Experiment-8: Determination of Chloride by the Mohr Method

1. Introduction

The chloride ion is one of the important negative ions found in natural waters. It imparts a salty taste to water when combined with sodium ions to form sodium chloride (table salt). Chloride salts are highly soluble in water. A high concentration of chloride ions in water can be toxic. Wastewater is generally richer in chlorides compared to distributed water because the human body excretes all the chlorides consumed in food. The recommended concentration of chlorides in water intended for human consumption is 250 mg/L.

2. Mohr method

The **Mohr method** (named after the German pharmacist **Karl Friedrich Mohr**), is a classical titration technique used to determine the concentration of chloride ions (**Cl^-**) in a solution. It is a type of precipitation titration that involves using silver nitrate **($AgNO_3$)** as the titrant and potassium chromate **(K_2CrO_4)** as an indicator.

3. Principle

3.1. Precipitation reaction : Chloride ions react with silver nitrate to form insoluble silver chloride (**AgCl**), which is white in color. Silver chloride precipitates first because its solubility product (**Ks**) is lower than that of silver chromate, as described by the following equation :

$$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3 \quad \text{(white)} \quad (1)$$

3.2. End point detection : Once all the chloride ions are precipitated, any excess silver ions react with the potassium chromate indicator to form the red precipitate of silver chromate **(Ag_2CrO_4)**, indicating the end point of the titration.

$$2AgNO_3 + K_2CrO_4 \rightarrow Ag_2CrO_4 + 2KNO_3 \quad \text{(red precipitate)} \quad (2)$$

4. Objective of the Experiment

The primary objective of the Mohr experiment is to determine the concentration of chloride ions **(Cl^-)** in a given sample using **precipitation titration**. The method is also applicable for the determination of other halide ions like bromide (**Br^-**) and cyanide (**CN^-**).

At the equivalence point :

$$n_{\mathrm{AgNO_3}} = n_{\mathrm{NaCl}} \rightarrow C_{\mathrm{AgNO_3}} \,.\, V_{\mathrm{AgNO_3}} = C_{\mathrm{NaCl}} \,.\, V_{\mathrm{NaCl}}$$

$$C_{\mathrm{NaCl}} = \frac{C_{\mathrm{AgNO_3}} \,.\, V_{\mathrm{AgNO_3}}}{V_{\mathrm{NaCl}}}$$

5. Materials

- Burette with stand and clamp.
- Graduated cylinder
- Erlenmeyer flask

6. Chemicals

- 0.01 M silver nitrate ($AgNO_3$) solution
- 10% potassium chromate (K_2CrO_4) solution
- Spring water

7. Procedure

1. Always rinse the materials with distilled water before using.

2. Fill the burette with 0.01 mol/L of $\mathbf{AgNO_3}$ solution and calibrate it to zero.

3. Using a graduated cylinder, take 50 ml of spring water and put it in erlenmeyer flask.

5. Add 5 drops of $\mathbf{K_2CrO_4}$ indicator to the erlenmeyer flask and mix well.

6. Place the erlenmeyer flask under the burette and begin the titration, adding the silver nitrate solution drop by drop while stirring.

7. When a persistent red precipitate forms that does not disappear upon stirring, close the burette valve and record the volume of silver nitrate ($AgNO_3$) consumed, denoted as $\mathbf{V_{AgNO3}}$.

8. Repeat the experience twice.