Engineering Chemistry

CYC 102

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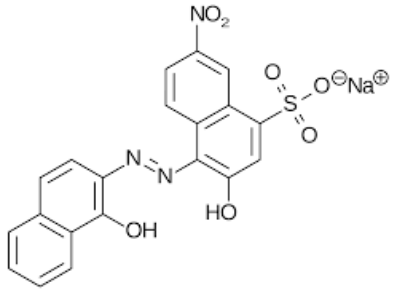
Overview

- Determination of Hardness By EDTA Method
- Chemicals required
- Steps followed in EDTA method
- Hardness determination
- Summary

Determination of Hardness By EDTA Method

Principle

The determination of hardness is carried out by titrating water sample with Sodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) using Eriochrome Black-T (sodium1-(1-hydroxy-2-napthylazo)-6-nitro-2-naphthol-4-sulphonate) as an indicator and keeping the pH of the water at 9.0 - 10.0. The end point is the change in color from wine - red to blue, when the EDTA solution complexes the calcium and magnesium salt completely.



$(Ca^{2+}$ or $Mg^{2+})$ + EBT → [Ca – EBT] (or) [Mg – EBT]

Hardness-salts **Indicator** **unstable complex (wine red)**

[Ca – EBT] (or) [Mg – EBT] + EDTA → [Ca – EDTA] (or) [Mg – EDTA] + EBT

Unstable complex (wine red) **Stable complex (colourless)** **Steel Blue**

Determination of Hardness By EDTA Method…Contd.

EDTA Method:-

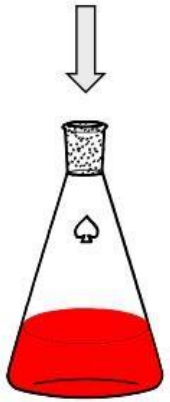
Hard water

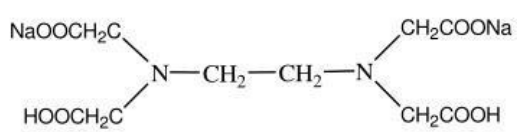
+

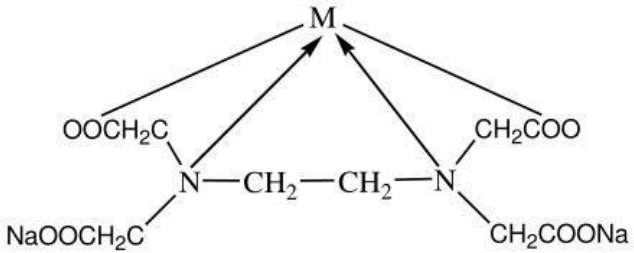
EBT Indicator

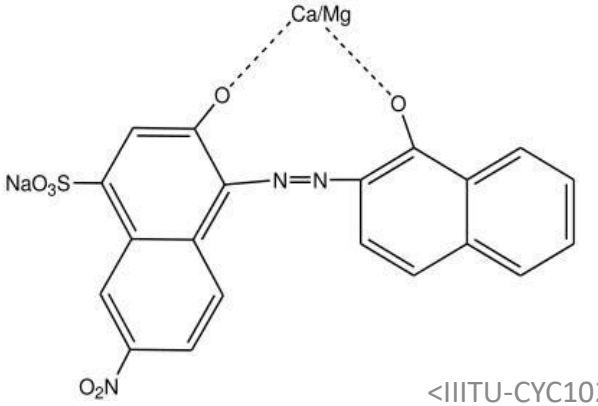
+

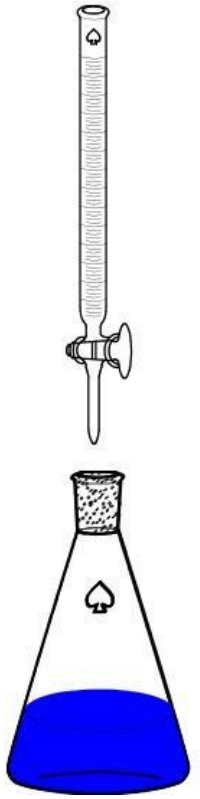
10 PH buffer solution











Chemicals Required In EDTA method

- **Standard hard water**

1 g (1000 mg) of CaCO3 dissolved in dil. HCl and made upto 1 L (1000 ml)

1 ml of std. hard water contains 1 mg of CaCO3

- **Preparation of EDTA solution**

Dissolve 4 g of pure EDTA crystals + 0.lg MgCl2 in 1 Litre of distilled water.

- **Indicator [Erichrome black-T]**

Dissolve 0.5 g of Eriochrome Black−T in 100mL alcohol.

- **Ammonia Buffer**

67.5g of NH_4Cl to 570 ml of Conc. ammonia solution -diluted to 1 L.

Various steps involved in EDTA method

- Pipette out 50 mL of the given water sample into a 250 mL conical flask.
- Add 3–5 mL of the (ammonia + ammonium chloride) buffer solution to elevate pH to approximately10.0.
- Add a tiny amount to dry Eriochrome black (EBT) indicator.
- The solution turns wine red.
- Titrate the sample of water slowly with 0.01 M EDTA until the last reddish tinge disappears from the solution.
- Add the last few drops at 3–5 second intervals to allow the end-point reaction to go to completion with the permanent blue coloration.
- Record the volume of EDTA used up at equivalence, V mL.

Various steps involved in EDTA method…Contd.

Calculation of the hardness of the sample using: [Note: 1 L of water = 10^6 mg of water]

The total hardness of water = $\frac{V \times B \times 1000mg}{volume\ of\ water\ taken}$ **$CaCO_3$/litre or ppm.**

where:

V is the mL of the EDTA used in the titration

'B' is the mg $CaCO_3$ equivalent to 1 mL of EDTA

solution B ≡1 mL of 0.01 M EDTA solution ≡ 1 mg CaCO3

The total hardness of water can also be reported in terms of parts per million (ppm).

Summary

- Complexometric titration
- Hardness can be determined by EDTA method
- Temporary, permanent and total hardness can be determined easily by this method

Reference

- O.G Palanna, Engineering Chemistry, Page No. 268-270.

Topic to be covered in Class

- Numerical based on EDTA method
- Alkalinity
- Numerical based on alkalinity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विद्या सर्वत्र गौरवः

Thank You!