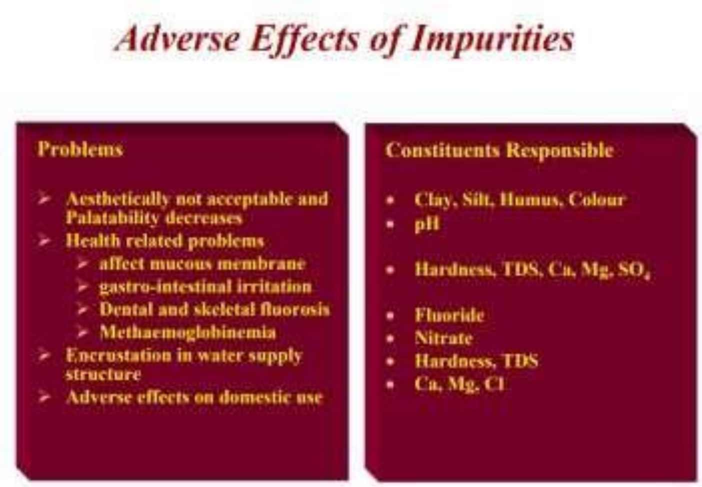
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

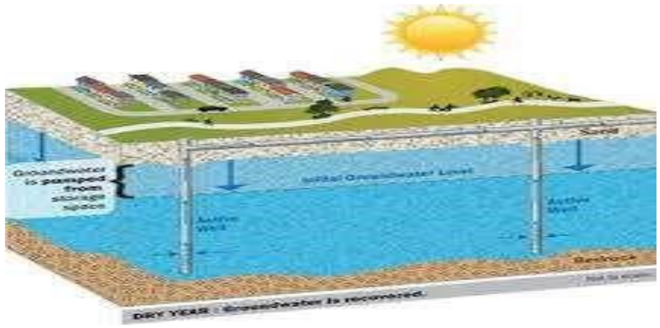
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution ($NH_4Cl + NH_4OH$), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$\underset{}{M^{2+}} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$\boldsymbol{M_1 \, X \, V_1 = M_2 \, X \, V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \, X \; 12.0}{20} = 0.006M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ $= N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \; 7.5}{20} = 0.0375$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

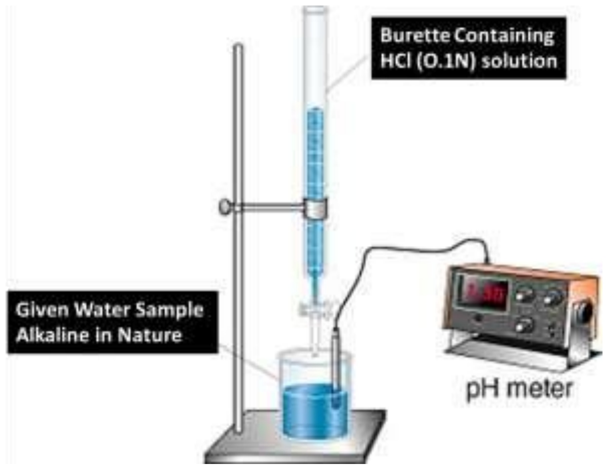
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the

electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) **pH-metric Titration:** Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

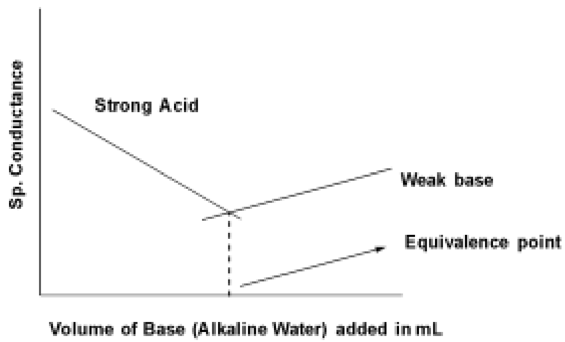
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of OH^-/HCO_3^-/CO_3^{2-} ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

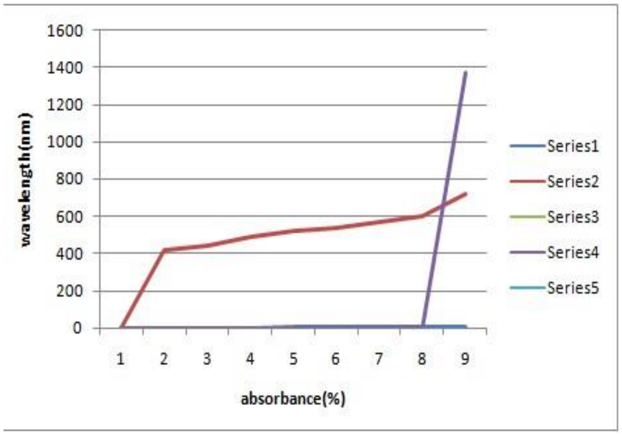
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality ***of Hard water*** = N_2 = $\frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

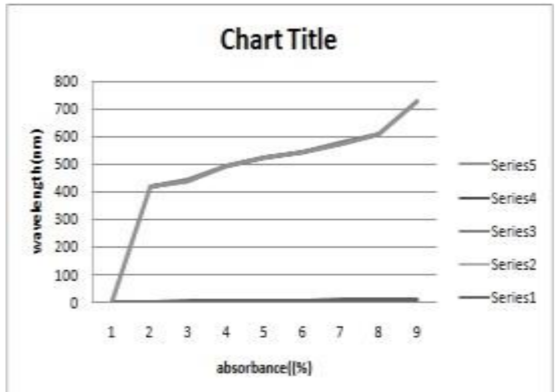
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430

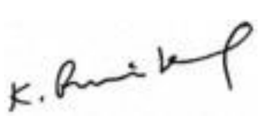


Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 600ppm	Hardness	EDTA Method-260ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity. This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Sekuru Water Analysis

SUBMITTED BY

JASTI SIVA GANESH (221FA14042)
GRANDHI MINUSHA KOWSALYA (221FA14043)
DODDA SWARNA CHARITHA (221FA14044)
VEMULAPALLI SRI VARSHA (221FA14045)
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Department of Chemistry

School of Applied Sciences and Humanities

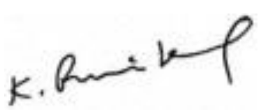
VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

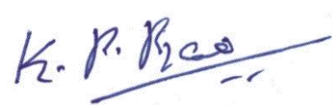
CERTIFICATE

This is to certify that the field project entitled "**Sekuru Water Analysis**" is submitted by **JASTI SIVA GANESH (221FA14042), GRANDHI MINUSHA KOWSALYA (221FA14043),DODDA SWARNA CHARITHA (221FA14044), VEMULAPALLI SRI VARSHA (221FA14045), CHALLA GAYATRI (221FA14046), ITAM RAKESH**

(221FA14047), KARANAM NANDA KOUSHIKANJUM (221FA14048) in partial fulfilment forthe 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator



Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Sekuru,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Sekuru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Permission granted
by Y. Omkaramma
JA Sekuru.

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

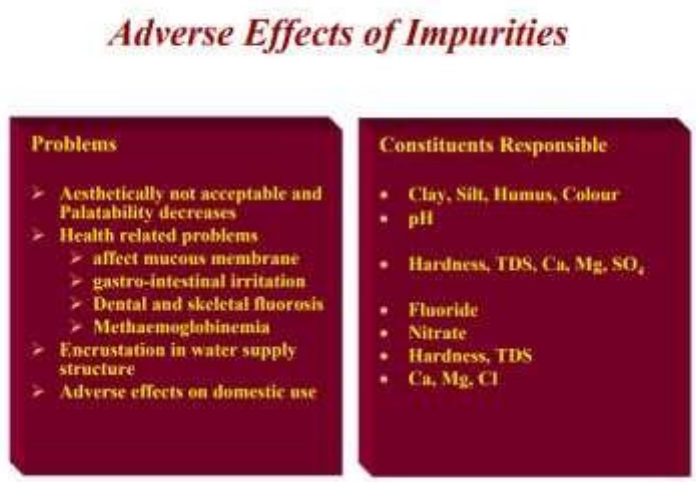
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

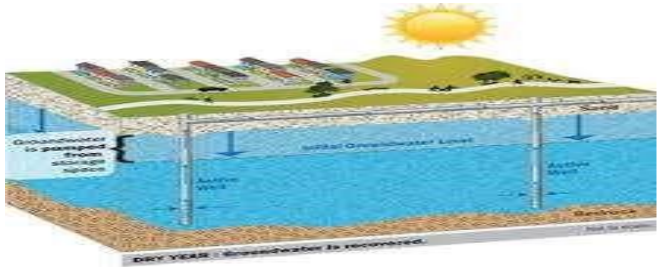
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{pH = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{pH = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \text{ X } 12.0}{20} = 0.006\text{M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \; X \; V_1 = N_2 \; X \; V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ $= N_2 = \dfrac{N_1 \, X \, V_1}{V_2} = \dfrac{0.1 \; X \; 7.5}{20} = 0.0375$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

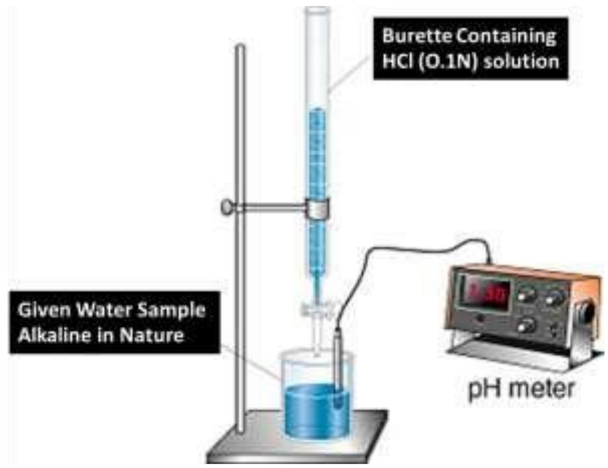
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	**Volume of Water sample taken (V_2 = 10 mL)**	**Volume of HCL added (V_1 = 1mL)**	**pH values**
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

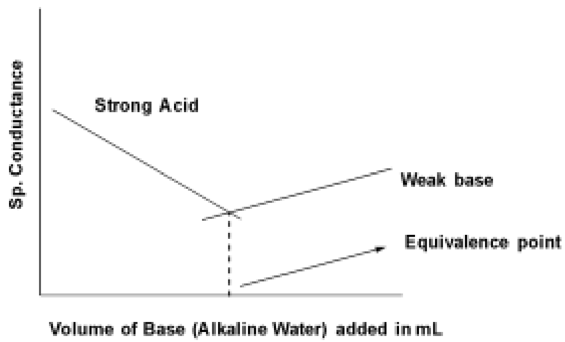
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

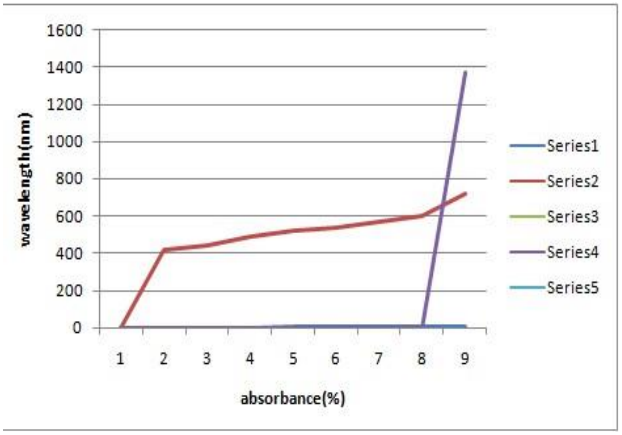
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026\ M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality ***of Hard water*** = N_2 = $\frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

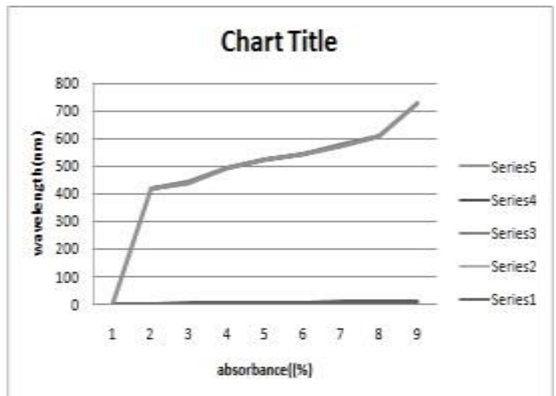
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.127**
2	**440**	**0.086**
3	**490**	**0.313**
4	**520**	**0.366**
5	**540**	**0.225**
6	**570**	**0.763**
7	**600**	**0.940**
8	**720**	**1.430**



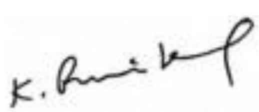
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 600ppm	Hardness	EDTA Method- 260ppm	300ppm
Alkalinity	Acid – Base Titration- 1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method- 8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method- 3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Narakoduru Water Analysis

SUBMITTED BY

SHAIK NADEEM (221FA14069)
GARIKAPATI RISHITHAMALYA (221FA14071)
KARUMURI AKHILA (221FA14072)
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VIGNAN'S Foundation for Science, Technology & Research (Deemed to be University) -Estd. u/s 3 of UGC Act 1956

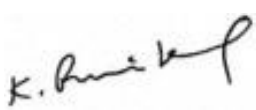
Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213
February 2023

CERTIFICATE

This is to certify that the field project entitled "**Narakoduru Water Analysis**" is submitted by **SHAIK NADEEM (221FA14069), GARIKAPATI RISHITHAMALYA (221FA14071), KARUMURI AKHILA (221FA14072), AVULA VENKATA MEGHANA (221FA14073), MEKALA AMULYA (221FA14074),SHAIK FUZEL AKTHER (221FA14075), SHAIK TASNEEM ANJUM (221FA14076)** in partial fulfilment for the 1^{st} B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.



Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC A Accredited

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Narakoduru,
Andhra Pradesh-522212

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of**Narakoduru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

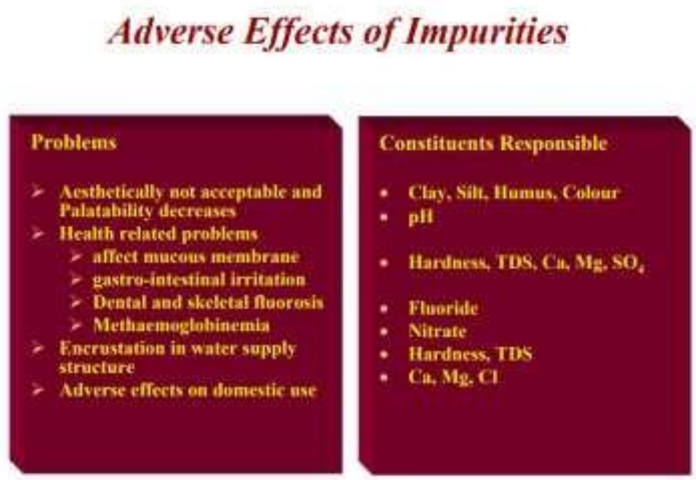
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

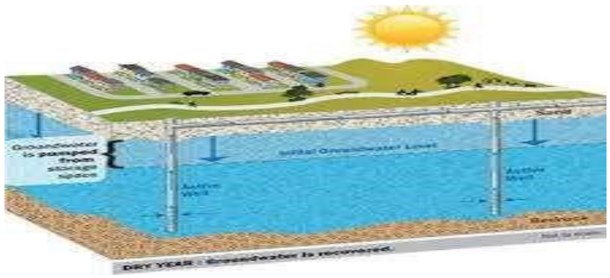
The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly



resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from Suddapalli village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen Suddapalli village ground water and I would like to analyze and submit the report on Suddapalli village ground water. The analysis of various PhysicalChemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

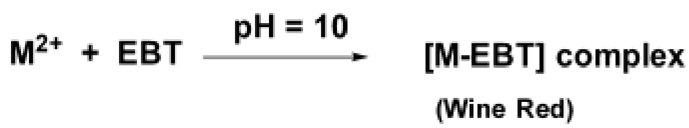
WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

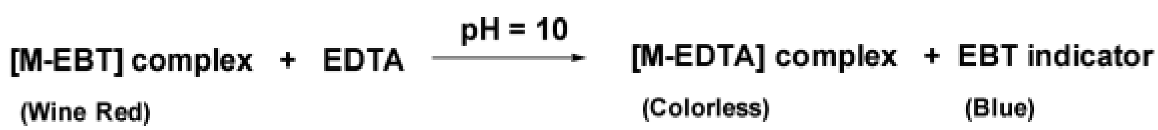
Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.



During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.



Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	12.0ml	12.0 ml
2	20 ml	13.6 ml	12.0ml	12.0 ml

$$M_1 \, X \, V_1 = M_2 \, X \, V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 12.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; V_1}{V_2} = \frac{0.01 \text{ X } 12.0}{20} = 0.006M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.006 X 100 x 1000 = 600mg/l or 600 ppm

Result: Total Hardness of given water sample before boiling process is 600ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$\text{Normality of Hard water} = N_2 = \frac{N_1 \times V_1}{V_2} = \frac{0.1 \times 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

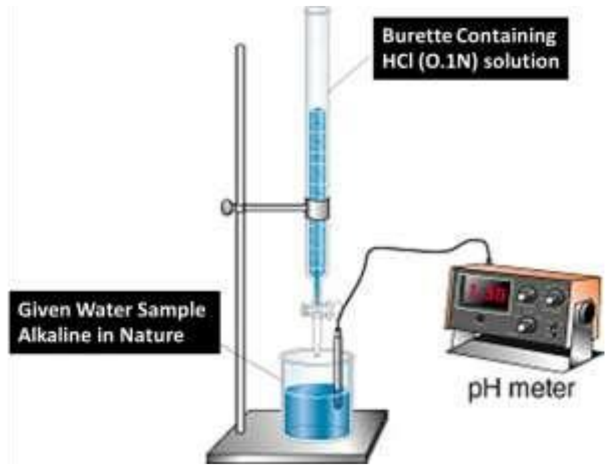
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) **pH-metric Titration:** Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

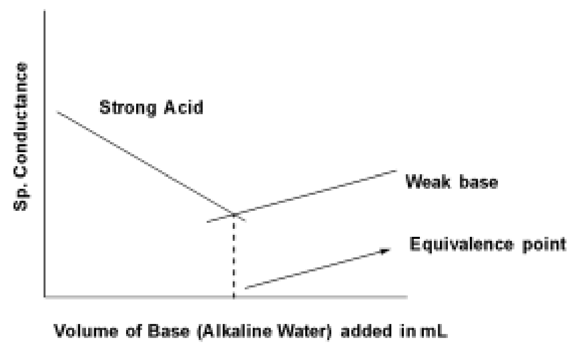
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.

2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.

4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.

5. Connect the conductivity cell to the conductometer.

6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.

7. Put the function switch to cell constant and set the value of cell constant.

8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

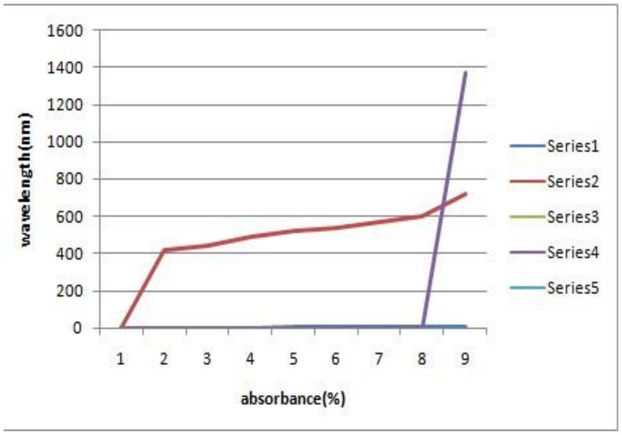
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.2 ml	5.2 ml
2	20 ml	5.2 ml	10.0 ml	4.8 ml

$$M_1 \times V_1 = M_2 \times V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.2 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\textit{Molarity of Hardwater} = M_2 = \frac{M_1 V_1}{V_2} = \frac{0.01 \times 5.2}{20} = 0.0026\ M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0026 X 100 x 1000 = 260 mg/l or 260 ppm

Result: Total Hardness of given water sample before boiling process is 260 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	1.9ml	1.9 ml
2	20 ml	1.9 ml	3.3ml	1.4 ml

$$N_1 \times V_1 = N_2 \times V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water}$ = N_2 = $\frac{N_1 V_1}{V_2} = \frac{0.1 \times 1.9}{20}$ = 0.0095 N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0095 X 50 x 1000 = 475 mg/l or 475 ppm

Result: Total Alkalinity of given water sample before boiling process is 475 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

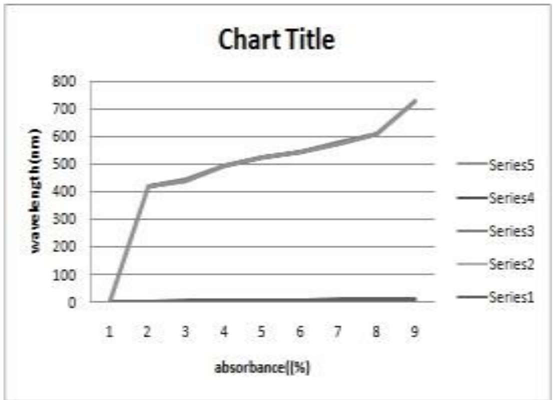
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.127**
2	**440**	**0.086**
3	**490**	**0.313**
4	**520**	**0.366**
5	**540**	**0.225**
6	**570**	**0.763**
7	**600**	**0.940**
8	**720**	**1.430**



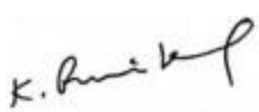
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 600ppm	Hardness	EDTA Method-260ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 475ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Narakoduru Water Analysis

SUBMITTED BY

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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Narakoduru Water Analysis**" is submitted by **JAINI VASAVI GAYATHRI (221FA14042), DUDEKULA SAFIYA (221FA14043), THUMMA SRI LAKSHMI SANJANA (221FA14044),AGRAJA AKSHITHA (221FA14045) , NAMEPALLI LALASA (221FA14046) SUNKARA GEETHIKA CHOWDARY (221FA14047), MANDALAPU YOGYA SRI (221FA14048) RAVURI YASASWI (221FA14049) in partial fulfilment for the 1st B.Tech to the Vignan's Foundationfor Science, Technology and Research, Deemed to be University.**

Coordinator

Head of the Department

Dept. of Chemistry

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Narakoduru,
Andhra Pradesh-522212

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of **Narakoduru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

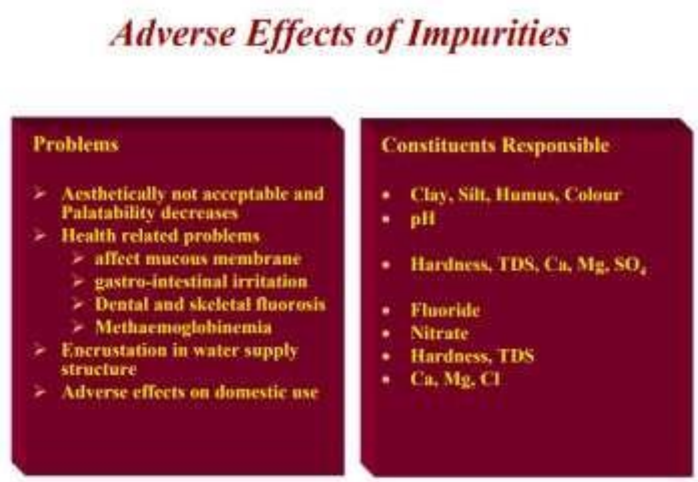
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health .   The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years.   . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{[\text{M-EBT}]\ \text{complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{[\text{M-EDTA}]\ \text{complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 13.0}{20} = 0.0065 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.		**Burette reading**	

	Volume of given sample water (in ml) (V_2)	Initial	Final	Volume of HCl consumed (in ml) (V_1)
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \ X \ V_1 = N_2 \ X \ V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

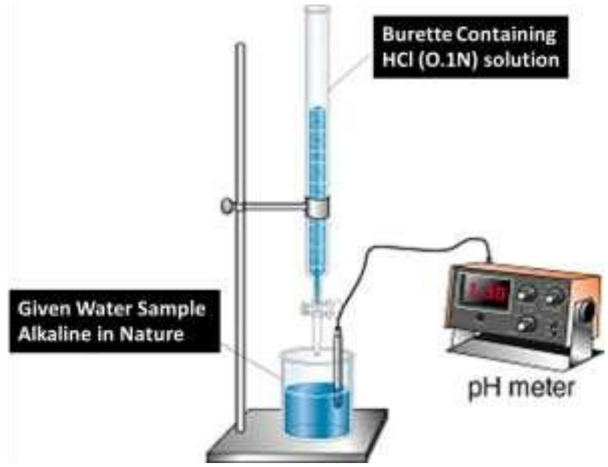
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) Calibration: Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	**Volume of Water sample taken (V_2 = 10 mL)**	**Volume of HCL added (V_1 = 1mL)**	**pH values**
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

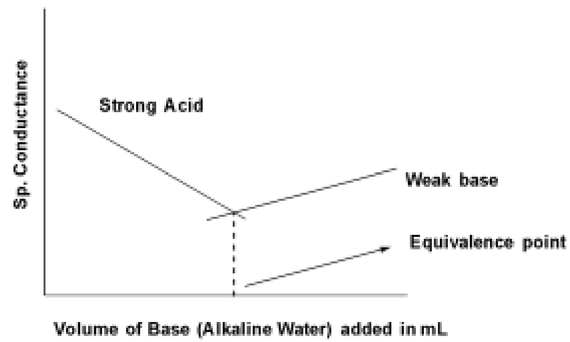
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	**Volume of HCl taken (V_2 = 10 mL)**	**Volume of Base (Alkaline Water) added (V_1 = 1mL)**	**Sp. Conductance**
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

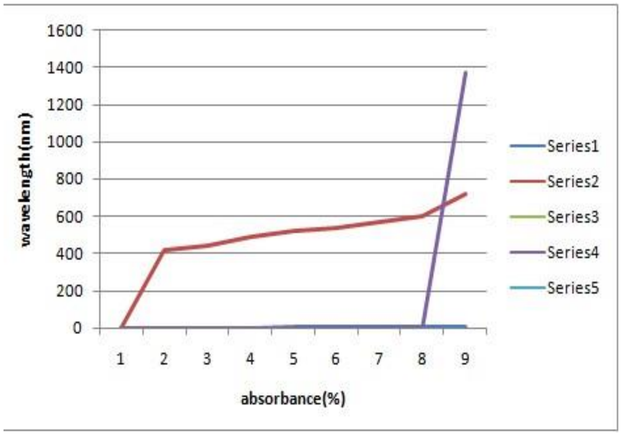
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \, X \; 5.0}{20} = 0.0025 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \, X \, V_1 = N_2 \, X \, V_2$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality *of Hard water* $= N_2 = \frac{N_1 \, X \, V_1}{V_2} = \frac{0.1 \, X \, 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

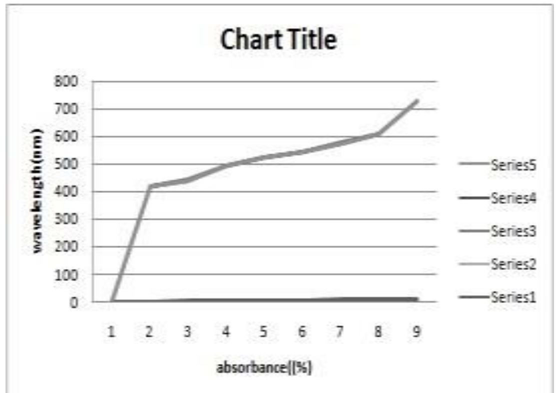
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**. Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	**420**	**0.127**
2	**440**	**0.086**
3	**490**	**0.313**
4	**520**	**0.366**
5	**540**	**0.225**
6	**570**	**0.763**
7	**600**	**0.940**
8	**720**	**1.430**



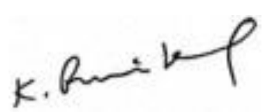
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

Water Analysis Report

Narakoduru Water Analysis

SUBMITTED BY

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VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**Narakoduru Water Analysis**" is submitted by **NIMMALA MADHAVI (221FA14052), KUMBHA SHOBHARANI (221FA14054), VELAMPALLI JAYA VYSHNAVI (221FA14055), KALLAM SATHWIKA (221FA14056) , MANNEM JAGADEESH (221FA14057), KARUTURI SAI SATYA KRISHNA (221FA14058), TALATAM HEMANTH NAGA SANJEEV (221FA14059),MELLACHERUVU RAMANA MAHARSHI (221FA14060)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Narakoduru,
Andhra Pradesh-522212

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to prov ide the necessary permission to the students to collect water samples from various places of**Narakoduru Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report. Please let us know if you need any further information to approve the above _ mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Objective:

The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

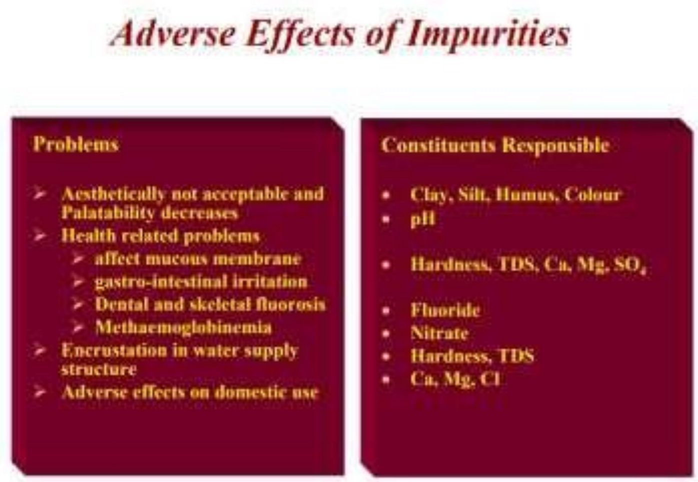
After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

Importance of water

The importance of water .The water in our bodies is essential for life .without water ,we cant survive...water is involved in every bodily function from digestion and circulation through to the control of body temperature and the excretion of waste product without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Water is used for the domestic purposes , cooking ,drinking,washing agriculture purpose ,hydro power generation high-nutrient loads . Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer residence times and their role as an integrating sink for pollutants from their drainage basins. Poor water quality has a direct impact on water quantity in several ways. Polluted water that cannot be used for drinking, bathing, industry or agriculture effectively reduces the amount of useable water within a given area.



WHAT IS WATER TECHNOLOGY?

Water treatment is any process that improves the quality of water to make it more acceptable for a specific end use . the end use may be drinking ,industrial water supply ,irrigation , river flow maintenance , water recreation or many other uses , including being safely returned to the environment of . Water puriffing systems can reduce the risk of medical conditions such as bledder cancer by removing chlorine and nasty bacteria in drinking water . drinking pure water generally protects the body from disease that may damage health . The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. . In India only 12% of people get good water for drinking. Inadequate management of water resources as directly or indirectly

resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Municipalities of Guntur district. The main water source of surface water used in Guntur District Municipalities. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Guntur District.

Water samples are collected from V.N.Palem (Ramalayam Bazar) village. The collected water samples are generally used for agriculture and house hold purpose. as part of my engineering chemistry field project, I have chosen V.N.Palem (Ramalayam Bazar) village ground water and I would like to analyze and submit the report on V.N.Palem (Ramalayam Bazar) village ground water. The analysis of various Physical-Chemical parameters includes Hardness (Temporary, Permanent and Total hardness), Total Alkalinity, pH, Electrical Conductivity and Colorimetric analysis of collected water samples.

Physic-Chemical Parameter – Method

Water Sample before Boiling Process		**Water Sample after Boiling Process**		**WHO/BIS Standards**
Hardness	EDTA Method	Hardness	EDTA Method	300ppm
Alkalinity	Acid – Base Titration	Alkalinity	Acid – Base Titration	200ppm
pH	pH metric method	pH	pH metric method	6.5 to 8.5
Electrical Conductivity	Conductometric method	Electrical Conductivity	Conductometric method	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl + NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal - indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH} = 10} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH} = 10} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue.

Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	13.0 ml	13.0 ml
2	20 ml	13.0 ml	26.0 ml	13.0 ml

$$\boldsymbol{M_1 \; X \; V_1 = M_2 \; X \; V_2}$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 13.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$\boldsymbol{Molarity of Hardwater} = \boldsymbol{M_2} = \frac{M_1 \, X \, V_1}{V_2} = \frac{0.01 \; X \; 13.0}{20} = 0.0065 \text{ M}$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0065 X 100 x 1000 = 650mg/l or 650 ppm

Result: Total Hardness of given water sample before boiling process is 650ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1 N HCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	7.5 ml	7.5 ml
2	20 ml	7.5 ml	15.0 ml	7.5 ml

$$N_1 \boldsymbol{X} \boldsymbol{V_1} = N_2 \boldsymbol{X} \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 7.5 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

$$Normality = N_2 = \frac{N_1 \ X \ V_1}{V_2} = \frac{0.1 \ X \ 7.5}{20} = 0.0375 \text{ N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

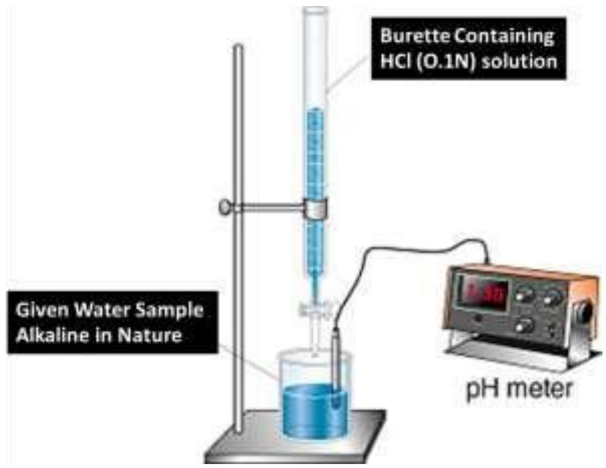
= 0.0375 X 50 x 1000 = 1875 mg/l or 1875 ppm

Result: Total Alkalinity of given water sample before boiling process is 1875 ppm.

3. Determination of pH of Water – pH metric method:

Apparatus required: pH meter, Glass electrode, Burette, Pipette and Beaker

Chemicals required: 0.1 N HCl solution, Distilled water and Alkaline water sample.



Principle: Most of the chemical and biochemical processes are profoundly affected by the acidity or alkalinity of the medium in which the reaction takes place. All acid dissociates in aqueous solution to yield H^+ ions. Some acids like HCl, H_2SO_4, HNO_3 etc. are completely ionized in aqueous medium where as CH_3COOH, HCOOH etc. ionize to a small extent only. The former is known as strong and the later as weak acid. pH of any solution is defined as (– log H^+) and has values between 0–14. pH < 7 indicate acidic solution, pH > 7 indicate basic solution and pH = 7 means neutral solution. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. The pH values of the solution at different stage of acid–base neutralization is determined and plotted against the volume of alkali added on adding a base to an acid, the pH rises slowly in the initial stages as the concentration of H+ ion decreases gradually. But, at the equivalence point, it increases rapidly as at the equivalent point H+ ion concentration is very small. Then it flattens out after the endpoint. The endpoint of the titration can be detected where the pH value changes most rapidly. However, the shape of the curve depends upon the Ionizability of the acid and the base used and on the acidity of base and basicity of the acid.

Procedure:

i) **Calibration:** Switch on the instrument and wait for 10–15 minutes so that machine gets warmed up. Prepare the buffer solution by adding buffer tablets of pH = 4 and pH = 9.2 in 100 mL of water separately. Wash the electrode with distilled water. Then, dip the electrode in the buffer solution (pH = 4) taken in a beaker, so that the electrode immersed

to the solution properly. Measure the temperature of the solution and set the temperature compensate control accordingly. Set the pointer to pH = 7 exactly means of set = 0 control. Put the selector switch to proper pH range 0–7 (as the buffer pH = 4). So, the pointers to the known pH value of the buffer by burning the set buffer control. Put back the selector at zero position. Wash the electrode with distilled water and standardize the pH meter using basic buffer solution pH = 9.2. Same procedure to be followed except the selector switch is put to range of 7–14.

ii) pH-metric Titration: Clean the electrode with distilled water and wipe them with tissue paper or filter paper. Take 20 mL of water sample in a 100 mL beaker or conical and immerse the electrode in it. Set the burette with HCl (0.1 N) solution. The reading shown on the scale of pH meter is pH value of the water sample. Add HCl solution drop wise from the burette (maximum 0.5 mL at a time), shake the solution well and note the corresponding pH values. Near the endpoint, volume of HCl added should be as small as possible because the base is neutralized and there will a sharp decrease in pH values. Further addition of even 0.01 mL of HCl, decrease the pH value to about 2–1. Equivalence point was determined based on the Graph drawn between volume of acid on x-axis and pH values on y-axis.

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 = 1mL)	pH values
1.	10 ml	1 ml	6.99

RESULT : The electrical pH metri of water before boiling process is 6.99

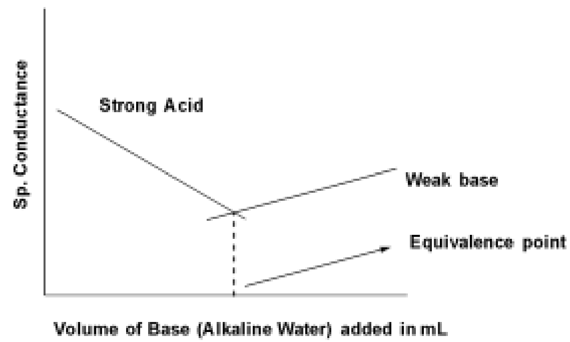
4 Determination of Electrical conductance of Water sample – Conductometric method:

Apparatus required: Conductivity meter, Conductivity Cell, Burette, Pipette, Beaker and Glass rod.

Chemicals required: 0.01 N HCl solution, 0.1 N KCl solution, Alkaline water sample, Distilled water.

Principle: Weak base (Alkaline water) Vs Strong acid

Before base (Alkaline water) is added, the conductance is high due to the presence of highly mobile hydrogen ions. When the base is added the conductance falls due to the replacement of H^+ by the added OH^- ions to form the undissociated water. Decrease in the conductance continues till the equivalence point. At the equivalence point, the solution contains only salt and undissociated water. After the equivalence point, the conductance increases due to the large conductivity of $OH^-/HCO_3^-/CO_3^{2-}$ ions in the solution.



Procedure:

1. Calibrate the conductivity cell.
2. Rinse the conductivity cell with the solution whose conductivity is to be measured. 3. Take 10 mL of the given HCl (N_2 = 0.01 N) solution in a 100 mL beaker. Add 30 ml of distilled water.
4. Wash the conductivity cell with distilled water and then rinse it with the given HCl solution. Dip the cell in the solution taken in the beaker.
5. Connect the conductivity cell to the conductometer.
6. Set the function switch to check position. Display must read 1.000. If it does not, set it with CAL control at the back panel.
7. Put the function switch to cell constant and set the value of cell constant.
8. Set the temperature control to the actual temperature of the solution under test.

9. Set the function switch to conductivity and read the display. This will be the exact conductivity. Note it down.

10. Take base (Alkaline water) in the burette and add 0.5 mL of it into the beaker containing HCl. Stir and determine the conductivity.

11. Repeat the procedure of addition of 0.5 mL of base and note down the conductivity in the observation table. Take 12-15 readings in this way. After each addition, stir the solution gently.

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Volume of Base (Alkaline Water) added (V_1 = 1mL)	Sp. Conductance
1.	10ml	1 ml	3.33

Result: the electrical conductance of water sample before boiling process is 3.33

4. Light Absorption studies of Water sample – Colorimetric method:

Apparatus required: Colorimeter, Sample cuvette, and Beaker.

Chemicals required: Hard water sample, Buffer solution (NH_4Cl + NH_4OH solution), EBT indicator and blank solution (distilled water).

Principle:

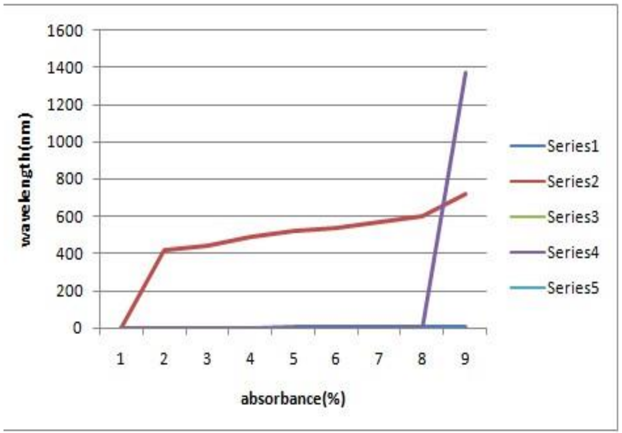
Determination λ_{max} for maximum Absorbance:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.**

Determination λ_{max} for maximum absorbance: The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.068
2	440	0.022
3	490	0.238
4	520	0.275
5	540	0.134
6	570	0.676
7	600	0.886
8	720	1.366



Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.275) and another one at 720 nm (abs: 1.366).

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0.0 ml	5.0 ml	5.0 ml
2	20 ml	5.0 ml	10.0 ml	5.0 ml

$$M_1 \; X \; V_1 = M_2 \; X \; V_2$$

M_1 = Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 5.0 ml M_2

= Molarity of hardwater sample = ?

V_2 = volume of hard water sample = 20 ml

$$Molarity of Hardwater = M_2 = \frac{M_1 \; X \; V_1}{V_2} = \frac{0.01 \; X \; 5.0}{20} = 0.0025 \; M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.0025 X 100 x 1000 = 250 mg/l or 250 ppm

Result: Total Hardness of given water sample before boiling process is 250 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1 mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	**Volume of given sample water (in ml) (V_2)**	**Burette reading**		**Volume of HCl consumed (in ml) (V_1)**
		Initial	**Final**	
1	20 ml	0.0 ml	2.1ml	2.1 ml
2	20 ml	2.1 ml	4.2 ml	2.1 ml

$$N_1 \, \boldsymbol{X} \, \boldsymbol{V_1} = N_2 \, \boldsymbol{X} \, \boldsymbol{V_2}$$

N_1 = Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed = 1.9 ml

N_2 = Normality of hard water sample w.r.to Alkalinity = ?

V_2 = volume of hard water sample = 20 ml

Normality $\boldsymbol{of Hard\ water} = N_2 = \frac{N_1 \text{ X } V_1}{V_2} = \frac{0.1 \text{ X } 2.1}{20} = 0.0105$ N

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0105 X 50 x 1000 = 525 mg/l or 525 ppm

Result: Total Alkalinity of given water sample before boiling process is 525 ppm.

3. Determination of pH of Water – pH metric method:

Observations:

S.No.	Volume of Water sample taken (V_2 = 10 mL)	Volume of HCL added (V_1 =1 mL)	pH values
1.	10 ml	1 ml	8.51

Result: Total Alkalinity of given water sample before boiling process is 8.51ppm.

4. Determination of Electrical conductance of Water sample – Conductometric method:

Observations:

S.No.	Volume of HCl taken (V_2 = 10 mL)	Sp. Conductance
1.	10 ml	1.2

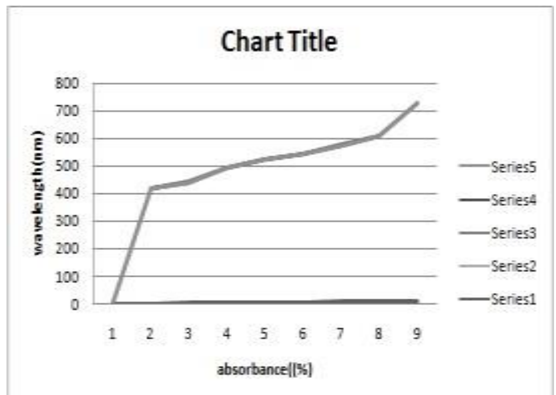
Result: Electrical conductance of given water sample after boiling process is 1.2ppm

4. Light Absorption studies of Water sample – Colorimetric method:

Preparation of Sample solution:

Pipette out 20 ml of hard water sample into a 100 ml beaker and add 2 ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 drops Eriochrome Black - T (EBT) indicator**.** The formed wine-red color solution was used for determination λ_{max} for maximum absorbance**.** **Determination λ_{max} for maximum absorbance:** The absorbance are noted at various wavelengths between 450–570nm and graph is drawn between wavelength and optical density. The graph shows maximum absorbance at (λmax) 720 nm.

S.No	Wavelength (nm)	Absorbance (%)
1	420	0.127
2	440	0.086
3	490	0.313
4	520	0.366
5	540	0.225
6	570	0.763
7	600	0.940
8	720	1.430



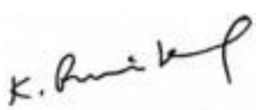
Result: The graph shows maximum absorbance at (λmax) 520 nm (abs: 0.366) and another one at 720 nm (abs: 1.430).

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process		Water Sample after Boiling Process		WHO/BIS Standards
Hardness	EDTA Method 650ppm	Hardness	EDTA Method-250ppm	300ppm
Alkalinity	Acid – Base Titration-1875ppm	Alkalinity	Acid – Base Titration 525ppm	200ppm
pH	pH metric method-6.99	pH	pH metric method-8.51ppm	6.5 to 8.5
Electrical Conductivity	Conductometric method-3.33ppm	Electrical Conductivity	Conductometric method-1.2ppm	……..
Light Absorption studies	Colorimetric method	Light Absorption studies	Colorimetric method	……..

By this analysis we should know that this sample has more hardness and more alkalinity.

This water should not be used for drinking cooking and washing clothes purposes.



Coordinator

ENGINEERING CHEMISTRY - FIELD PROJECT

WATER ANALYSIS REPORT

SELAPADU(SAIBABA TEMPLE ROAD) WATER ANALYSIS

SUBMITTED BY

VELAGAPUDI HEMA SAI (221FA14066)
A.JYOTHI SREE (221FA14067)
DEVIREDDY MALLA REDDY (221FA14068)

Department of Chemistry

School of Applied Sciences and Humanities

VFSTR (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh - 522213

February 2023

CERTIFICATE

This is to certify that the field project entitled "**SELAPADU(SAIBABA TEMPLE ROAD) WATER ANALYSIS**" is submitted by **VELAGAPUDI HEMA SAI (221FA14066), A.JYOTHI SREE (221FA14067), DEVIREDDY MALLA REDDY (221FA14068)** in partial fulfilment for the 1st B.Tech to the Vignan's Foundation for Science, Technology and Research, Deemed to be University.

Coordinator

Head of the Department

Dept. of Chemistry

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

NAAC Accredited A

Date: 02-02-2023

To

The Panchayat Secretary,
Gram Panchayat Office,
Selapadu,
Andhra Pradesh-522213

Respected sir,

Sub: Water Sample Collection-Reg.

As a part of **Field Project** for the Engineering Chemistry/Organic chemistry course,1st Year B.Tech. students of VFSTR (Deemed to be University), Vadlamudi are supposed to analyze water samples from villages / areas near VFSTR.

In this connection, we would like to request you to pro vide the necessary permission to the students to collect water samples from various places of **Selapadu Gram Panchayat**. Those water samples will be analyzed in our laboratory and the results will be submitted in the form of water analysis report.

Please let us know if you need any further information to approve the above – mentioned request.

Thanking you

Yours sincerely

K. P. Rao

Head, Department of Chemistry

Md. [signature]

SELAPADU GRAMA PANCHAYAT
Govt. of Andhra Pradesh
Chebrolu (Mdl.), Guntur (Dt.)

Vadlamudi, Guntur Dist. - 522213. Andhra Pradesh, India. | Phone : +91 863 2344 700 | e-mail : info@vignan.ac.in

Objective:

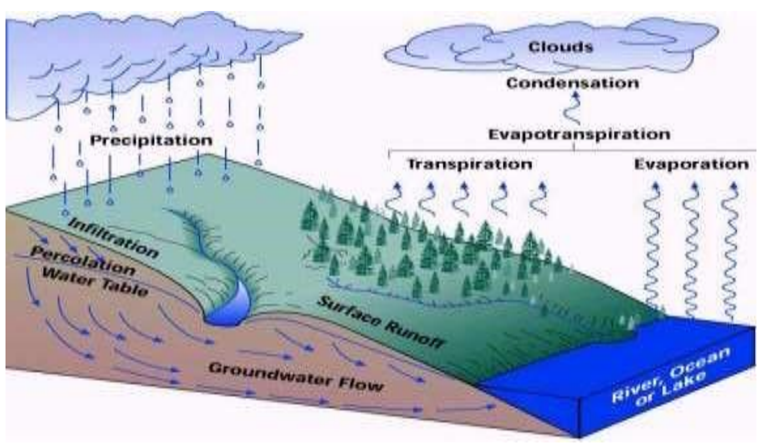
The main aim of the this filed project is to explore the practical knowledge on the water analysis by using various titration methods in order to identify the suitable water purification mechanism.

Outcome:

After completion of this filed project, students will be able to get hands on experience on various titrimetric analysis methods for analyzing water purity in terms of hardness and pH value. Also, students will be able to get through knowledge on theoretical aspects of EDTA titration method & total alkalinity of water sample.

Introduction

The quality of ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.



Water is a transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H2O at standard ambient temperature and pressure.

Water Sample - Collection

Water is essential for the survival of any form of life particularly the Human beings. The fresh water about 3% present in the globe is enough to meet the requirements of Human race for millions of years. Water pollution is phenomenon by which the quality of the water is deteriorated because of various activities. In India only 12% of people get good water for drinking. In adequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment. The surface water is the main resource of water used for drinking purposes in Selapadu(Saibaba temple road) pond water. The main water source of surface water used in Selapadu(Saibaba temple road) pond water and its branches. The present study is carried out to study the variations in the Physic-Chemical qualities of water sample in the region of Selapadu(Saibaba temple road) pond water.

Water samples are collected from Selapadu(Saibaba temple road) pond water. The collected water sample are generally used for household purpose. Due to recent development s in our village and changes in climatic conditions Selapadu(Saibaba temple road) pond water was highly effected. Therefore, as part of my engineering chemistry filed project, I have chosen vejendla pond water and I would like to analyze and submit the report on Selapadu(Saibaba temple road) pond water.

Characteristics of water

As per the suggestion given by World Health Organization (WHO) and by Indian Council of Medical Research (IMCR), the following are the important characteristics of the portable water.

- It should be clear, colourless and odourless.
- It should be cool and pleasant to taste.
- It should be free from harmful bacteria and suspended impurities.
- It should be free from dissolved gases like CO_2, H_2S, NH_3, *etc.*, and poisonous minerals like lead, arsenic, manganese etc., Hardness should be less than 500 ppm.
- Chloride ion content should be less than 250 ppm.
- Fluoride ion content should be less than 1.5 ppm.
- Total Dissolved Solids (TDS) content should be less than 500 ppm.
- pH of the potable water should be 6.5-8.5.

Acidic	Neutral	Basic
pH=0-7	pH=7	pH=7-14

HARD WATER

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water. In other words, water that contains mineral salts (an calcium and magnesium ions) that limit the formation of lather with soap.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{++}$======>$(C_{17}H_{35}COO)_2Ca + 2Na^{+}$

SOFT WATER

Water, which produces lather, readily with soap solution is called soft water. This is due to the absence of Ca and Mg salts. Water that is not hard (i.e., does not contain mineral salts that interfere with the formation of lather with soap).

HARDNESS OF WATER

How to detect hardness?

Hardness of water can be detected in two ways.

- When the water is treated with soap solution, if it prevents lathering and forms white scum, the water contains hardness.

COMPARISION OF *WHO* AND *BIS* S TANDARDS:

S.no	**Compounds**	**WHO Standards**	**BIS Standards**
1	Colour	Colourless	Colourless
2	Taste	Tasteless	Tasteless
3	Odour	Odourless	Odourless
	Chemical Parameters		
1	pHvalue	7-8ppm	6.5-8ppm
2	DissolvedOxygen(D.O)	6-8ppm	6-8ppm
3	DissolvedSolids	500ppm	500-2000ppm
4	Calcium(Ca^{2+})	200ppm	75-200ppm
5	Magnesium(Mg^{2+})	100ppm	3-100ppm

WATER ANALYSIS BEFORE BOILING PROCESS

1. Determination of Total Hardness of Water – EDTA method:

Apparatus required: Burette, Pipette, Volumetric flask, Conical flask, Beaker, Funnel and Burette stand.

Chemicals required: 0.01 M disodium salt of EDTA, Buffer solution (NH_4Cl+NH_4OH), EBT indicator and Water sample for analysis.

Principle: The hardness of the water is generally due to the presence of calcium and magnesium ions. Ions like Ca^{2+} and Mg^{2+} tend to form complexes with EDTA. Certain dyestuffs like EBT which form weak colored complexes with cations can serve as indicator. For titrimetric determination of such metal ions, first the metal -indicator complex is formed which is wine red in color.

$$M^{2+} + \text{EBT} \xrightarrow{\text{pH = 10}} \underset{\text{(Wine Red)}}{\text{[M-EBT] complex}}$$

During titrations with EDTA, the metal ions are progressively complexed by EDTA. Once all the metal ions formed EDTA complex, finally the indicator is displaced from metalindicator (M-In) complex leaving free indicator. The color change accompanying this progress gives the endpoint.

$$\underset{\text{(Wine Red)}}{\text{[M-EBT] complex}} + \text{EDTA} \xrightarrow{\text{pH = 10}} \underset{\text{(Colorless)}}{\text{[M-EDTA] complex}} + \underset{\text{(Blue)}}{\text{EBT indicator}}$$

Procedure:

Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	8.4 ml	8.4 ml
2	20 ml	0 ml	8.4 ml	8.4 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 8.4 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$Molarity of Ha dwater = M_2 = \frac{M_1 \ X \ V_1}{V_2} = \frac{0.01 \ X \ 4.5}{20} = 0.00435 M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00435 X 100.09 x 1000 = 435.3915 mg/l or 435 ppm

Result: Total Hardness of given water sample before boiling process is 435ppm.

2. Determination of Total Alkalinity of Water – Acid-Base titration /Alkalimetry method:

Apparatus required: Burette, Pipette, Conical flask, Beaker, and Burette stand.

Chemicals required: 0.1NHCl solution, Methyl-Orange indicator, Phenolphthalein indicator and Water sample for analysis.

Principle: The knowledge of alkalinity of water is necessary for controlling the corrosion, in conditioning the boiler feed water (internally), for calculating the amounts of lime and soda needed for water softening and also in neutralizing the acidic solution produced by the hydrolysis of salts. In boilers for steam generation, high alkalinity of water may not only lead to caustic embrittlement but also to the precipitation of sludges and deposition of scales. The alkalinity of water is due to the presence of hydroxide ion (OH-), carbonate ion (CO3-2) and bicarbonate ion (HCO3-) present in the water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange as indicators. The chemical reaction involved can be shown by the equations given below:

$$OH^- + H^+ \longrightarrow H_2O$$

$$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$$

$$HCO_3^- + H^+ \longrightarrow H_2O + CO_2$$

Procedure:

Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	5.3ml	5.3 ml
2	20 ml	0 ml	5.3ml	5.3 ml

$$N_1 X V_1 = N_2 X V_2$$

N_1= Normality of StandardizedHCl solution = 0.1 N

V_1 = Volume of HCl consumed= 5.3ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 2.0}{20} = 0.0265N$$

Total Alkalinity of water sample in terms of $CaCO_3$equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

= 0.0265X 50 x 1000 = 1325mg/l or 1325 ppm

Result: Total Alkalinity of given water sample before boiling process is 1325 ppm.

WATER ANALYSIS AFTER BOILING PROCESS

1. Determination of Total hardness of Water:

Pipette out 20 ml of hard water sample into a 250 ml conical flask and add 2ml of NH_4OHNH_4Cl buffer solution of pH = 10 and 2 to 3 drops Eriochrome Black - T (EBT) indicator and titrate against with standard disodium salt of EDTA solution whose concentration (M_1) is 0.01 M till the wine-red color of the solution changes to clear blue. Know down the volume of EDTA consumed by sample hard water V_1 ml in the below table.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of EDTA consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$M_1 X V_1 = M_2 X V_2$$

M_1= Molarity of Standard EDTA solution = 0.01 M

V_1 = Volume of EDTA rundown = 4.5 ml M_2=

Molarity of hardwater sample = ?

V_2= volume of hard water sample = 20 ml

$$MolarityofHa\,dwater = M_2 = \frac{M_1\ X\ V_1}{V_2} = \frac{0.01\ X\ \ 2.6}{20} = 0.00225M$$

Total Hardness of water sample in terms of $CaCO_3$ equivalents

= Molarity of Hardwater sample X Molecular weight of $CaCO_3$ x 1000 mg/L

= M_2 X 100 x 1000 mg/L

= 0.00225 X 100 x 1000 = 225.2025 mg/l or 225 ppm

Result: Total Hardness of given water sample before boiling process is 225 ppm.

2. Determination of Total Alkalinity of Water:

Pipette out 20 mL of the water sample into a conical flask. Add 1-2 drops of phenolphthalein indicator and titrate this sample against acid until the pink color caused by phenolphthalein just disappears. Note down this reading as phenolphthalein endpoint. Now add 2 drops of methyl orange in the same solution. It will give light yellow color. Continue the titration against acid until the light-yellow color changes to red. Now note the total volume of acid as V_1mL. This is methyl orange endpoint. The same procedure is repeated till the concordant readings are obtained.

S. No.	Volume of given sample water (in ml) (V_2)	Burette reading		Volume of HCl consumed (in ml) (V_1)
		Initial	Final	
1	20 ml	0 ml	4.5 ml	4.5 ml
2	20 ml	0 ml	4.5 ml	4.5 ml

$$N_1 V_1 = N_2 X V_2$$

N_1= Normality of Standardized HCl solution = 0.1 N

V_1 = Volume of HCl consumed= 4.5 ml

N_2= Normality of hardwater sample w.r.to Alkalinity= ?

V_2= volume of hard water sample = 20 ml

$$\text{Normality } \boldsymbol{of Ha\ dwater} = N_2 = \frac{N_1\ X\ V_1}{V_2} = \frac{0.1\ X\ \ 1.0}{20} = 0.0225\text{N}$$

Total Alkalinity of water sample in terms of $CaCO_3$ equivalents

= Normality of Water sample X Equivalent weight of $CaCO_3$ x 1000 mg/L

= N_2 X 50 x 1000 mg/L

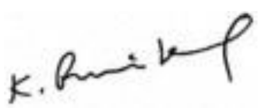
= 0.0225 X 50 x 1000 = 1125 mg/l or 1125 ppm

Result: Total Alkalinity of given water sample before boiling process is 1125 ppm.

Conclusions: Based on the analysis reports the results were tabulated here.

Water Sample before Boiling Process(8.4)		**Water Sample after Boiling Process(4.5)**		**WHO/BIS Standards**
Hardness	EDTA Method (435 ppm)	Hardness	EDTA Method (225 ppm)	500 ppm
Alkalinity	Acid – Base Titration (1325 ppm)	Alkalinity	Acid – Base Titration (1125 ppm)	300 ppm
pH	pH metric method(8.1)	pH	pH metric method(9.46)	6.5-8.5

Here by we conclude that based on the water analysis of tenali ground water,the hardness, alkalinity and pH values of experiments done according to the WHO/BIS standards, this water is experimented carefully and conclude this water can be used for drinking.



Coordinator

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(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

Department of Chemistry

List of students involved in Field Projects

SL	Regd.No	Name of the Student
1.	221FA01001	Saklen Raza
2.	221FA01003	Manmohan Prasad Sah
3.	221FA01004	Amresh Kumar
4.	221FA01005	Prince Kumar
5.	221FA01006	Bhukke Vidhya Varshini
6.	221FA01007	Sawan Kumar Das
7.	221FA01008	Rithika Surapaneni
8.	221FA01009	Cherukuri Charan Kumar
9.	221FA01010	Malladi Pravallika
10.	221FA01011	Kalluri Siva Reddy
11.	221FA01012	Yadala Akhila
12.	221FA01013	Maddina Rupa
13.	221FA01014	Tenali Vasundara
14.	221FA01015	Tiyyagura Tejaswini
15.	221FA01016	Mamillapalli Tejaswi
16.	221FA01017	Velaga Likhitha Gayathri
17.	221FA01018	Gandham Mayukha Sai
18.	221FA01019	Bathula Sharanya
19.	221FA01020	Sunny Kumar
20.	221FA01021	Janapaneni Gayatri Sowmya
21.	221FA01022	Muthyalampalli Praneetha
22.	221FA01023	Talla Swathi
23.	221FA01024	Koppireddy Naga Sairam
24.	221FA01025	Guntupalli Phaneendra
25.	221FA01026	Morla Sai Venkata Lakshmi Durga Meghana
26.	221FA01027	Nitish Kumar
27.	221FA01029	Aashritha Marouthu

28.	221FA01030	Mannava Sindu Priya
29.	221FA01031	Raveena Katuri
30.	221FA01032	Shamila Afreen
31.	221FA01033	Shaik Rizwan Ahmad
32.	221FA01034	Nambula Nishanth
33.	221FA01035	Pamulapati Harika
34.	221FA01036	Tadava Padma Sree
35.	221FA01037	Thumma Jaswanthi
36.	221FA01038	Tella Sahithi
37.	221FA01039	Shaik Sumayya Siddiqi
38.	221FA01040	Akula Bhavana
39.	221FA01041	Ganta Santhosh
40.	221FA01042	Veraparaju Venkata Sowmya Lakshmi
41.	221FA01043	Koduru Jahnavi Sai Durga
42.	221FA01044	Gogasani Sai Mounika
43.	221FA01045	Panem Poojitha
44.	221FA01046	Gorrepati Pravalli
45.	221FA01047	Bikki Naga Vyshnavi
46.	221FA01048	Kopparthi Tharunmai
47.	221FA01049	Safiya Shaik
48.	221FA01050	Samimoon Shaik
49.	221FA01051	Janapati Venkata Lakshmi Padmavathi
50.	221FA01052	Nandagari Meghana
51.	221FA01053	Varanasi Tulasi Pravaranwitha
52.	221FA01054	Mandru Teja Sri
53.	221FA01055	Gundepudi Karthikeya
54.	221FA01056	Bachina Dharani
55.	221FA01057	Jagarlamudi Sohith Chaitanya
56.	221FA01058	Murali Pradeep Yadla
57.	221FA01059	Pothuganti Gulnaz Mabunni
58.	221FA01062	Matluru Sai Dhanush
59.	221FA01063	Nadikattu Suchita Sharon
60.	221FA01066	Allamsetti Charitha Sri
61.	221FA01067	Ikkurthi Bhavya Sri
62.	221FA01068	Ummadi Ramya

63.	221FA01069	Setti Ananya
64.	221FA01070	Godavarthy Lakshmi Vardhani
65.	221FA01071	Meenisetti Geeta Krishnamanaidu
66.	221FA01072	Chennupati Prudvi Raj
67.	221FA01073	Yarlagadda Aanathi
68.	221FA01074	Mudraboyina Jagadeesh
69.	221FA01075	Abburi Naga Bharath
70.	221FA01076	Kamatham Misritha Prasanna
71.	221FA01077	Akkala Srilatha
72.	221FA01079	Arjula Sri Surya Kanthi
73.	221FA01080	Pattela Sai Mounika
74.	221FA01081	Narottam Kumar
75.	221FA01082	Matta Dola Sai Naga Divya Sri
76.	221FA01083	Polarowthu Sri Swarna Lakshmi
77.	221FA01084	Ravipati Sai Vyshnavi
78.	221FA01085	Yadlapalli Rishitha
79.	221FA01086	Ramalakshmi Tejaswi Maddi
80.	221FA01087	Sure Lakshmi Sai Sree
81.	221FA01088	Shaik Asif
82.	221FA01089	Pedalanka Venkata Mani Kumar
83.	221FA01090	Mokhamatam Sravanthi
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113.	221FA01128	Munnelli Lahari
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118.	221FA01134	Talari Venkata Vyshnavi
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