



Engineering Chemistry

CYC 102

Dr. Sukriti

School Of Basic Sciences

Indian Institute of Information Technology, Una
Himachal Pradesh



Overview

- ✓ **Alkalinity: Introduction**
- ✓ **Determination of alkalinity**
- ✓ **Types of alkalinity in water**
- ✓ **Drawbacks of high alkalinity**
- ✓ **Summary**



Alkalinity: Introduction

- Alkalinity measures the acid-neutralizing capacity of a water sample
- Substances which increased $[\text{OH}^-]$ upon dissociation or due to hydrolysis.
- Alkalinity of water is due to:
 - ✓ Caustic alkalinity (due to OH^- to CO_3^{2-} ions)
 - ✓ Temporary hardness (due to HCO_3^-)
- ✓ Alkalinity is used to determine the suitability of water:
 - ✓ For Irrigation and Industrial Use
 - ✓ Raw Water Characterization
 - ✓ Wastewater Monitoring
 - ✓ Body Resistivity



Determination of alkalinity

- 100 mL of sample taken in 250 mL conical flask
- Record initial pH of the sample.
- If the pH is above 8.3, add several drops of phenolphthalein indicator.
- Titrate the sample with 0.02 N H₂SO₄ or HCl until the pH end-point (colourless) is reached.
- Total volume (V₁ mL) of acid needed to reach the end-point is recorded.
- Phenolphthalein alkalinity, P.

$$P = \frac{V_1 \times N \times 50,000 \text{ mg}}{\text{volume of water (V)}} \text{ mg CaCO}_3/\text{L}$$

Where,

V₁ is the volume in mL of the standard acid used

N is the normality of the standard acid used

[50 × 1000] = 50,000 is a conversion factor to change the normality into units of mg CaCO₃/L.



Determination of alkalinity...Contd.

- If pH is below 8.3, add several drops of bromocresol green indicator.
- Titrate the water sample with 0.02 N H₂SO₄ or HCl until the pH 4.5 end-point (colour changes from blue to yellow) is reached.
- Volume (V₂) of acid needed to reach the endpoint noted.

• Total alkalinity, T:

$$T = \frac{V \times N \times 50,000 \text{ mg}}{\text{volume of water (V)}}$$

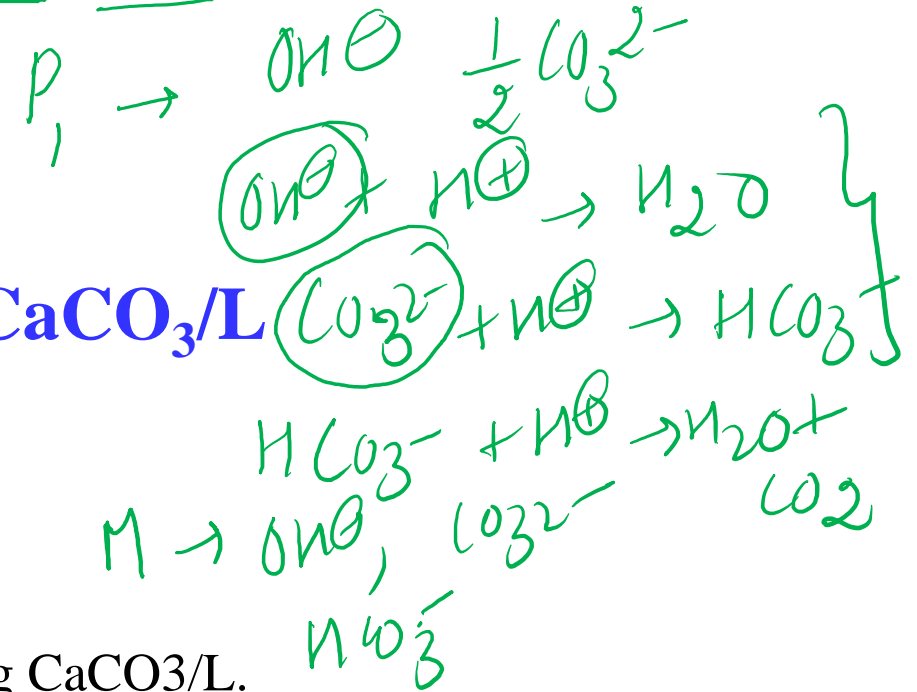
mg CaCO₃/L

Where,

V = (V₁ + V₂), is the total 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.

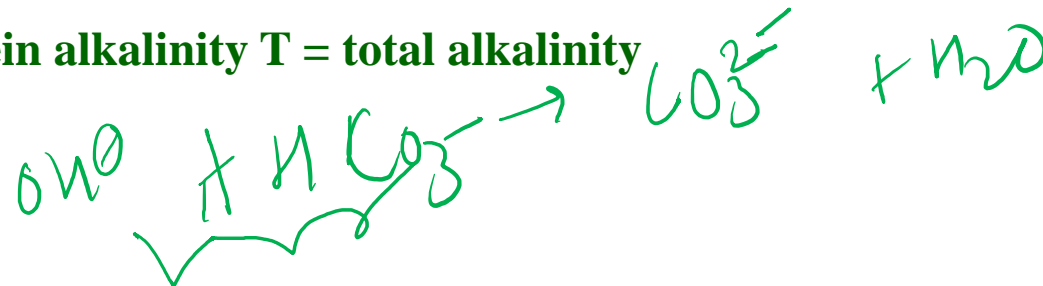




Types of alkalinity in water

Result of titration	Hydroxide alkalinity as CaCO_3	Carbonate alkalinity as CaCO_3	Bicarbonate alkalinity as CaCO_3
$P = 0$	0	0	T
$P < \frac{1}{2}T$	0	$2P$	$T - 2P$
$P = \frac{1}{2}T$	0	$2P$	0
$P > \frac{1}{2}T$	$2P - T$	$2(T - P)$	0
$P = T$	T	0	0

Where, P = phenolphthalein alkalinity T = total alkalinity





Drawbacks of high alkalinity

- ✓ Caustic embrittlement
- ✓ Deposition of precipitates and sludge in boiler tubes.



Summary

- Alkalinity is acid-neutralizing capacity of a water sample
- ✓ • Hydroxide, carbonate and bicarbonate ion main ions.
- ✓ • Phenolphthalein alkalinity corresponds to OH^- and $\frac{1}{2}$ of CO_3^{2-}
- ✓ • Total alkalinity represents OH^- , CO_3^{2-} and HCO_3^-
- ✓ • Excess alkalinity is harmful.



Thank You!