



Zagdu Singh Charitable Trust's (Regd.)

THAKUR COLLEGE OF

ENGINEERING & TECHNOLOGY

(Approved by AICTE, Govt. of Maharashtra & Affiliated to University of Mumbai*)

Institute Accredited by National Assessment and Accreditation Council (NAAC), Bangalore#

Programmes Accredited by National Board of Accreditation (NBA), New Delhi**

Among Top 200 Colleges in the Country where Ranked 193rd in NIRF India Ranking 2019
in Engineering College category

*Permanent Affiliated UG Programmes : • Computer Engineering • Electronics & Telecommunication Engineering • Information Technology (w.e.f. A.Y. 2015-16)

• Electronics Engineering (w.e.f. A.Y. 2017-18)

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ISO 9001:2015 Certified

Subject :-

Experiment / Tutorial / Assignment No. :-

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D DETERMINATION

OF

TOTAL

HARDNESS

OF

WATER



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ДИКИЕ
ГОДЫ
НАТОРИ
ХАРДИНГ
СЕТЭВ



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Aim:

To determine the Total Hardness of Water Sample by Complexometric Method.

Objectives:

After performing this practical, the learner will be able to:

PRO 1: Understand the Apparatus set up for Titration.

PRO 2: Understand the relation between consumption of EDTA & Standard Hard Water (SHW).

PRO 3: Calculate the strength of EDTA solution.

PRO 4: Estimation of total hardness of water.

Apparatus & Chemical used:

Burette, Pipette, Conical Flask, Beaker, EDTA, Buffer Solution, standard Hard Water (Strength 1mg/mL), Hard water sample, EBT indicator etc.



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PART-I: Standardisation of EDTA

PRO-I

Observations:

- Solution in Burette: EDTA solution.
- Solution in Conical Flask: 10 mL of SHW + 1/2 T.T. Buffer solution.
- Indicator: EBT (1-2 drops).
- End point: Wine Red to Blue.
- Pilot Reading: 8 mL to 9 mL.

PRO-II

Observation Table:

Sr. No.	Initial Reading (mL)	Final Reading (mL)	Difference (mL)
1	0.0	8.8	8.8
2	0.0	8.9	8.9
3	0.0	8.9	8.9

Constant Burette Reading = 8.86 mL

PRO-III

Calculations:

$$10 \text{ mL S.H.W.} = 8.86 \text{ mL of EDTA}$$

$$\text{Also, } 1 \text{ mL of SHW} = 1 \text{ mg of CaCO}_3$$

$$\therefore 10 \text{ mL of SHW} = 10 \text{ mg of CaCO}_3$$

$$\text{Thus, } 8.86 \text{ mL of EDTA} = 10 \text{ mg of CaCO}_3.$$

$$\therefore 1 \text{ mL of EDTA} = 10 / 8.86 = 1.128 \text{ mg of CaCO}_3.$$

$$\therefore 1 \text{ mL of EDTA} = 1.128 \text{ mg of CaCO}_3.$$



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- #### **• Electronics Engineering (3 years w.e.f. 01-07-2015)**

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Volume 20 Number 10 December 2012 ISSN 1062-1024

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PART - II : Estimation of Total Hardness.

Observations:

- Solution in Burette : EDTA solution.
- Solution in Conical Flask : 10 mL of Hard Water + $\frac{1}{2}$ T.T. Buffer Solution.
- Indicator : EBT (1-2 drops).
- End Point : Wine Red to Blue.
- Pilot Reading : 7 mL to 8 mL.

Observation Table :

Sr. No.	Initial Reading (mL)	Final Reading (mL)	Difference (mL)
1.	0.0	7.1	7.1
2.	0.0	7.1	7.1
3	0.0	7.1	7.1

Constant Burette Reading (CBR) = 7.1 mL

PRO 4:

Calculations:

10 mL of sample hard water = 7.1 mL of EDTA (CBR).
 But, 1 mL of EDTA = 1.128 mg of CaCO_3 (From Expt. 1) Eq. 1

$$\begin{aligned} \therefore 10 \text{ mL of Hard Water} &= \text{Value from Eq. 1} \times (\text{CBR}) \text{ mg of } \text{CaCO}_3 \\ &= 1.128 \times 7.1 \\ &= 8.008 \text{ mg of } \text{CaCO}_3. \end{aligned} \quad \text{Eq. 2}$$

$$\begin{aligned} \therefore \text{For } 1000 \text{ mL of Hard Water} &= 100 \times \text{Value from Eq. 2} \\ &= 100 \times 8.008 \\ &= 800.8 \text{ mg of } \text{CaCO}_3. \end{aligned}$$

$$\therefore \text{Total Hardness of Water} = 800.8 \text{ mg of } \text{CaCO}_3 / \text{Litres or ppm.}$$



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• Result & Discussion:

PRO 1: Use of Burette & Pipette results into Increased Accuracy.
Buffer solution allows the Wine-Red colour to Last as the EBT-complex is stable in Alkaline Medium.

PRO 2: EDTA replaces EBT, to form Metal-EDTA complex, as it is a Hexadentate & more stable, resulting in colour change from Wine-Red to Colourless. The FBT solution remaining in the flask shows the Blue Colour.

PRO 3: Strength of EDTA Solution is found using the Standard Water Sample. This value is expressed in Mg of CaCO₃ as it has Mol.wt. 100, hence easier for calculations & is highly insoluble in Water.

PRO 4: The Strength of Hard Water sample is found by the same procedure. Doing this thrice results in Accurate Readings for CBR. Then using Eq. 1 Total Hardness of Hard Water is Calculated.

• Conclusion:

Total Hardness of given Hard water Sample is calculated using Complexometric Method.

[notary's seal]

James Johnson to John Howell his wife and son John Jr 1811
and in the presence of John Howell and John Johnson
witnessed by John Howell 1811

James Johnson 1811 - John Howell 1811 and John Jr 1811
and John Howell and John Johnson witnessed by
John Howell 1811 and John Johnson
and John Howell 1811

John Howell and John Johnson 1811
and John Howell and John Johnson
and John Howell and John Johnson
and John Howell and John Johnson

John Howell and John Johnson 1811
and John Howell and John Johnson
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[notary's seal]

John Howell and John Johnson 1811
and John Howell and John Johnson





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• Precautions:

While performing the practical, the learner must:

- 1] Ensure that glassware are cleaned.
- 2] Ensure burette is holding properly to burette stand.
- 3] Ensure that there is no leakage of burette before starting the Titration.
- 4] Ensure that lower meniscus of burette is adjusted to zero.

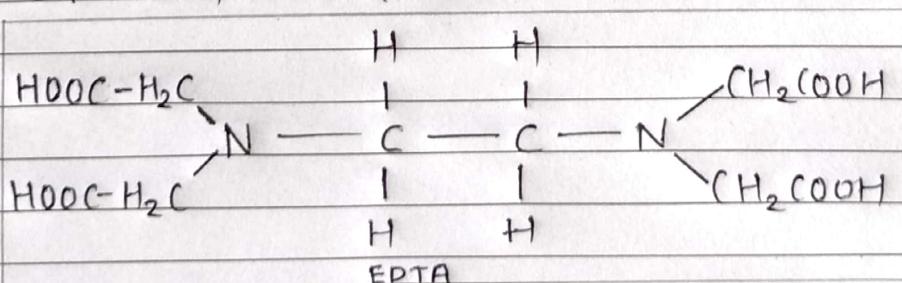
• Quiz:

- 1] How many types of titration are there?

→ There are 3 types of titrations, namely Acid-Base Titrations, Redox Titrations & Precipitation Titrations.

- 2] What is EDTA? Write its Structural Formula.

→ EDTA is Ethylenediaminetetraacetate, an Hexadentate ligand, that combines with metal ions by donating its 6 Electron Lone Pairs.



[Exhibit 1]

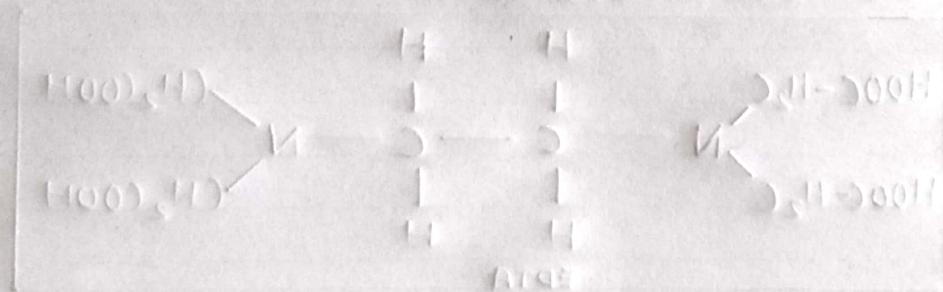
Item numbered 10 in the original printed copy of the
Statement of charges made out by Mr. H.
Anstey of the Royal Engineers, dated 18th
September 1808, and signed by him, and
of his being called to witness the following article

.002

[Exhibit 2]

Item 10 in the original printed copy of the
Statement of charges made out by Mr. H.
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1808, and signed by him, and

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3] What is the Endpoint during titration?

→ The Endpoint during a Titration is the point at which a colour change can be observed in the solution, due to presence of an Indicator. The specific purpose of titration is carried at this exact point & hence it's a crucial point of Experiment.

4] At what pH range Eriochrome Black T form a complex with metal ion?

→ Indicator Eriochrome Black T forms a stable complex with Metal ion only in Alkaline Medium of pH 7 - 11. To maintain this specific pH, Ammonia Buffer (pH 10.5) is used.

Objective	PRO	PRO	PRO	PRO	
	1	2	3	4	Total

Weight 20 20 20 20 Score
Points

Score

Earned points (EP) = Marks in 100 = EP * 20
Total Score / 80 =



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	071	081	081	081	Exhibit
Total	4	8	5	4	
over 2	02	02	02	02	02/06/01 2/6/01 01/01
0-12-00-01-02-03-04	01/01	01/01	01/01	01/01	01/01