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 whic increased [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.**

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

Where,

V1 is the volume in mL of the standard acid used

N is the normality of the standard acid used

[50 × 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:**

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

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 = O	O	O	T
P < ½T	O	2P	T – 2P
P = ½T	O	2P	O
P > ½T	2P – T	2 (T – P)	O
P = T	T	O	O

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 ½ of CO_3^{2-}
- Total alkalinity represents OH^-, CO_3^{2-} and HCO_3^-
- Excess alkalinity is harmful.


भारतीय सूचना प्रौद्योगिकी संस्थान, ऊना
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, UNA
विद्या सर्वत्र गौरवं

Thank You!