Experiment No. 7

Object: To determine the amount of sodium hydroxide (NaOH) and sodium carbonate (Na_2CO_3) in the given alkali mixture (or in water sample) by titrating against an intermediate hydrochloric acid (HCl) using phenolphthalein and methyl orange as indicators.

Apparatus/ Reagent required: Burette, pipette, mixed alkali (NaOH + Na_2CO_3) solution, hydrochloric acid (N/40), phenolphthalein, methyl orange, sodium carbonate solution.

Theory: It is a double indicator titration method , hence different indicators are used at two different stages of the titration. In this titration when sodium carbonate and sodium hydroxide mixture solution is titrated with hydrochloric acid, the neutralization occur in two stages. In the first stage, sodium hydroxide is completely neutralized while Na_2CO_3 partially neutralized.

Phenolphthalein is used as an indicator.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

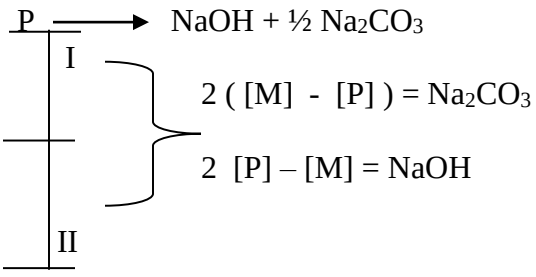
$$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$$

$$NaHCO_3 + NaCl \longrightarrow NaCl + H_2O + CO_2$$

At the first end point [P] the pink colour of phenolphthalein disappears with change of pH 8.3 – 10.0. At this stage indicator methyl orange is added and the titration is continued. At the next end point [M] the yellow colour of the solution turn to cherry red in the pH- range 3.1 – 4.4

Here reading [M] means total volume of HCl used, from the beginning of the experiment.

$[P] = NaOH + (1/2)\ Na_2CO_3$
$[M] = NaOH + Na_2CO_3$
$[M] - [P] = (1/2)\ Na_2CO_3$



Procedure:

1. Wash the apparatus with distilled water.

2. Prepare solution of Na_2CO_3 in volumetric flask. Standardize the intermediate HCL solution.
3. Rinse the burette with HCl solution, then fill the burette with HCL solution, make sure there are no air bubbles in the burette.
4. Note down the burette reading.
5. Rinse the pipette with mixed alkali solution. Transfer 10ml of mixed alkali solution to washed conical flask.
6. Add 2 - 3 drops of phenolphthalein indicator to mixed alkali solution in conical flask, a pink colour is appeared.
7. Add HCL from burette solution drop wise with constant shaking, observe the colour change.
   The disappearance of pink colour indicates the first end point [P].
8. Add 2 - 3 drops of methyl orange. Continue the titration with same solution in the conical flask.
9. Add more HCL from burette drop - wise into mixed alkali solution and observe the colour change. The change of colour from yellow to cherry red indicates the second end point. Note down the burette reading [M].
10. Repeat the titration till concordant readings are obtained.

Observation:

Titration between unknown mixed alkali solution and standardized HCL

	Volume of mixed alkali aq. solution (ml)	Volume of HCl aq. solution (ml) (burette reading)			Concordant reading (ml) [P]	Concordant reading (ml) [M]
		Initial	phenolphthalein end point [P]	Methyl orange end point [M]		
	10 10 10	0.0 0.0 0.0				

Calculation:

Calculation for strength of NaOH

HCL	NaOH
N_1V_1	N_2V_2

N_1 = Normality of HCL = N/40
V_1 = Volume of HCL consumed with NaOH only = [2P– M]
N_2 = Normality of NaOH
V_2 = Volume of alkali mixture taken (10 ml)

Strength of NaOH in alkali mixture (gm/L) = N_2 × equivalent weight of NaOH
= N_2 × 40

Calculation for strength of Na_2CO_3

HCL Na_2CO_3
N_1V_1' = N_3V_3

N_1 = Normality of HCL = N/40
V_1' = Volume of HCL consumed with Na_2CO_3 only (***i.e***- 2 [M - P])
N_3 = Normality of Na_2CO_3
V_3 = Volume of alkali mixture taken (10 ml)

Strength of Na_2CO_3in alkali mixture (gm/L) = N_3 × equivalent weight of Na_2CO_3
= N_3 × 53

Result: Alkalinity of given water sample due to:

1. Presence of Na_2CO_3 = …….gm/L
2. Presence of NaOH = …….gm/L

Precautions:

1. Solution titrated must be cold enough.
2. Use indicator carefully (only 1-3 drops).
3. Loss of CO_2 must be prevented by keeping the tip of the burette immersed in the solution present in the conical flask.
4. Observe decolourisation of phenolphthalein indicator at the end point carefully.\

Viva-Voce Questions:
1. What do you mean by Alkalinity?
2. Which ions are responsible for the alkalinity of water?
3. Name of the indicator used in this experiment?
4. What will be the colour of phenolphthalein and methyl orange indicator in acidic and basic medium?
5. Why hydroxide ions and bicarbonate ions cannot be mix together?
6. Name of the type of titration used in the estimation of alkalinity in water?