

## **Experiment Name: Determining Alkalinity in Wastewater**

### **Objective**

To determine the alkalinity of wastewater samples by titration, in accordance with Indian Standard **IS 3025 (Part 23): 1986**, reaffirmed in 2003.

### **Scope**

This method is applicable to all types of wastewater to determine alkalinity, which reflects the presence of hydroxides, carbonates, and bicarbonates.

### **Principle**

The alkalinity of wastewater is measured by titration with standard acid using indicators such as phenolphthalein and methyl orange to determine various forms of alkalinity.

### **Apparatus**

1. **Conical flask** (250 mL)
2. **Burette** (50 mL capacity)
3. **Pipette** (10 or 20 mL)
4. **Measuring cylinder** (100 mL)
5. **Beaker** (100 mL)
6. **Glass rod**
7. **Wash bottle**

### **Reagents**

1. **Standard Sulphuric Acid ( $\text{H}_2\text{SO}_4$ ), 0.02 N**
  - Standardize the acid solution using sodium carbonate.
2. **Phenolphthalein Indicator**
  - Dissolve 0.5 g of phenolphthalein in 50 mL of ethyl alcohol and dilute to 100 mL with distilled water.
3. **Methyl Orange Indicator**
  - Dissolve 0.5 g of methyl orange in 100 mL distilled water.
4. **Distilled Water** (free from carbon dioxide)

### **Procedure**

#### **Preparation of the Sample**

- Collect a representative wastewater sample in a clean bottle.

- Filter the sample (if turbid) to remove suspended solids.

### Titration Process

1. **Take the sample:** Pipette **25 mL** of wastewater into a conical flask.
2. **Phenolphthalein Alkalinity (P):**
  - Add **2-3 drops** of phenolphthalein indicator.
  - If the solution turns **pink**, titrate with **0.02 N H<sub>2</sub>SO<sub>4</sub>** until the pink color just disappears. Record the burette reading as **V1**.
  - If no pink color develops, phenolphthalein alkalinity is zero.
3. **Total Alkalinity (T):**
  - Add **2-3 drops** of methyl orange indicator to the same sample (after phenolphthalein titration).
  - Titrate with **0.02 N H<sub>2</sub>SO<sub>4</sub>** until the color changes from yellow to **orange** (or light pink). Record the burette reading as **V2**.
4. **Final Observations:**
  - Phenolphthalein alkalinity (P) = V1 mL
  - Total alkalinity (T) = V2 mL

### Observation Table

S.No.	Vol. of Sample	Burette Reading		Vol. of H <sub>2</sub> SO <sub>4</sub> used (V)
		initial	final	

### Calculations

The alkalinity is expressed as **mg/L of CaCO<sub>3</sub>** using the following formulae:

1. **Phenolphthalein Alkalinity (as CaCO<sub>3</sub>):**

$$P = V_1 \times N \times 50,000 / V_s$$

## 2. Total Alkalinity (as CaCO<sub>3</sub>):

$$T = V_2 \times N \times 50,000 / V_s$$

Where:

- **V<sub>1</sub>** = Volume of H<sub>2</sub>SO<sub>4</sub> used for phenolphthalein alkalinity (mL)
- **V<sub>2</sub>** = Volume of H<sub>2</sub>SO<sub>4</sub> used for total alkalinity (mL)
- **N** = Normality of H<sub>2</sub>SO<sub>4</sub> (0.02 N)
- **V<sub>s</sub>** = Volume of sample taken (mL, typically 25 mL)

## Reporting Alkalinity:

- Report the results as **Phenolphthalein Alkalinity** and **Total Alkalinity** in mg/L as CaCO<sub>3</sub>.
- If **P = 0**, only total alkalinity is reported.

## Results

Record the following:

Sample ID	Phenolphthalein Alkalinity (mg/L)	Total Alkalinity (mg/L)

## Conclusion

This procedure allows for the accurate determination of alkalinity in wastewater samples, which is crucial for assessing water quality and treatment processes.

## Precautions

1. Use freshly prepared indicators and standardized H<sub>2</sub>SO<sub>4</sub>.
2. Ensure the glassware is clean and rinsed with distilled water.
3. Avoid contamination of the sample during collection and testing.
4. Perform titration slowly near the endpoints for accuracy.
5. Use distilled water free from CO<sub>2</sub>.

## References

1. **IS 3025 (Part 23): 1986** - Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater.
2. Standard Methods for the Examination of Water and Wastewater, APHA.