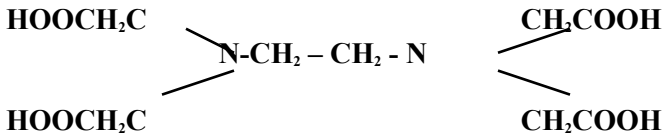
Signature of the teacher

EXPERIMENT NO: **DATE:**

Determination of Total Hardness of a sample of Water using Disodium salt of EDTA.

PRINCIPLE: Hardness of water is mainly due to the presence of calcium and magnesium salts in it. Total hardness is the sum of temporary hardness (due to bicarbonates of calcium and magnesium) and permanent hardness(due to chlorides, sulphates etc, of calcium and magnesium) Ethylene dia minetetra acetic acid is a reagent, which reacts with metal ions like Ca^{2+}, Mg^{2+} forming complex compounds. Therefore, this reagent can be used to determine the concentration of hardness causing substances.



The completion of the reaction (end point of the titration) is identified using Erichrome black T indicator. This is an organic dye, blue in colour. It also forms relatively less stable complexes with bivalent metal ions of Ca, Mg etc., which produces wine-red colour.Therefore, addition of the indicator to hard water produces wine-red colour. When EDTA is added to hard water, it first reacts with free metal ions and then attacks the metal-indicator complex.The latter reaction can be represented as

M^{2+}-Indicator complex +EDTA ⟶ M^{2+}-EDTAComplex +Free Indicator
(Colourless) (Blue)

So, at the end point a change from wine-red to blue colour is observed. Since the reaction involves the liberation of H^+ ions and the indicator is sensitive to the concentration of H^+ions(metal indicator complex is stable at pH 10) of the solution, a constant pH of around 10 has to be maintained. For this purpose ammonia-ammonium chloride buffer is used.

PROCEDURE:

Part-A:Preparation of standard EDTAsolution:

Weigh the weighing bottle containing disodium salt into the funnel placed on a 250cm^3 volumetric flask. Weigh thebottle again. The difference between the two weights will give the amount of EDTA transferred. Pour small quantities of water over the salt on the funnel and transfer the salt into the flask.Wash the funnel with the same water 3-4 times. Dissolve the salt by adding about 100-150 cm^3 of deionised water. Make up the solution to the mark and shake well for uniform concentration.

Part-B:Estimation of hardness of water:

Pipette out 25cm^3 of the given sample of hard water into a clean conical flask. Add 3cm^3 of NH_3-NH_4CL buffer followed by 5-6 drops of Erichrome black-T indicator. Titrate this against EDTA taken in a burette till the colour changes from wine-red to blue. Note down the burette readings and repeat the titration to get concordant values.

Experiment no

Observation and Calculations

Part A: Preparation of standard EDTA solution

Weight of weighing bottle and EDTA salt:…….. g
Weight of empty weighing bottle:……g
Weight of EDTA salt:……g

$$\text{Molarity of EDTA: } \frac{\text{Weight of EDTA salt X 4}}{\text{Molecular weight of EDTA}} = \frac{\text{W X 4}}{372.24} \quad \text{(X)}$$

Part B: Determination of total hardness of water sample

Burette: Standard EDTA solution
Conical flask: 25 cm^3 of water sample + 3 cm^3 of NH_4Cl-NH_4OH buffer solution
Indicator: A pinch of Eriochrome Black T indicator
End point: Wine red to Blue

Trials Burette readings	I	II	III
Final reading			
Initial reading			
Volume of EDTA run down in cm^3			

1000cm^3 of 1M EDTA solution = 100g of $CaCO_3$
Therefore Vcm^3 of X M EDTA = $\frac{Xx\ V\ X\ 100}{1000}$

= (a g) of $CaCO_3$

25cm^3 of hard water contains …….. g of $CaCO_3$

Therefore total hardness of water = $\frac{a \times 10^6}{25}$ = = =ppm

RESULT: Total hardness of water= ppm