Experiment no: 3

Titration of Na_2CO_3 + $NaHCO_3$ mixture vs HCl using phenolphthalein and methyl orange indicators

Theory

The neutralisation of Na_2CO_3 by HCl occurs in two steps:

$$Na_2CO_3 + HCl = NaHCO_3 + NaCl$$

$$NaHCO_3 + HCl = NaCl + CO_2 + H_2O$$

After half neutralisation of Na_2CO_3, i.e. after complete conversion of Na_2CO_3 into $NaHCO_3$, the pH of the solution falls below 8.5 and so the pink colour of phenolphthalein disappears. Methyl orange can indicate the alkaline nature of $NaHCO_3$. So, after complete neutralization, titration is again carried out in presence of methyl orange indicator.

Procedure

(a) 25 ml of the supplied solution was pipetted out into a 250 ml conical flask. Then, 2 drops of phenolphthalein indicator was added and it was diluted to 100 ml with distilled water. The solution was then titrated with standardized HCl solution by adding dropwise from a burette with constant shaking (or stirring) until the pink color just disappears. Burette reading was then recorded as listed in Table 1.

Table 1

Titration of supplied solution vs. hydrochloric acid solution using phenolphthalein indicator

No. of titrations	Volume of supplied solution taken in ml	Volume of sulphuric acid solution required in ml			
		Initial reading	Final reading	Difference	Average (V_1)
1	25	0	10.6	10.6	10.57
2	25	0	10.5	10.5	
3	25	0	10.6	10.6	

(b) 25 ml of the supplied solution was again pipetted out into a 250 ml conical flask. Then, 2 drops of methyl orange indicator was added and it was diluted to 100 ml with distilled water. The solution was then titrated with standardized HCl solution by adding dropwise from a burette with constant shaking (or stirring) until the colour changes from light yellow to pale red. Burette reading was then recorded as listed in Table 2.

Table 2

Titration of supplied solution vs. hydrochloric acid solution using methyl orange indicator

No. of titrations	Volume of supplied solution taken in ml	Volume of sulphuric acid solution required in ml			
		Initial reading	Final reading	Difference	Average (V_2)
1	25	0	27.2	27.2	27.13
2	25	0	27.1	27.1	
3	25	0	27.1	27.1	

Given Normality of HCl solution = 0.102 (N)

Calculation

Na_2CO_3 in 25 ml mixture = $2 \times V_1$ ml of 0.102(N) HCl
= 2×10.57 ml of 0.102(N) HCl
= $2 \times 10.57 \times 0.102$ ml of (N) HCl
= $2 \times 10.57 \times 0.102$ ml of (N) Na_2CO_3
= $2 \times 10.57 \times 0.102 \times 0.053$ gm Na_2CO_3
= 0.114 gm Na_2CO_3

$NaHCO_3$ in 25 ml mixture = (V_2-2V_1) ml of 0.102(N) HCl
= (27.13-2×10.57) ml of 0.102(N) HCl
= 5.99 ml of 0.102(N) HCl
= 0.611 ml of (N) HCl
= 0.611 ml of (N) $NaHCO_3$
= 0.611×0.084 gm $NaHCO_3$
= 0.050 gm $NaHCO_3$

Result

Therefore, the given sample contains 0.114 gm of Na_2CO_3 and 0.050 gm of $NaHCO_3$

Lab Precautions

1. During titration, the conical flask was constantly swirled.
2. It was always ensured that there are no air bubbles in the burette.
3. For each titration, same number of the drops of indicator was used
4. A white paper was used under the flask during titration to clearly observe the end point.