

- Aim : To determine hardness of water by EDTA method.
- Apparatus : Burette, pipette, flask, test tube
- Preparation of standard solutions / reagents :

A. Standard hard water (0.01M CaCl_2) -

Weigh accurately 0.5g of dried CaCO_3 , transfer to 500ml volumetric flask, add about 100ml of water. Further add 1N HCl solution drop-wise till effervescence ceases and the solution become clear. Make up the solution to the mark with distilled water and shake the flask well for uniform concentration.

B. EDTA solution (0.01M EDTA) -

Dissolve 4g of EDTA crystals along with 0.1g MgCl_2 in little distilled water in 1L standard flask and make it upto the mark with distilled water. Shake the flask for uniform concentration.

If the solution is turbid, add a few drops of 0.1N NaOH solution to the solution clear.

C. Indicator (EBT solution) -

Dissolve 0.5g of Eriochrome Black-T in 100ml of ethanol / methanol. Date the bottle. Solutions older than 6 weeks should not be used.

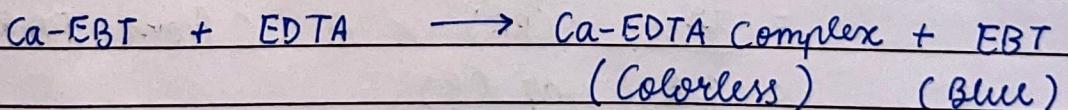
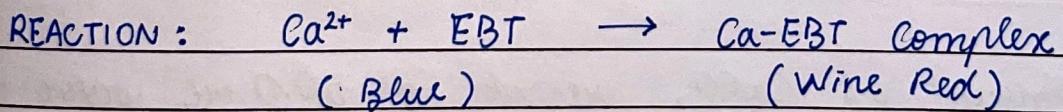
D. Buffer solution (pH 10) :

Add 6.75g of NH_4Cl to 5ml of conc. ammonia solution and dilute with distilled water to one liter. pH will be slightly above 10.

• Procedure :

PART I - Standardisation of EDTA solution

Take 10mL of 0.1M CaCl_2 solⁿ in a conical flask & $\frac{1}{2}$ test tubl of buffer solⁿ. Then add 2-3 drops of indicator solution. Titrate carefully against EDTA solution to the end point where the color changes from wine-red to pure blue. The titration should be carried out ~~not~~ slowly near the end point with constant stirring. No tinge of red color should remain in the solution. Repeat the titration with four other aliquots of the Ca^{2+} solⁿ. Calculate the molarity of the EDTA solⁿ & the CaCO_3 equivalent of EDTA solⁿ.



PART 1

STANDARDISATION OF EDTA SOLⁿ

Observation :

Burette : 0.01M EDTA solⁿ

Flask : 10 mL 0.01M CaCl_2 solⁿ + $\frac{1}{2}$ T.T of buffer solⁿ

Indicator : Eriochrome Black-T (EBT) solⁿ (2-3 drops)

End pt : Wine Red to Blue

Observation Table :

Sr. no.	Initial Burette Reading (mL)	Final Burette Reading (mL)	Differences (mL)
1	0	9.0	9.0
2	0	8.7	8.7
3	0	8.7	8.7

Concurrent reading : 8.7 mL

Calculation 1 :

$$1 \text{ mole of } \text{Ca}^{2+} = 2 \text{ mole of Na EDTA}$$

Hence,

$$\text{Molarity of EDTA soln} \times \text{Vol. of EDTA soln} = \text{Molarity of } \text{Ca}^{2+} \text{ soln} \times \text{Vol. of } \text{Ca}^{2+} \text{ soln}$$

$$\Rightarrow M_2 \times BR = 0.01 \times 10 \quad BR - \text{Burette Reading}$$

$$\bullet M_2 = \frac{0.1}{8.7} = \frac{0.1}{8.7} = 0.0114 \text{ M}$$

$$\text{Molarity of EDTA soln} = 0.0114 \text{ M}$$

$$1.0 \text{ mL of EDTA soln} = \text{Molarity of EDTA} \times 100 \rightarrow \text{Mwt of } \text{CaCO}_3$$

$$\text{Eq. of } \text{CaCO}_3 = 1.14 \text{ mg of } \text{CaCO}_3 (\text{A})$$

PART-2 Estimation of Hardness of Water

Take 50mL of given water sample in a conical flask. To this sample add $\frac{1}{4}$ test tube of buffer soln & 2-3 drops of indicator soln. Titrate with EDTA soln from burette. End pt. is marked by a color change from wine red to pure blue. Repeat the titration with 4 other aliquots. Calculate the total hardness of the water as ppm of CaCO_3 .

- Results :

The given order sample has total hardness of 282.72 ppm of CaCO_3 .

PART 2

Estimation of Hardness of Water

Burette : 0.0114 M EDTA soln

Flask : 50 mL water sample + $\frac{1}{4}$ TT Buffer soln

Indicator : Eriochrome Black-T-solution (2-3 drops)

End pt. : Wine Red to Pure Blue

Observation Table :

Sr no.	Initial Burette Reading (mL)	Final Burette Reading (mL)	Differences
1	12.0	12.3	0.3
2	12.0	12.4	0.4
3	0	12.4	12.4
4	0	0	0

Reactions : $\text{Ca}^{2+} + \text{EBT} \rightarrow \text{Ca-EBT Complex}$
 $(\text{Blue}) \rightarrow (\text{Wine Red})$

$$\text{Ca-EBT} + \text{EDTA} \longrightarrow \text{Ca-EDTA Complex} + \text{EBT} \\ (\text{Colourless}) \quad (\text{Blue})$$

Calculations :

$$\begin{aligned}
 1) \text{ Amount of } \text{CaCO}_3 \text{ present in } 50.0 \text{ mL water sample.} \\
 &= \frac{12.4}{1000} \text{ (BR)} \times A \text{ (from PART - 1)} \\
 &= \underline{9.57} \text{ mg (B)}
 \end{aligned}$$

2) Total hardness of given water sample as ppm of CaCO_3

$$= \frac{B \times 1000}{50.0} = \frac{9.57 \times 1000}{50}$$

$$= \underline{\underline{282.72}} \text{ ppm} (= \text{Mg/L})$$