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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 1.0 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.

I) M^{++} + [EBT] $\xrightarrow{\text{at 10PH}}$ [M-EBT]
Hard water — Wine red, constable complex

$M^{++} = Ca^{++}$ or Mg^{++}

(II) $[M\text{-}EBT] + [Na_2EDTA] \longrightarrow [M\cdot EDTA] + [EBT] + 2Na^+$

Colorless, Soluble Stable Complex — Blue

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 -

4) 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.

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6) The same experiment is repeated with water sample.

Observation Table –

(I) For standard hard water (SHW)

S. No	Pipette reading (Volume of SHW) V1 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 = 1.0 g/L

So its normality $N_1 = 1/50$ ———

(Normality = Strength / Equivalent weight)

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Now using NV = Constant equation

$$\underset{(SHW)}{N_1V_1} = \underset{(EDTA)}{N_2V_2}$$

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

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

And $\underset{(EDTA)}{N_2V_2'} = \underset{(WS)}{N_3V_3}$

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 = $N_3 \times 50$ g/L

= _____ g/L

So total hardness of water sample

= $N_3 \times 50 \times 1000$ mg/Litre

= _____ mg/L or ppm

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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.