AIM OF THE EXPERIMENT-

To determine the hardness of water by EDTA method.

APPARATUS REQUIRED-

Burette, Pipette, Conical flask, Measuring flask

CHEMICALS REQUIRED-

(a) Standard disodium EDTA sol^n
(b) $NH_4Cl - NH_4OH$ Buffer
(c) Eriochrome black -T indicator (EBT)

THEORY-

A knowledge of the magnitude and the type of hardness is important in determining the suitability of water for domestic and industrial purposes. Use of hard water for cleaning purpose is unsatisfactory as they increase the consumption of soaps. Hardwater offers difficulties in dyeing of the textiles. They are uneconomical and even hazardous in steam generation. they impart many of the undersirable characteristics to finished production. In paper industry beverages, diarries and allied industries. Therefore, the determination of hardness and the relative amount of the Ca^{++}ing hardness is important.

Hardness is usually determined by the following

(a) Soap sol^n method
(b) EDTA method
(c) O Hehners method

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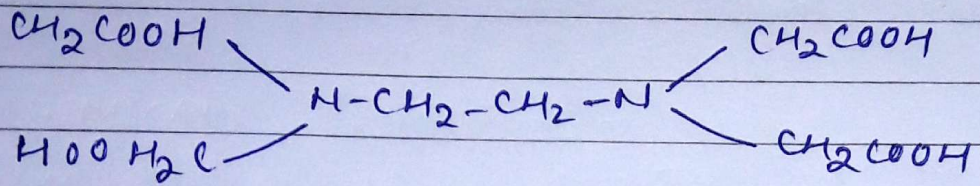
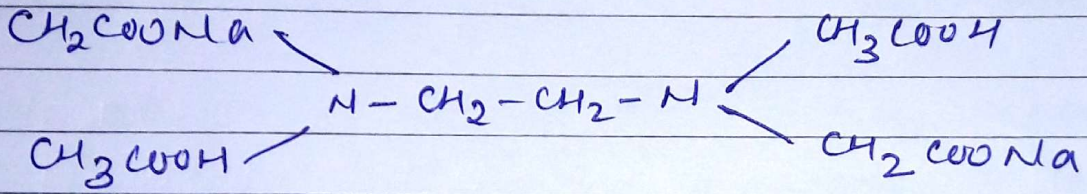
EDTA method -

This method gives more accuracy results than the other methods. Ethylene diamine tetra acetic acid (EDTA) forms complex with Ca^{2+} and Mg^{2+} as well as with other metal cations in aqueous sol^{n}.

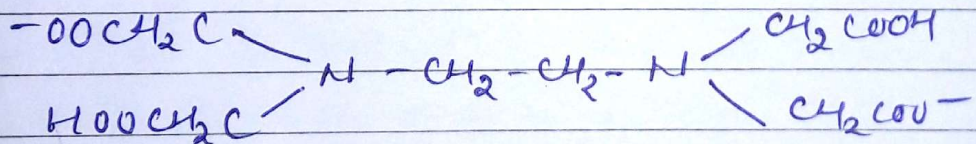


(EDTA)



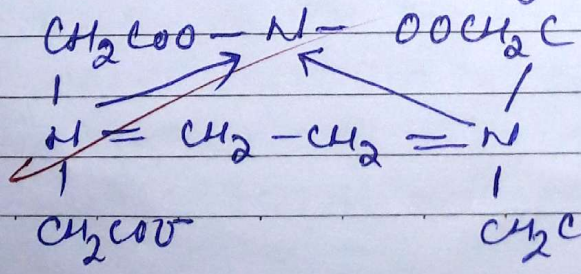
(Disodium salt of EDTA)

Disodium salt of EDTA ionises in water to give $2Na^{+}$ ions and a strong chelating agent as follows:-



(Chelating agent)

This forms complexes with Ca^{2+} and Mg^{2+} and with other divalent or higher valent cations as



The titration is carried out in presence of metal indicator eriochrome black-T. when the indicator is added in small amount in hardwater buffered to a pH value about 10. It combines with a few Ca^{2+} and Mg^{2+} ion to form a weak complex of wine red colour (the complex in alkaline med) pH range 8-10.

$$\left[\begin{matrix} Ca^{+2} \\ Mg^{+2} \end{matrix}\right] + EBT \longrightarrow \left[\begin{matrix} Ca \\ Mg \end{matrix}\ EBT\right]$$

of water (unstable complex)

The unstable complex is quickly replaced by $\left[\begin{matrix} Ca \\ Mg \end{matrix}\right]$[EDTA] complex according to the eq^n.

$$\left[\begin{matrix} Ca \\ Mg \end{matrix}\right][EBT] + EDTA \longrightarrow \left[\begin{matrix} Ca \\ Mg \end{matrix}\ EDTA\right] + EBT$$

(unstable) (complex) (Blue)

When EBT is released free the wine red colour changed to blue marking the end of titration.

PROCEDURE:-

(a) Standardisation of EDTA sol^n with standard hard water (1 ml SHW = 1 mg $CaCO_3$). Rinse and fill the burette with EDTA sol^n. Pipette out 50 ml of standard hard water in a conical flask. Add 10 + 5 ml of buffer sol^n and 4-5 drop of indicator. Titrate with EDTA sol^n till wine red colour

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changes to clear blue. Let the volume be V_1 ml.

(b) Determination of temporary and permanent hardness. Take 250 ml of the hard water sample in a large beaker & filled for about one hour (till the carbonates are decomposed to insoluble $CaCO_3 + Mg(OH)_2$) Cool filter into 250 ml measuring flask and make the volume upto the mark. Take 50 ml of this sol^n and proceed in the same way above.

The vol of EDTA used corresponding to permanent hardness the water sample.

CALCULATION –

Total hardness :-

1000 ml of 1M EDTA = 100 gm of $CaCO_3$

1 ml of 1M EDTA = $\frac{100}{1000}$ gm of $CaCO_3$.

1 ml of $\frac{M}{50}$ EDTA = $\frac{100}{1000} \times \frac{1}{50}$ gm of $CaCO_3$.

5.5 ml of $\frac{M}{50}$ EDTA = $\frac{100}{1000} \times \frac{1}{50} \times 5.5$ gm of $CaCO_3$

$= \frac{5.5}{500} = 0.011$ gm of $CaCO_3$

$= 11.0 \times 10^{-3}$ gm of $CaCO_3$

40 ml of supplied water sample contains

$= 11 \times 10^{-3}$ gm of $CaCO_3$

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1 ml of supplied water sample contains

$= \frac{11 \times 10^{-3}}{40}$ gm of $CaCO_3$

$= 0.275 \times 10^{-3}$ gm

1000 gm of supplied water sample contains

$= 0.275 \times 10^{-3} \times 1000$ gm of $CaCO_3$

$= 275$ PPM.

Permanent hardness-

1000 ml of 1M EDTA = 100 gm of $CaCO_3$

1 ml of 1M EDTA = $\frac{100}{1000}$ gm of $CaCO_3$

4.5 ml of $\frac{M}{50}$ EDTA = $\frac{100}{1000} \times \frac{1}{50} \times 4.5$ gm of $CaCO_3$

$= \frac{4.5}{500}$ gm

$= 0.009$ gm

$= 9 \times 10^{-3}$ gm of $CaCO_3$.

40 ml of supplied water sample contains

$= 9 \times 10^{-3}$ gm of $CaCO_3$.

1000 ml of supplied water sample contains

$= \frac{9 \times 10^{-3}}{40} \times 1000$

$= 2.25 \times 10^{-1}$

$= 0.225$ gm

$= 225$ PPM

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Temporary hardness –

= Total hardness – permanent hardness

= 275 – 225

= 50 PPM

CONCLUSION –

From the above titration of sample water with EDTA, the hardness (total) of the supplie is found to be ~~2110~~ 275 PPM and permanent hardness of water to be 225 PPM, temporary hardness " " is 50 PPM

Susmita S. Mishra
Sec- E-2 Roll 15011132