**Experiment – 1**

**Object:** To determine the temporary and permanent hardness of water sample by complexometry using EDTA.

**Chemicals Required:** 0.02 N EDTA, buffer solution of pH 10(+/-0.1), Eriocrome black-T (indicator), Standard hard water given water sample.

**Apparatus Required**: Conical flask, burette, pipette beaker, measuring flask.

**Principle:** When Eriochrome black-T (Indicator) is added to hard water solution at around pH 10.0 it gives wine red coloured unstable complex with Ca 2+ and Mg 2+ ion of the sample water. When this wine red coloured complex is titrated against EDTA solution, the colour of the complex changes from wine red to original blue colour showing the end point.

Ethylene diamine tetra acetic acid (EDTA) is a well known complexing agent, which is widely used in analytical work, on account of its powerful complexing action and commercial availability.

**HOOC.H2C CH2COOH**

**N-CH2- CH2-N**

**HOOC.H2C CH2COOH**

**Structure of EDTA**

**CH2COO M OOCH2C**

**N CH2  CH2 N**

**CH2COO-  CH2COO-**

**EDTA** complex with divalent Metal cation **(M=Ca2+, Mg2+)**

In aqueous solution EDTA ionizes to give two Na+ ions and it is strong chelating agent. The indicator used is a complex organic compound (sodium-1(hydroxyl-2 –naphthylazo)-6-nitro-2-naphthol-4 sulphonate) commonly known as Eriochrome black-T. It has two ionisable phenolic hydrogen atoms and for simplicity it is represented as:

**Indicator –Eriochrome Black-T**

**OH OH**

**Na+O3S- N N**

**NO2**

**Procedure:** Take 20ml of unknown hard water in a conical flask. Add 5ml of buffer solution and 5 drops of Eriochrome black –T indicator, when colour of the solution turns wine red. Titrate the solution against EDTA so that the colour changes from wine red to blue. Repeat the titration for two concordant readings.

**Reaction: EB-T + Ca+ or Mg+ [EB-T + Ca+ or Mg+]**

Wine Red or Violet colour

**[EBT + Ca+ or Mg+] + EDTA [EDTA + Ca+  or Mg+] + EB-T**

Blue

**Observations:**

Reading with unknown Solution:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Vol. of unknown Solution taken** | **Burette reading** | | **Vol. of EDTA solution used** |
| **Initial** | **Final** |
| **1.**  **2.**  **3.** | *20ml*  *20ml*  *20ml* |  |  | V1 |

Reading after boiling the solution:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Vol. of unknown Solution taken** | **Burette reading** | | **Vol. of EDTA solution used** |
| **Initial** | **Final** |
| **1.**  **2.**  **3.** | *20ml*  *20ml*  *20ml* |  |  | V2 |

Volume of EDTA used for unknown solution = V**1** ml.

Volume of EDTA used for boiled Solution = V**2** ml

1. **Total hardness**:

20ml unknown solution = V1 ml EDTA

= V1 mg of CaCO**3**

Total hardness = V**1**x 1000/20ppm

1. **Permanent hardness**:

20ml boiled water = V2 mlEDTA

= V2 mg of CaCO**3**

Permanent hardness = V2 x 1000/20 ppm

1. **Temporary hardness :**

= (Total Hardness) - (Permanent Hardness).

**Result:**

1. Total hardness =…………………….ppm or mg/ Ltr.
2. Permanent hardness =…………………….ppm or mg/ Ltr.
3. Temporary hardness =………………….…ppm or mg/Ltr.