pH

pH is a way of expressing the hydrogen-ion concentration of a solution. As acids and bases in solution dissociate to yield hydrogen ions [H+] and hydroxyl ions [OH-] respectively, pH is used to indicate the intensity of the acidic or alkaline condition of a solution.

Alkalinity is a measure of the acid-neutralizing capacity of dissolved substances in water and equals the amount of strong acid required to lower the solution from initial pH to about 4.5. Many materials may contribute to the alkalinity of water. For most practical purposes, it is due primarily to presence of salts of weak acids (mainly bicarbonate and carbonate) and hydroxide (at high pH).

pH and alkalinity are key water quality parameters in environmental engineering practice. In the water supply and treatment fields, these parameters have great influence on the chemical coagulation, disinfection and softening processes, and corrosion control for water distribution pipe networks. Effective chemical coagulation of water, for instance, occurs only within a specific pH range. Chemicals used for coagulation release, as a by-product of their reactions with water to form insoluble hydroxide precipitates, hydrogen ions (acid-causing). If unchecked, these hydrogen ions could lower the pH of the water sufficiently to render the coagulants ineffective. The presence of sufficient amount of alkalinity in the water can react and remove the hydrogen ions released by the coagulants, thus buffering the water in the pH range where the coagulant can be effective.

In pure water, water molecules dissociate into equal amounts of hydrogen and hydroxyl ions (10-7 moles/L). From the law of mass action, it can be shown that, for pure water at about 25°C:

$[H^+] [OH^-] = Kw = 10^{-14}$

The pH value of a solution has been defined to be the negative log of the hydrogen ion concentration:

$pH = -\log[H^+]$

The pH scale runs from 0 to 14, with pH 7 representing neutrality. Acid conditions increase as pH values decrease, and alkaline (base) conditions increase as the pH values increase. Measurement of the hydrogen ion concentration is made by pH meters via a glass electrode and a calomel reference electrode.

2. Steps of the Experiment

1. Calibrate the pH meter according to instructions supplied by the Lab staff.

2. Pour sample into a clean beaker.

3. Rinse the probe thoroughly with distilled water to prevent any carry-over. Switch to

pH mode.

4. Immerse the probe in the sample.

5. Establish equilibrium between probe and sample by stirring to insure homogeneity. Gently drop a stirring bar into the sample and place the beaker on a magnetic stirrer. Start the magnetic stirrer and adjust the speed to give thorough but gentle mixing.

6. Read and record the pH.

7. Rinse the electrode thoroughly with distilled water.

8. When not in use, the electrode should be replaced in the beaker containing water.

ACİDİTY

Acidity is a measure of the capacity of water to neutralise bases. Acidity is the sum of all titrable acid present in the water sample. Strong mineral acids, weak acids such as carbonic acid, acetic acid present in the water sample contributes to acidity of the water. Usually dissolved carbon dioxide (CO_2) is the major acidic component present in the unpolluted surface waters.The volume of standard alkali required to titrate a specific volume of the sample to pH 8.3 is called phenolphthalein acidity (Total Acidity).

The volume of standard alkali required to titrate a specific volume of the water sample (wastewater and highly polluted water) to pH 3.7 is called methyl orange acidity (Mineral Acidity).

Acidity interferes in the treatment of water. Carbon dioxide is of important considerations in determining whether removal by aeration or simple neutralisation with lime /lime soda ash or NaOH will be chosen as the water treatment method.

The size of the equipment, chemical requirements, storage spaces and cost of the treatment all depends on the carbon dioxide present. Aquatic life is affected by high water acidity. The organisms present are prone death with low pH of water.

High acidity water is not used for construction purposes. Especially in reinforced concrete construction due to the corrosive nature of high acidity water. Water containing mineral acidity is not fit for drinking purposes.

Industrial wastewaters containing high mineral acidity is must be neutralized before they are subjected to biological treatment or direct discharge to water sources.

Hydrogen ions present in a sample as a result of dissociation or hydrolysis of solutes reacts with additions of standard alkali (NaOH). Acidity thus depends on end point of the indicator used.

The colour change of phenolphthalein indicator is close to pH 8.3 at 25^{o}C corresponds to stoichiometric neutralisation of carbonic acid to bicarbonate.

1. Experimental Procedure
1.1. Materials and Equipment
A. Apparatus Required

1. Burette with Burette stand
2. porcelain tile
3. 500 mL conical flask
4. Pipette with elongated tips
5. Pipette bulb
6. Conical flask
7. Measuring cylinders
8. Wash Bottle and Beakers

B. Chemicals Requıred

1. Sodium Hydroxide
2. Phenolphthalein
3. Methyl Orange
4. Ethyl alcohol
5. Distilled Water

Sample Handlıng And Preservatıon

- Preservation of 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 in samples, keep all samples at 4o C. Do not allow samples to Freeze.
- Analysis should begin as soon as possible.
- Do not open sample bottle before analysis.

Precautıons

- Colored and turbid samples may interfere in end point. Those samples may be analyzed electrometrically, using pH meter.
- Do not keep the indicator solution open since it contains the alcohol which tense to evaporate. The mixed indicator solution is containing die in it. Care should be taken so that it is not spill to your skin. If it spills on your skin the scare will remain for at least 2 to 3 days.
- Presence of residual chlorine may interfere in the colour response, which can be nullified by addition of small amount of sodium thiosulphate or destroy it with ultraviolet radiation.
- Presence of iron and aluminum sulphate may interfere in the colour response while titrating in room temperature, which can be nullified by titrating the sample at boiling temperature.
- Dissolved gases contributing to acidity such as CO_2, H_2S may interfere in the titration, hence avoid vigorous shaking.
- Samples suspected to have hydrolysable metal ions or reduced forms of polyvalent cations need hydrogen per oxide treatment.

Preparatıon Of Reagents

Sodium Hydroxide (0.02 N)

- Take 1000 mL standard measuring flask and fill 3/4th of it with distilled water.
- Accurately measure 20 mL of 1N sulphuric acid solution using a pipette and transfer to 1000 mL standard flask containing the distilled water. Make up to 1000 mL using distilled water.

Phenolphthalein Indicator

- Weigh accurately 1 g of phenolphthalein and dissolve it in 95% ethyl alcohol.
- Take 100 mL standard measuring flask and place a funnel over it.
- Transfer it to the 100 mL standard flask and make up to 100 mL using 95% ethyl alcohol.

Methyl Orange Indicator

- Weigh accurately 1 g of methyl and dissolve it in distilled water.
- Take 100 mL standard measuring flask and place a funnel over it.
- Transfer it to the 100 mL standard flask and make up to 100 mL using distilled water.

2. Steps of the Experiment

 Rinse the burette with 0.02N sodium hydroxide and then discard the solution.

 Fill the burette with 0.02N sodium hydroxide and adjust the burette.

 Fix the burette to the stand.

 A sample size is chosen as the titre value does not exceed 20mL of the titrant. For highly concentrated samples, dilute the sample. Usually, take 100 mL of a given sample in a conical flask using pipette.

 Add few drops of methyl orange indicator in the conical flask.

 The colour changes to orange. Now titrate the sample against the 0.02N sodium hydroxide solution until the orange colour faints.

 Note down the volume (V1) consumed for titration.This volume is used for calculating the mineral acidity.

 To the same solution in the conical flask add few drops of phenolphthalein indicator.

 Continue the titration, until the colour changes to faint pink colour.

 Note down the total volume (V2) consumed for titration. This volume is used for calculating the total acidity.

 Repeat the titration for concordant values.

3. Calculatıon

$$\mathbf{Acidity\ mg\ CaCO3/L} = \frac{\mathbf{A * N * 50000}}{\mathbf{Volume\ of\ sample}}$$

A= consumption of NaOH

N= Normality of NaOH