**Name:**

**Roll No.: Batch:**

**Date:**

**CO1:** Understand the methods to produce soft and potable water and use of green chemistry principles in real life applications.

**Experiment No. 4**

# **Title: Hardness of water by column chromatography**

**Aim** : Determination of residual hardness of softened water using ION

exchange method

**Requirements**  : Amberlite AR-400 resin 0.01 M EDTA soln., buffer of pH 10,

Eriochrome Black-T indicator, Distilled water

**Apparatus** : Burette, Conical flask, pipette, etc.

**Theory** : Activated Amberlite AR-400 Resin is a cation exchange resin,

this has the capability to exchange its H+ ions with bivalent

(Ca++ and/or Mg++) hardness causing cations

**Procedure** :

**Part-A** : Preparation of cation Exchange Resin Column :

About 20 gm of amberlite AR-400 resin is taken in a 250 mL beaker. The resin is soaked in 100mL of 2N HCl for about 5 hours. Then it is stirred well and allowed to settle down. The acid is decanted. The activated resin is then washed 2- 3 times using 100mL distilled water. The upper clear soln. is decanted.

A column (burette) is plugged with cotton and then filled with distilled water. Then the activated resin is transferred into the column. The column is then washed with distilled water till it is free from acid/ chloride. This is ensured by testing with freshly prepared AgNO3 and methyl orange respectively. The cation exchange column is now ready.

**Part-B:**  To determine the hardness of given water sample

Part I :

Pipette out 10 mL standard hard water (1mg/mL) in conical flask. Add a full dropper of buffer soln. of pH 10. Add few crystals (3- 5) of Eriochrome Black-T indicator. Titrate against 0.01M EDTA soln. from burette till colour changes from wine red to blue. Note down constant burette reading (A mL).

Part II :

Pipette out 50 mL of unknown water sample (tap) in a conical flask. Add a full dropper of buffer solution and few crystals Eriochrome Black-T indicator. Titrate against 0.01M EDTA till colour changes from wine red to blue. Note down the constant burette reading (B mL).

Part III :

Pass 50 ml of water sample (tap) through the cation exchange column. Collect the eluted water and (distilled water) washings together in a 250 mL conical flask. Add a full dropper of buffer solution and few crystals of Eriochrome Black –T indicator. Titrate this against 0.01 M EDTA till colour changes from wine red to blue. Note this reading (C mL).

**Observation**

**Part I**

Burette : 0.01M EDTA soln.

Conical flask : 10 mL of Standard hard water + indicator +Buffer of pH 10

Indicator : Eriochrome Black –T.

End point : Wine red to blue

Reaction:

Metal + indicator Metal-indicator complex

Metal-indicator complex + EDTA Free acid indicator + Metal- EDTA complex.

# Pilot Reading : \_\_\_\_\_\_\_\_\_\_ (mL) to \_\_\_\_\_\_\_\_\_\_(mL)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reading | I (mL) | II (mL) | III (mL) | Constant (mL) A |
| Initial |  |  |  |  |
| Final |  |  |  |
| Difference |  |  |  |

**Calculation:**

Constant Burette reading = AmL = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mL

**Observation**

**Part II**

Burette : 0.01M EDTA solution

Conical flask : 50 mL of water sample (tap) + indicator + Buffer of pH 10

Indicator : Eriochrome Black –T

End point : Wine red to blue.

# Reaction:

# Pilot Reading : \_\_\_\_\_\_\_\_\_\_ (mL) to \_\_\_\_\_\_\_\_\_\_(mL)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reading | I (mL) | II (mL) | III (mL) | Constant (mL) B |
| Initial |  |  |  |  |
| Final |  |  |  |
| Difference |  |  |  |

Constant burette reading = B mL = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mL

**Calculation of Part II**

A ml of EDTA = 10 mg of CaCO3 hardness

B ml of EDTA = B/A x 10 mg = \_\_\_\_\_\_\_\_\_\_\_\_

= X = \_\_\_\_\_\_\_\_\_\_ mg of hardness present in 50 ml of sample

50 ml of sample = X = \_\_\_\_\_\_\_\_\_\_\_ mg of CaCO3 hardness

1000 ml of sample = 1000 x X = \_\_\_\_\_\_\_\_\_\_\_ 50

= \_\_\_\_\_\_\_\_\_\_\_\_ppm of CaCO3 (Total hardness)

**Observation**

**Part III**

Burette : 0.01M EDTA

Conical flask : 50 mL of eluted water sample along with washings + indicator + Buffer of pH 10

Indicator : Eriochrome Black –T.

End point : Wine red to blue

Reaction :

Na2(H2C10H12O8N2) 2Na+  + (H2C10H12O8N)- -

Ca++ + (H2C10H12O8N2) (CaC10H12O8N2) -- + 2H+

# Pilot Reading : \_\_\_\_\_\_\_\_\_\_ (mL) to \_\_\_\_\_\_\_\_\_\_(mL)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reading | I (mL) | II (mL) | III (mL) | Constant (mL) C |
| Initial |  |  |  |  |
| Final |  |  |  |
| Difference |  |  |  |

**Calculation:**

A ml of EDTA = 10 mg of CaCO3 hardness

(C) ml of EDTA = C/A x 10 = \_\_\_\_\_\_\_\_\_\_\_\_

= Y = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mg of hardness present in 50 ml of sample

50 ml of sample = Y mg of CaCO3 hardness

1000 ml of sample = 1000 x Y = \_\_\_\_\_\_\_\_\_\_ 50

= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ppm of CaCO3 (Residual hardness)

**Result** : 1. Total Hardness = \_\_\_\_\_\_\_\_\_\_\_\_\_ppm.

2. Residual hardness of given water sample after softening

= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ppm.