

EXPERIMENT NO. 6AIM :

To determine the temporary and permanent hardness of given water sample by EDTA method.

APPARATUS REQUIRED:

Burette, pipette, retort stand, funnel, beakers, iodometric flask and measuring cylinders.

CHEMICALS REQUIRED:

Standard N/50 EDTA solution, EBT indicator, Buffer solution.

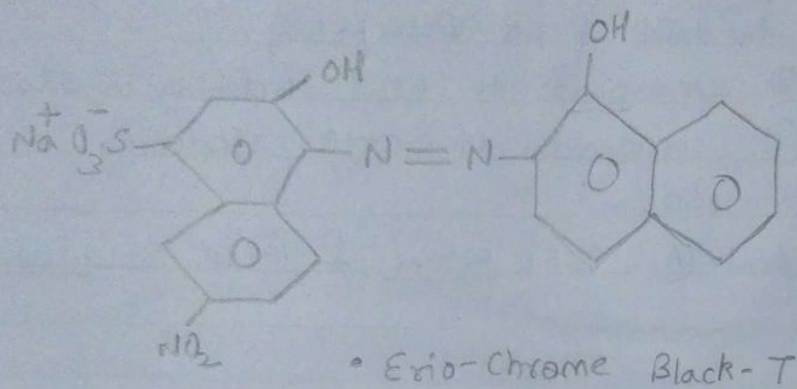
THEORY :

- Titration process involved is complexometric titration.
- Erio-Chrome Black T (EBT) is used as an indicator.
- The indicator EBT is dye stuff and is effective between pH 8-11. It is therefore essential while determining the hardness of water by EDTA method, the pH of solution must be maintained (pH 10) by using a suitable buffer solution.
- End point is achieved when solution turns blue from wine red colour.

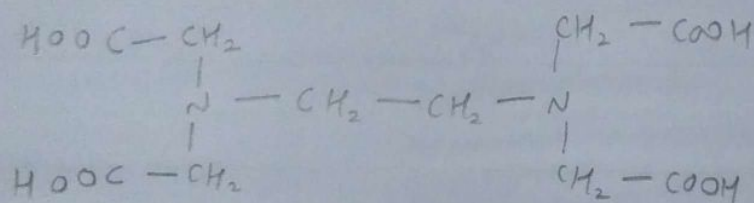
EDTA (Ethylene Diammine Tetra Acetic acid) is an excellent complexing agent. It forms water soluble complexes with divalent and trivalent metal ions. The substance causing hardness to water (primarily dissolved salts of Ca & Mg bicarbonates, sulphates and chlorides) can, therefore be easily estimated by titrating water sample with a standard EDTA soln., using EBT as indicator.

Teacher's Signature :

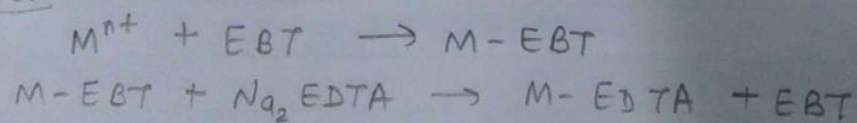
• EBT indicator:



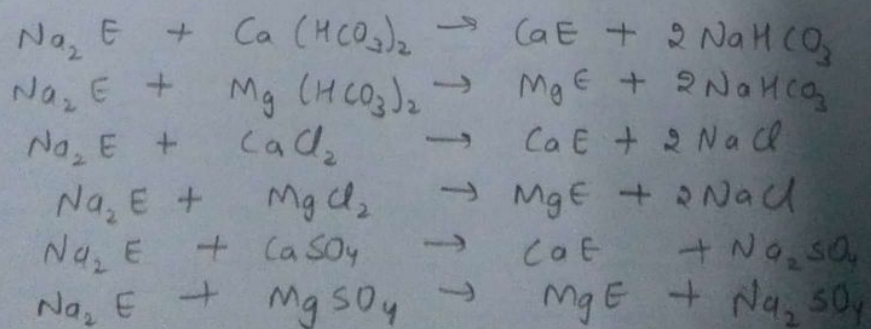
• EDTA:



Chemical Reaction:



Consider $Na_2E \equiv$ Disodium salt of EDTA



Expt. No.

Date

Page No.

- The total hardness of water thus can be determined by titrating a water sample with standard soln. of EDTA in presence of EBT indicator and suitable buffer soln. The hardness causing metals ions will react with EBT indicator and forms metal-indicator wine unstable complex, then on adding EDTA, metal ion will form a stable colorless complex with EDTA & indicator will be set free and hence soln. becomes blue in colour.
- Permanent hardness can be determined by precipitation of temporary hardness by boiling and then titrating in the same manner. Temporary hardness can be calculated by subtracting permanent hardness from total hardness.

PROCEDURE :

• Determination of Total Hardness:

1. Measure 10 mL of the water sample into a 250 mL Erlenmeyer flask. Add 2-3 mL of pH 10 ammonical buffer and 2 drops of EBT indicator. You will get a wine red color soln.
2. Titrate the water sample with EDTA soln. until the color changes from wine red to blue. Record the volume.
3. Repeat this two more times till you get concordant readings.

• Permanent Hardness of Water Sample:

1. Gently boil the water for 30 minutes. Allow the boiled water to cool to room temperature.
2. Pipette 10 mL of the sample into a flask and add 2-3 mL of pH 10, ammonical buffer and 2 drops of EBT indicator.
3. Titrate the water sample with EDTA soln. until colour changes from wine red to blue. Repeat the volume.
4. Repeat this 2 more times till you get concordant readings.

Teacher's Signature :

Observation Table :

• For total hardness (using tap water) -

S. No.	Volume of water sample (ml)	Burette Reading		Volume of $N/50$ EDTA used (ml)
		Initial Reading	Final Reading	
1.	10	0	2.9	2.9
2.	10	2.9	5.8	2.9
3.	10	5.8	8.7	2.9

Concordant Reading = 2.9ml

• For permanent hardness (using boiled water) -

S. No.	Vol. of sample (ml)	Burette Reading		Vol. of $N/50$ EDTA used/ml
		Initial Reading	Final Reading	
1.	10	0	2.6	2.6
2.	10	2.6	5.3	2.7
3.	10	5.3	7.9	2.6

Concordant Reading = 2.6ml

Calculations :

• For total hardness:

$$N_1 V_1 = N_2 V_2$$

EDTA Water sample

$$\frac{1}{50} \times 2.9 = (N_2) (10)$$

$$N_2 = \frac{2.9}{500} = \underline{0.0058N}$$

Expt. No.

Date

Page No.

RESULT:

The given water sample contains:

a) Total Hardness = 290 ppm

b) Permanent Hardness = 260 ppm

c) Temporary Hardness = 30 ppm

Teacher's Signature :

$$\rightarrow \text{Eq. weight of } \text{CaCO}_3 = \frac{100}{2} = 50$$

$$\text{Total hardness} = 0.0058 \times 50 = 0.29 \text{ g/L}$$

$$= \underline{290 \text{ ppm}}$$

Permanent hardness:

$$N_1 V_1 = N_2 V_2$$

EDTA

Boiled water

$$\frac{1}{50} \times 2.6 = N_2 (10)$$

$$N_2 = \frac{2.6}{50} = 0.0052N$$

$$\text{Permanent hardness} = \frac{2.6}{10.509} \times 50 \rightarrow \text{Eq. weight of } \text{CaCO}_3 = \frac{100}{2} = 50$$

$$= 0.26 \text{ g/L}$$

$$= \underline{260 \text{ ppm}}$$

$$\text{Temporary hardness} = \text{Total hardness} - \text{Permanent hardness}$$

$$= (290 - 260) \text{ ppm}$$

$$= \underline{30 \text{ ppm}}$$