

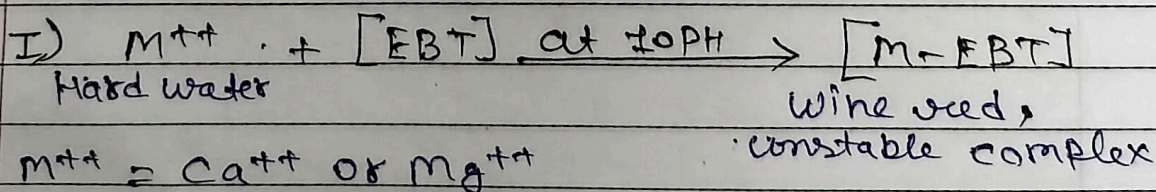
EXPERIMENT-01

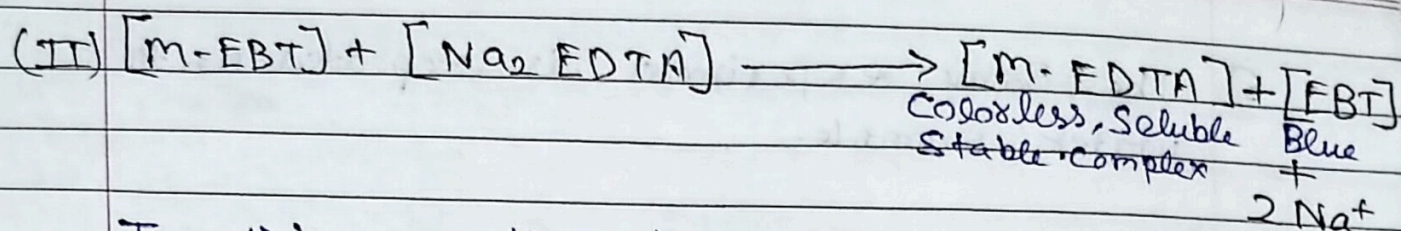
Object- To determine total hardness of given water sample in PPM in terms of CaCO_3 equivalents by complexometric titration using EDTA solution as an intermediate and Eriochrome Black-T (EBT) as an internal metal ion indicator. The strength of standard hard water of CaCO_3 is 4.0 g/L.

Requirements-

- 1) Apparatus Required, Pipette, Conical flask, beaker, dropper etc.
- 2) Chemical Required: EDTA, water sample, Standard hard water, Eriochrome Black-T, buffer solution of NH_4Cl & NH_4OH .

Theory - AS EDTA is a chelating agent, hence Ca^{++} and Mg^{++} ions form a complex with EDTA and at the end point all the Ca^{++} and Mg^{++} ions present in the water sample convert to Ca-EDTA and Mg-EDTA complex.





In this reaction the result is expressed in terms of $CaCO_3$ equivalents by converting the amount of all types of hardness causing salts in $CaCO_3$ equivalents due to the following reasons -

- 1) To convert the amount of all types of salts in one unit.
- 2) Molecular weight of $CaCO_3$ is 100 and its equivalent weight is 50, therefore calculation becomes easier.
- 3) $CaCO_3$ is the most insoluble salt in water.

Procedure -

- 1) Burette is filled with standard EDTA solution.
- 2) Standard hard water is pipette out in conical flask.
- 3) 2ml of buffer solution and then 2-3 drops of Eriochrome Black-T are added into it, the solution becomes wine red in color.
- 4) The solution is titrated with EDTA solution till the color changes to sky blue.
- 5) The volume of EDTA solution consumed is noted and same experiment is repeated to get concordant reading.

- 6) The same experiment is repeated with water sample.

Observation Table -

(I) For standard hard water (SHW)

S. No	Pipette reading (Volume of SHW) (V_1 ml)	Burette reading (ml)		Volume of EDTA (V_2 ml)
		Initial	Final	

(II) For water sample (WS) -

S. No.	Pipette reading (Volume of WS) (V_3 ml)	Burette readings (ml)		Volume of EDTA (V_2 ml)
		Initial	Final	

Calculation -

As the strength of SHW is ≈ 4.0 g/L

So its normality $N_1 = \frac{1}{50}$

(Normality = Strength / Equivalent weight)

Now using $NV = \text{constant}$ equation

$$\begin{array}{ccc} N_1 V_1 & = & N_2 V_2 \\ \text{(SHW)} & & \text{(EDTA)} \end{array}$$

where,

N_1 is the normality of Standard hard water (N/50 given)

N_2 is the normality of EDTA

V_1 is the Volume of Standard hard water

V_2 is the Volume of EDTA

$$\frac{1}{50} \times \frac{V_1}{V_2} = N_2$$

$$\text{And } \begin{array}{ccc} N_2 V_2' & = & N_3 V_3 \\ \text{(EDTA)} & & \text{(WS)} \end{array}$$

where,

N_3 is the normality of water sample

N_2 is the Normality of EDTA

V_3 is the Volume of Water Sample

V_2' is the Volume of EDTA

$$\frac{1}{50} \times \frac{V_1}{V_2} \times \frac{V_2}{V_3} = N_3$$

Strength of water sample $= N_3 \times 50 \text{ g/L}$

$=$ _____ g/L

So total hardness of water sample

$= N_3 \times 50 \times 1000 \text{ mg/Litre}$

$=$ _____ mg/L or ppm

Result - The total hardness present in the given water sample is

_____ ppm.

Precautions -

- 1) Burette and pipette should be rinsed before experiment.
- 2) Burette should be filled up to zero mark.
- 3) Air bubbles should be removed from burette.
- 4) Last drop from pipette should not be transferred into conical flask.
- 5) End point should be noted carefully.