Engineering Chemistry

CYC 102

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Overview

- **Numerical based on Alkalinity**
- **Summary**

Numerical based on Alkalinity

1. 100 mL of a water sample required 20 mL of N/50 H_2SO_4 for neutralization to phenolphthalein endpoint. After this, methyl orange indicator was added to this and further acid required was again 20 mL. Calculate the alkalinity of water as $CaCO_3$ in ppm.

Solution:

- Volume of N/50 H_2SO_4 required to neutralize100 mL water to phenolphthalein end-point V1 = 20 mL.

$$\mathbf{P = \frac{V1 \times N \times 50{,}000\ mg}{volume\ of\ water\ (V)}\ mg\ CaCO_3/L}$$

Where, V1 is the volume in mL of the standard acid used

N is the normality of the standard acid used

50, 000 is a conversion factor to change the normality into units of mg CaCO3/L.

Numerical based on Alkalinity…Contd.

Phenolphthalein alkalinity, $P = \frac{20 \times 0.02 \times 50{,}000\ mg}{100}$ **mgCaCO$_3$/L**

= 200 mg/L

Now 100 mL of water up to methyl orange end-point = 20 + 20 = 40 mL N/50 H2SO4

Total alkalinity, $T = \frac{[20+20] \times 0.02 \times 50{,}000\ mg}{100}$ **mgCaCO$_3$/L**

= 400 mg/L

Now, P = 200 mg/L = ½ T [½ × 400], so the alkalinity is only due to CO_3^{2-}.

(a) $CO_3^{2-} + H^+ \rightarrow HCO_3^- \cdot P$

(b) $HCO_3^- + H^+ \rightarrow H_2O + CO_2]T$

Hence, total alkalinity (due to CO_3^{2-} only), T, is 400 mg/L

Numerical based on Alkalinity…Contd.

2. 50 mL of sample of water required 5 mL of N/50 H2SO4 using methyl orange as indicator but did not give any coloration with phenolphthalein. What type of alkalinity is present? Express the same in ppm.

Solution:

As the water sample does not give any coloration with phenolphthalein (P = 0), hence only HCO_3^- are present.

Now, 50 mL of water sample upto methyl orange end point = 5 mL of N/50 H2SO4

$$\therefore 50\ mL \times Nm = 5\ mL \times \frac{N}{50}$$

Normality, Nm = 5 mL × N/50 × 1/50 = 1/500 N

Numerical based on Alkalinity…Contd.

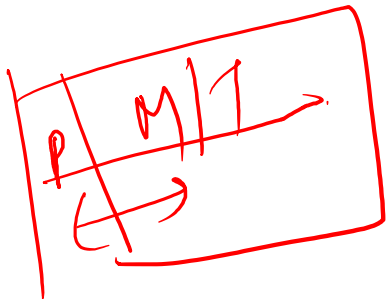
Now, strength of alkalinity upto methyl orange end point (in terms of CaCO3 equivalents)

= (Nm × 50)g/L

M = 1/500 × 50 g/L × 1000 gm/g

M = 100 mg /L = 100 ppm

Hence, alkalinity due to HCO_3^- = M=100 ppm



Summary

- Phenolphthalein and total alkalinity can be estimated
- Hydroxide, carbonate, bicarbonate ions can be identified along with the concentration based on alkalinity.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Thank You!