

# DETERMINATION OF TOTAL, TEMPORARY AND PERMANENT HARDNESS OF WATER BY EDTA METHOD

## SHORT PROCEDURE :

Titration 1 : Standardization of EDTA.

Burette Solution : EDTA solution.

Pipette Solution : Standard Hard water.

Reagents added : 5 ml of ammonia buffer

Indicator : Eriochrome Black - T

End Point : Colour change from wine red to clear blue.

Standard Hard Water Vs EDTA.

S.No	Volume of Standard Hard water (ml)	Burette Reading (ml)		Volume of EDTA solution (ml)
		Initial	Final	
01.	20	0	23.5	23.5
02	20	0	23.5	

Concordant Value : 23.5 ml

## Calculation :

Volume of hard water

$$V_1 = 20 \text{ ml}$$

Strength of standard hard water

$$N_1 = 0.015 \text{ N}$$

Volume of EDTA

$$V_2 = 23.5 \text{ ml}$$

Strength of EDTA

$$N_2 =$$

According to the law of volumetric analysis,  $V_1 N_1 = V_2 N_2$

$$N_2 = \frac{V_1 N_1}{V_2}$$

$$= \frac{20 \times 0.015}{23.5}$$

Strength of EDTA,

$$N_2 = 0.0127 \text{ N.}$$

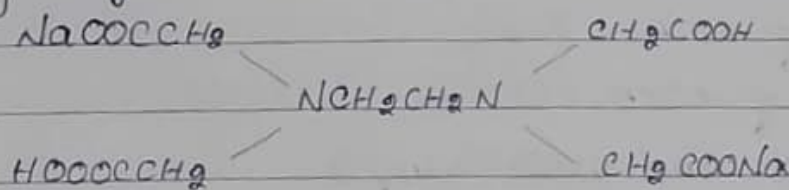
## DETERMINATION OF TOTAL, TEMPORARY AND PERMANENT HARDNESS OF WATER BY EDTA METHOD.

AIM :

To determine the total, temporary and permanent hardness in the given sample of hard water by EDTA method. Standard hard water (0.015 N) and EDTA solution are provided.

PRINCIPLE :

Hard water does not give lather freely with soap. Such water forms precipitate with soap. Water is said to be hard when it contains  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  or any other heavy metal ion (other than alkali metal ion). Disodium salt of Ethylene Diamine Tetra Acetic acid (EDTA) is a well known complexing agent. Its structure is shown below



Disodium salt of Ethylene Diamine  
Tetra Acetic Acid (EDTA).

Disodium salt of EDTA is used to estimate the various hardness of the given hard water.

# SHORT PROCEDURE :

Titration II : Determination of Total Hardness of Hard Water Sample.

Burette Solution : EDTA Solution.  
 Pipette Solution : Hard water Sample.  
 Reagents added : 5 ml of ammonia buffer.  
 Indicator : Eriochrome Black-T  
 End point : Colour change from wine red to blue.

Hard Water Sample Vs EDTA.

S.No	Volume of hard water sample (ml)	Burette Reading (ml)		Volume of EDTA Solution (ml).
		Initial	Final	
1.	20	0	17	17
2.	20	0	17	

Concordant value : 17 ml.

Calculation :

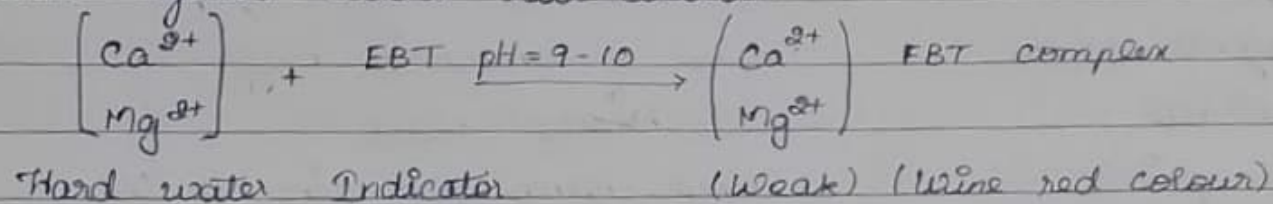
Volume of EDTA  $V_1 = 17 \text{ ml}$   
 Strength of EDTA  $N_1 = 0.0127 \text{ N}$   
 Volume of hard water sample  $V_2 = 20 \text{ ml}$   
 Strength of hard water sample  $N_2 =$   
 According to the law of volumetric analysis,  $V_1 N_1 = V_2 N_2$   

$$N_2 = \frac{V_1 N_1}{V_2} = \frac{17 \times 0.0127}{20}$$

Strength of hard water sample,  $N_2 = 0.0107 \text{ N}$ .



containing  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions. When EDTA is added to hard water, it reacts with calcium and magnesium ions present in hard water to form stable EDTA metal complexes. From the volume of EDTA consumed the hardness can be calculated. Eriochrome Black-T is used as an indicator. The indicator forms a weak complex with the metal ions present in the hard water and gives wine red colour.



#### MATERIALS REQUIRED :

EDTA, Ammonium Chloride, Ammonium hydroxide, Eriochrome Black-T, Calcium carbonate, Standard hard water, Sample hard water, Burette, Pipette, Conical flask.

When EDTA is added into the hard water, the metal ions form a stable metal complex with EDTA by leaving the indicator. When all the metal ions are taken by EDTA from the indicator metal ion complex, the wine red colour changes into steel blue, which denotes the end point. The metal EDTA

Total hardness of the given sample of hard water =  $N \times 50 \times 1000$

$$= 0.0107 \times 50 \times 1000$$

$$= 535 \text{ ppm.}$$

#### SHORT PROCEDURE :

Titration iii : Determination of Permanent Hardness.

Burette Solution : EDTA solution

Pipette Solution : Boiled hard water sample.

Reagents added : 5 ml of ammonia buffer.

Indicator : Eriochrome black - T

End point : Colour change from wine red to clear blue.

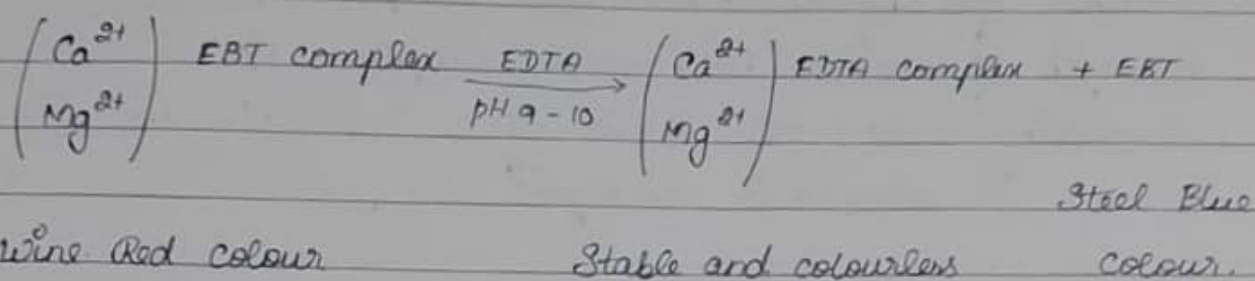
Equivalent weight of  $\text{CaCO}_3 = 50$ .

Boiled hard water vs EDTA.

S.No	Volume of boiled hard water sample (ml)	Burette Reading (ml)		Volume of EDTA Solution (ml)
		Initial	Final	
1.	20	0	7.3	7.3
2.	20	0	7.3	

Concordant value : 7.3 ml

complex is stable at pH 8-10. This pH range can be maintained by adding ammoniacal buffer ( $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$ ).



#### PROCEDURE :

##### Titration : Standardization of EDTA.

The burette is washed with distilled water and rinsed with a little amount of given EDTA solution and filled with the same upto zero mark. 20 ml of standard hard water solution is pipetted out into a clean conical flask. 5 ml of ammonia buffer solution and a pinch of Eriochrome Black-T indicator are added. The solution turns wine red in colour. It is then titrated against EDTA taken in the burette. The end point is change in colour from wine red to steel blue. The reading is noted. The titration is repeated to get concordant values.

calculation :

Volume of EDTA  $V_1 = 7.3 \text{ ml}$

Strength of EDTA  $N_1 = 0.0127 \text{ N}$

Volume of boiled hard water sample  $V_2 = 80 \text{ ml}$

Strength of boiled hard water sample  $N_2 =$

According to the law of volumetric analysis  $V_1 N_1 = V_2 N_2$

$$N_2 = \frac{V_1 N_1}{V_2}$$

$$N_2 = \frac{7.3 \times 0.0127}{80}$$

Strength of boiled hard water sample  $= 0.0046 \text{ N}$

Permanent hardness of the given sample of hard water  $= \text{N} \times 50 \times 1000$

$$= 0.0046 \times 50 \times 1000$$

permanent hardness  $= 230 \text{ ppm}$



Titration II : Determination of Total hardness of hard water sample.

20 ml of the given hard water sample is pipetted out into a clean conical flask. 5 ml of ammonia buffer solution and a pinch of Eriochrome Black-T indicator is added. The solution turns wine red in colour. This solution is titrated against EDTA solution taken in the burette. The end point is change in colour from wine red to steel blue. The titration is repeated to get concordant values.

Titration III : Determination of Permanent Hardness

20 ml of the given boiled hard water sample is pipetted out into a clean conical flask. 5 ml of ammonia buffer solution and a pinch of Eriochrome Black-T indicator are added. The solution turns wine red in colour. This solution is titrated against the EDTA taken in the burette. The end point is change in colour from wine red to steel blue. The titration is repeated to get concordant values.



Determination of Temporary Hardness:

$$\text{Temporary hardness of the given sample of water} = \text{Total hardness} - \text{permanent hardness}$$

$$= 535 - 230 \text{ ppm}$$

$$\text{Temporary hardness} = 305 \text{ ppm}$$

### Determination of Temporary Hardness.

Temporary hardness of the water sample is calculated by subtracting permanent hardness from total hardness.

### RESULT :

1. Total hardness of the given sample of water = 525 ppm.
2. Permanent hardness of the given sample of water = 320 ppm.
3. Temporary hardness of the given sample of water = 205 ppm.