# 1. DETERMINATION OF ALKALINITY OF WATER

**AIM:**

To determine the alkalinity of the given water sample.

**PRINCIPLE:**

Alkalinity is primarily a way of measuring the acid-neutralizing capacity of water. In other words, its ability to maintain a relatively constant pH value. The possibility to maintain constant pH is due to the Hydroxide ($OH^-$), Carbonate $(CO_3)^{2-}$ and Bicarbonate $(HCO_3)^-$ ions present on the water.

The alkalinity of water can be determined by titrating the water sample with sulphuric acid of known values of pH, volume and concentrations. When the water sample is mixed with phenolphthalein indicator which turns the solution into pink colour due to the presence of hydroxyl ions. If sulphuric acid is added to it, the pink colour disappears. i.e., $OH^-$ ions are neutralized. Then addition methyl orange indicator for the presence of $CO_3^{2-}$ and $HCO_3^-$ ions in the solution changes the colour to yellow. While adding sulphuric acid, the colour changes into faint orange. This colour change indicates that all the $CO_3^{2-}$ and $HCO_3^-$ ions have been neutralized. Based on the known concentrations of Sulphuric acid, the alkalinity of water sample will be calculated.

**ENVIRONMENTAL SIGNIFICANCE:**

Alkalinity is important for fish and aquatic life. Because it protects or buffers against rapid pH changes. Higher alkalinity levels in surface waters will buffer acid rain and other acid wastes and prevent pH changes that are harmful to aquatic life.

A large amount of alkalinity imparts bitter taste in water.

The principal objection of alkaline water is the reactions that can occur between alkalinity and certain cations in water. The resultant precipitate can corrode pipes and other accessories of water distribution systems.

Wastewaters containing excess caustic (hydroxide) alkalinity are not to be discharged into natural water bodies or sewers.

**MATERIALS REQUIRED:**

**Apparatus Required**

1. Burette with burette stand and porcelain tile
2. Pipettes with elongated tips
3. Pipette bulb
4. Conical flask
5. 250 ml Measuring cylinder
6. Standard flask
7. Beakers

**Chemicals Required**

1. Standard sulphuric acid
2. Phenolphthalein
3. Methyl orange
4. Distilled water

**Sample Handling and Preservation**

Preservation of the sample is not practical. Because biological activity will continue after a sample has been taken. Changes may occur during handling and storage. To reduce the change on the sample, keep all the sample at 4°C. Do not allow samples to freeze. Do not open the sample bottle before analysis. Begin analysis as soon as possible.

**Precautions**

Following precautions should be observed while experimenting.

1. Do not keep an indicator solution open since it contains the alcohol which tends to evaporate.
2. Indicator solutions contains dye in it. Care should be taken so that it is not spilt on to our skin.
3. If it spills on our skin, the scar will remain at least for two to three days.

**PROCEDURE**

**Preparation of reagents**

Sulphuric Acid Solution (0.02N)

1. Take approximately 50 ml of distilled water in a 100 ml standard flask.
2. Pipette 20 ml of Concentrated 0.1 N sulphuric acid and add slowly along the sides of the standard flask.
3. Then make up the volume to 100 ml mark. Now the strength of this solution is 0.02 N.

Phenolphthalein Indicator Preparation

Weigh 1g of phenolphthalein and add to 100 ml of 95% ethyl alcohol or 100 ml of distilled water.

Testing of Water Sample

- Rinse the burette with 0.02N Sulphuric acid and discard the solution
- Fill the burette with 0.02N Sulphuric acid and adjust it to zero.
- Fix the burette in stand
- Using a measuring cylinder exactly measure 100 ml of sample and pour it into 250 ml of the conical flask.
- Add a few drops of phenolphthalein indicator to the contents of the conical flask. The colour of the solution will turn to pink. This colour change is due to the alkalinity of hydroxyl ions in the water sample.
- Titrate it against 0.02 N sulphuric acid till the pink colour disappears. This indicates that all the hydroxyl ions are removed from the water sample. Note down the titre value($V_1$). This is used for calculating the phenolphthalein alkalinity.
- To the same solution in the conical flask add few drops of methyl orange indicator. The colour of the solution turns to yellow.
- Continue the titration from the point were stopped for the phenolphthalein alkalinity. Titrate till the solution becomes faint orange. The entire volume of sulphuric acid ($V_2$) is noted down and it is accountable in calculating the total alkalinity.
- Repeat the titration for the concordant values.

**TABULATATION I:**

| S.No | Volume of Sample | Burette Reading (Phenolphthalein Indicator) | | Volume of $H_2SO_4$ |
|---|---|---|---|---|
| | | Initial | Final | |
| | | | | |
| | | | | |
| | | | Concordant Value | |

**TABULATATION II:**

| S.No | Volume of Sample | Burette Reading (Methyl Orange Indicator) | | Volume of $H_2SO_4$ |
|---|---|---|---|---|
| | | Initial | Final | |
| | | | | |
| | | | | |
| | | | Concordant Value | |

**CALCULATION :**

Phenolphthalein Alkalinity= $\frac{V1\ x\ N\ x\ 50\ x\ 1000}{Volume\ of\ Sample}$

Methyl orange Alkalinity= $\frac{V2\ x\ N\ x\ 50\ x\ 1000}{Volume\ of\ Sample}$

Total Alkalinity= Phenolphthalein alkalinity+ Methyl orange alkalinity

**RESULT**

The total alkalinity of the given water sample is -------mg/L

**INFERENCE**

Alkalinity is a measure of the capacity of water to neutralize acids. The predominant chemical system present is natural waters is one where carbonates, bicarbonates and hydroxides are present. The bicarbonate ion is usually prevalent. However, the ratio of there ions is a function of pH, mineral composition, temperature and ionic strength. Water may have low alkalinity rating but a relatively high pH or vice versa. So, alkalinity alone is not of major importance as a measure of water quality. Alkalinity is not considered detrimental to humans but is generally associated with high pH values, hardness and excess dissolved solids. High alkalinity waters may also have a distinctly flat, unpleasant taste. Based on the testing, it is found that the alkalinity o the sample is _____mg/L. As per the provisional code alkalinity should not exceed 200mg/L for portable water. For the freshwater alkalinity ranges between 20-100 mg/L. The alkalinity of the tested sample is within the limits specified in the standards hence the water sample is fit (Or Not Fit) for drinking.