



## ESTIMATION OF HARDNESS OF WATER BY EDTA METHOD

Experiment No. ....

Date:.....

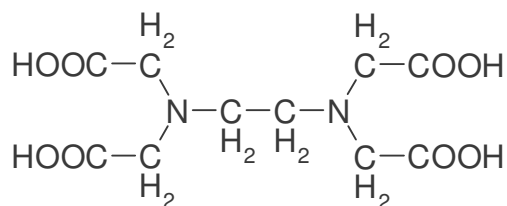
**Aim:** To estimate the amount of total hardness present in the given sample of water by EDTA titration method.

**Apparatus required:** 50 ml Burette, 20 ml Pipette, 250 ml Conical flask, 100 ml Beaker, 250 ml beaker, Glass funnel.

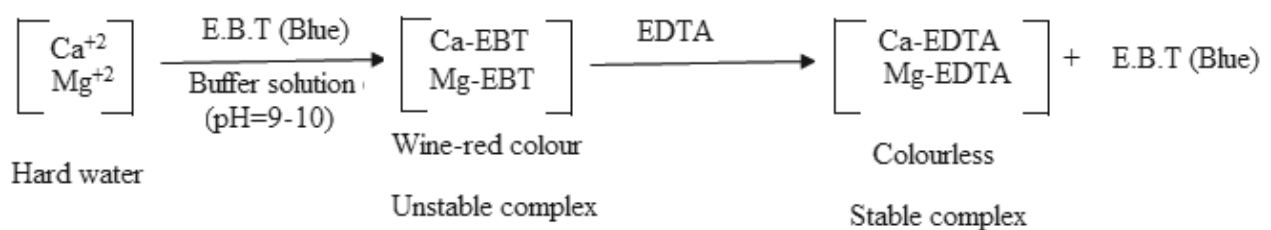
**Reagents:** EDTA solution, Standard  $\text{CaCO}_3$  solution, Eriochrome Black-T indicator, Buffer solution.

**Theory:** EDTA (Ethylenediamine tetra acetic acid) forms colorless stable complexes with  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions present in water at pH = 9-10. To maintain the pH of the solution at 9-10, buffer solution ( $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$ ) is used. Eriochrome Black-T (E.B.T) is used as an indicator.

The sample of hard water must be treated with buffer solution and EBT indicator which forms unstable, wine-red colored complex s with  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  present in water.



Structure of EDTA





## Procedure

### 1. Standardization of EDTA

- (i) Pipette out 20 ml of standard hard water into a conical flask.
- (ii) Add 5 ml of buffer solution and few drops of Eriochrome Black-T. The indicator, which is originally blue color would acquire a wine-red color.
- (iii) Titrate with EDTA solution taken in the burette, till the wine red color changes to blue which is the end point. Let the burette reading of EDTA be  $V_2$  ml.

### 2. Determination of Total hardness

Repeat the above titration method for sample hard water instead of standard hard water. Let the burette reading of EDTA be  $V_3$  ml.

### 3. Determination of Permanent hardness

Take 100 ml of sample hard water in 250 ml beaker. Boil it to remove temporary hardness to about half of this volume and cool to room temperature. Filter through filter paper to remove insoluble  $\text{CaCO}_3$  and  $\text{MgCO}_3$ . Make up the volume to the original 100 ml by adding distilled water. Now pipette out 20 ml of this solution into a clean conical flask. Then repeat the process of titration steps as mentioned above. Let the burette reading of EDTA be  $V_4$  ml.

## Observations

### 1. Standardization of EDTA

S.No	Vol. of Hard water taken (ml)	Burette Reading		Vol. of EDTA Consumed ( $V_2$ ml)
		Initial	Final	
1.				
2.				
3.				



## 2. Determination of Total hardness

S.No	Vol. of Hard water taken (ml)	Burette Reading		Vol. of EDTA Consumed (V <sub>3</sub> ml)
		Initial	Final	
1.				
2.				
3.				

## 4. Determination of Permanent hardness

S.No	Vol. of Hard water taken (ml)	Burette Reading		Vol. of EDTA Consumed (V <sub>4</sub> ml)
		Initial	Final	
1.				
2.				
3.				

## Calculations

### 1. Standardization of EDTA

$$M_1V_1 = M_2V_2$$

Where, M<sub>1</sub> = Molarity of standard hard water

V<sub>1</sub> = Volume of standard hard water in conical flask

M<sub>2</sub> = Molarity of EDTA

V<sub>2</sub> = Volume of EDTA consumed (burette reading)



**2. Determination of Total hardness**

$$M_2V_2 = M_3V_3$$

Where,  $M_3$  = Total hardness of sample water

$V_1$  = Volume of sample hard water in conical flask

**3. Determination of Permanent hardness**

$$M_2V_2 = M_4V_4$$

Where,  $M_4$  = Permanent hardness of sample water

$V_4$  = Volume of sample hard water in conical flask

*Note:* Multiply  $M_3$  and  $M_4$  with  $10^5$  to convert hardness into parts per million (ppm).

**4. Determination of Temporary hardness**

Temporary hardness = Total hardness – Permanent hardness

**Result:** The hardness of the given water sample has been found to be as follows:

Total hardness = ----- ppm

Permanent hardness = ----- ppm

Temporary hardness = ----- ppm