EXPERIMENT

Titration of Hydrochloric Acid (HCl) with Sodium Hydroxide (NaOH)

Aim:- To determine the normality and strength of a given solution of Hydrochloric acid (HCl) using standard Sodium hydroxide (NaOH) solution.

Reference:- Indian Pharmacopoeia by Ministry of Health And Family Welfare, Gov. of India, Volume I 2007, P-316.
Practical book of Pharmaceutical Chemistry, Fourth edition edited by A.H Beckett, J.B Stenlake, CBS Publishers and Distributors, 2005 P-217.

Requirements:

- **Chemical Requirement:-** Standard NaOH solution (0.1 N), HCl solution (unknown strength), Phenolphthalein indicator.
- **Glassware Requirement:-** Conical flask, Burette ,Pipette ,Water bath, Burner ,Measuring Cylinder ,Beaker ,Dropper , Glass rod ,Butter paper.

Principle

The titration between HCl and NaOH is an **acid-base neutralization reaction**. The reaction is:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

The equivalence point is detected using **phenolphthalein indicator**, which changes from **pink (in base)** to **colorless (in acid)**.

Procedure

1. Rinse the **burette** with HCl solution and fill it with the same.
2. Rinse the **pipette** with NaOH solution and transfer **20 mL** of NaOH into a **conical flask**.
3. Add **2–3 drops of phenolphthalein indicator** to the NaOH in the flask. → The solution will appear **pink**.
4. Titrate the NaOH against HCl by **adding acid from the burette** slowly with constant swirling.
5. Near the endpoint, add HCl **drop by drop** until the pink color just disappears, indicating the endpoint.
6. Note the **burette reading**.
7. Repeat the titration 3 times to get **concordant readings**.

Observation Table

S. No.	Initial Burette Reading (mL)	Final Burette Reading (mL)	Volume of HCl Used (mL)
1	0.0	19.8	19.8
2	0.0	20.0	20.0
3	0.0	19.9	19.9

Concordant value = 19.9 mL

Calculations

Let,

- Normality of NaOH (N_1) = 0.1 N
- Volume of NaOH (V_1) = 20.0 mL
- Volume of HCl (V_2) = 19.9 mL
- Normality of HCl (N_2) = ?

According to the law of equivalence:

$$N_1 V_1 = N_2 V_2$$

$$0.1 \times 20.0 = N_2 \times 19.9$$

$$N_2 = \frac{0.1 \times 20.0}{19.9} = 0.1005\,N$$

To Find Strength of HCl

$$\text{Strength (g/L)} = \text{Normality} \times \text{Equivalent weight of HCl}$$

Equivalent weight of HCl = 36.5 g

$$\text{Strength} = 0.1005 \times 36.5 = 3.67\,g/L$$

Result:- The Normality of HCl solution = 0.1005 N, Strength of HCl solution = 3.67 g/L

Viva voce questions

1. What is the principle of this titration?
2. Why is phenolphthalein used as an indicator here?
3. Why do we add indicator only 1–2 drops?
4. What is the purpose of titration?
5. What type of error can occur during titration?