

Practical work N°2 :

DETERMINATION OF WATER HARDNESS BY COMPLEXOMETRY



OBJECTIVES:

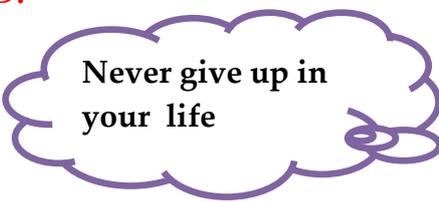
Determine the concentration of calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions in water by complexometric titration using EDTA (ethylenediaminetetraacetic acid).

PRINCIPLE:

Water hardness depends on the amount of calcium and magnesium salts present in the water. Water hardness is determined by colourimetric titration of the ion concentration with a solution of EDTA. Ethylene diamine tetra acetic acid is a strong chelating agent that 'captures' metal ions and forms Mg-EDTA and Ca-EDTA complexes.

MATERIALS AND PRODUCTS USED:

- Erlenmeyer flask (250 mL)
- Burette (50 mL)
- pipette (25 mL)
- Magnetic stirrer
- Beaker (100 mL)
- Eriochrome Black T indicator
- Ammonia buffer solution (pH 10)
- 0.01 mol.l^{-1} EDTA (ethylene diamine tetra-acetic acid) standard solution
- Water sample to be analysed



Never give up in
your life

EXPERIMENTAL PROTOCOL:

1-Preparation of the sample :

- Take 50 mL of the water sample to be analysed and place in a 250 mL Erlenmeyer flask.

2-Add the indicator:

- Add about 2 to 3 drops of Eriochrome Black T indicator to the water sample.
- The solution should turn wine red in the presence of Ca²⁺ and Mg²⁺.

3-Add the buffer solution:

- Add 5 mL of ammonia buffer solution (pH 10) to the sample.
- This step is essential to maintain the optimum pH for the reaction between the metal ions and EDTA.

4-Titration:

- Fill the burette with the 0.01 M EDTA solution.
- Place the Erlenmeyer flask containing the sample on the magnetic stirrer.
- Titrate slowly with the EDTA solution while constantly shaking the sample.
- Observe the change in color of the solution.
- The end point of the titration is reached when the color of the solution changes from wine red to blue.

QUESTIONS

- Give some of the devices used in English?
- Determine the volume of EDTA solution used to reach the end point.
- Why is the buffer solution at pH=10 used?
- Determine C_{sample} in mol/l from the volume of EDTA added.

Using the following relationship :

$$C_{sample} = V_{EDTA} \times C_{EDTA} / V_{sample}$$

- The total hardness (D) of the water is calculated using the following relationship::

$$D(^{\circ}f) = C_{\text{sample}} / X$$

When ; $C_{\text{sample}} = [\text{Ca}^{+2}] + [\text{Mg}^{+2}]$ and $X = 10^{-4} \text{ mol/l}$ (limestone)

- Measure the mass concentration of calcium and magnesium in the selected water.
- Compare the results obtained with the values indicated on the label of the water analysed.

-CONCLUSION

NOTES :

$$1^{\circ}f = 4 \text{ mg/l of Ca}^{+2} = 2.4 \text{ mg/l. of Mg}^{+2} = 10^{-4} \text{ mol/l (limestone)}$$

- Always check and calibrate the measuring instruments before starting the analysis. The temperature of the water sample can affect the titration, so it is advisable to work at room temperature.

Note:

Each student is required to bring a copy of the PW

(The telephone is forbidden).