Practical Work N°2

Simple Distillation of NaCl and $KMnO_4$ Solutions

1. Objectives

- Understand the principle of simple distillation.
- Separate a volatile solvent (water) from non-volatile solutes.
- Identify the ions present before and after distillation.
- Study the temperature evolution during phase change.

2. Theoretical Principle

Simple distillation allows separation of a volatile liquid from dissolved non-volatile substances.

When heating an aqueous solution:

-Water evaporates at 100 °C.
-Dissolved ions remain in the distillation flask.

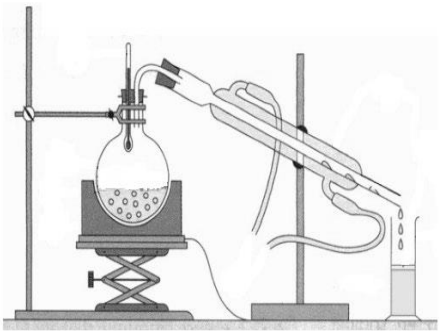

Fig 1 : Simple Distillation Setup

Case 1: Sodium chloride

$NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

Case 2: Potassium permanganate

$KMnO_4(aq) \rightarrow K^+(aq) + MnO_4^-(aq)$

During boiling, temperature remains constant at the phase change (liquid → vapor).

3. Equipment and Reagents

Equipment:

-Round-bottom flask (250 mL)
-Distillation head
-Thermometer
-Liebig condenser
-Heating plate
-Beakers -Test tubes
-Bunsen burner (flame test)
-Retort stand and clamps
-Boiling chips

Reagents:

- Aqueous NaCl solution
- Aqueous $KMnO_4$ solution
- Silver nitrate solution ($AgNO_3$)
- Acidified Fe^{2+} solution
- Distilled water

4. Sample Preparation

- Prepare 100 mL of NaCl solution (≈ 0.5 – 1 M).
- Prepare 100 mL of $KMnO_4$ solution (dilute violet solution).

5. Experimental Protocol

Step 1: Ion detection before distillation

NaCl solution

- Add $AgNO_3$ → white precipitate (AgCl) → presence of Cl^-
- Perform flame test (NaCl + methanol) → yellow flame → presence of Na^+

$KMnO_4$ solution

- Observe purple color → presence of MnO_4^-
- Add acidified Fe^{2+} → decolorization → confirmation of MnO_4^-
- Flame test ($KMnO_4$+methanol)→ light purple flame → presence of K^+

Step 2: Distillation Setup

- Introduce 100 mL of solution into the flask.
- Add boiling chips.
- Start water circulation in condenser.

Step 3: Heating and Data Collection

- Heat gradually.
- Record temperature every minute.
- Maintain a distillation rate of 1–2 drops/sec.
- Collect the distillate.

Step 4: Ion detection after distillation

Perform the same tests on the distillate:

- $AgNO_3$ test
- Fe^{2+} test
- Flame test
- Visual observation

6. Results

Expected observations:

- Distillate is colorless.

- No precipitate with $AgNO_3$.
- No reaction with Fe^{2+}.
- No characteristic flame coloration.
- Temperature increases then stabilizes at ~100 °C.

Graph:
Temperature (°C) vs Time (min)
→ Increasing curve followed by a plateau at boiling point.

7. Questions

1. Why is the distillate colorless?
2. complete the following reactions

$$NaCl + AgNO_3 \longrightarrow ? + ?$$

$$FeCl_2 + KMnO_4 \xrightarrow{H^+} ? + ? + ?$$

3. Why do dissolved ions not evaporate?
4. What does the temperature plateau represent?
5. Why are boiling chips added?
6. What would happen if the solute were volatile?
7. What is the difference between simple and fractional distillation?
8. Can distillation remove all impurities from water? Explain.