1.0 EXPERIMENT ON DETERMINATION OF pH

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PREAMBLE:

"**How to determine pH in Water and Wastewater**".

Test procedure is in accordance to IS: 3025 (Part 11) - Reaffirmed 2002.

In addition to our Indian Standard, we also discuss in brief regarding the procedure stated in

(1) APHA Standard Methods for the Examination of Water and Wastewater - 20th Edition. Method 4500-H^+ B.

(2) Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, Method 150.1.

1.1 AIM

To determine the pH of the given water sample with the stipulations as per **IS: 3025 (Part 11) - Reaffirmed 2002**

1.2 INTRODUCTION

The term pH refers to the measure of hydrogen ion concentration in a solution and defined as the negative log of H^+ ions concentration in water and wastewater. The values of pH 0 to a little less than 7 are termed as acidic and the values of pH a little above 7 to 14 are termed as basic. When the concentration of H^+ and OH^- ions are equal then it is termed as neutral pH.

1.2.1 ENVIRONMENTAL SIGNIFICANCE

Determination of pH is one of the important objectives in biological treatment of the wastewater. In anaerobic treatment, if the pH goes below 5 due to excess accumulation of acids, the process is severely affected. Shifting of pH beyond 5 to 10 upsets the aerobic treatment of the wastewater. In these circumstances, the pH is generally adjusted by addition of suitable acid or alkali to optimize the treatment of the wastewater. pH value or range is of immense importance for any chemical reaction. A chemical shall be highly effective at a particular pH. Chemical coagulation, disinfection, water softening and corrosion control are governed by pH adjustment.

Dewatering of sludges, oxidation of cyanides and reduction of hexavalent chromium into trivalent chromium also need a favorable pH range. It is used in the calculation of carbonate, bicarbonate, CO_2 corrosion, stability index and acid base equilibrium.

Lower value of pH below 4 will produce sour taste and higher value above 8.5 a bitter taste. Higher values of pH hasten the scale formation in water heating apparatus and

also reduce the germicidal potential of chlorine. High pH induces the formation of trihalomethanes, which are causing cancer in human beings.

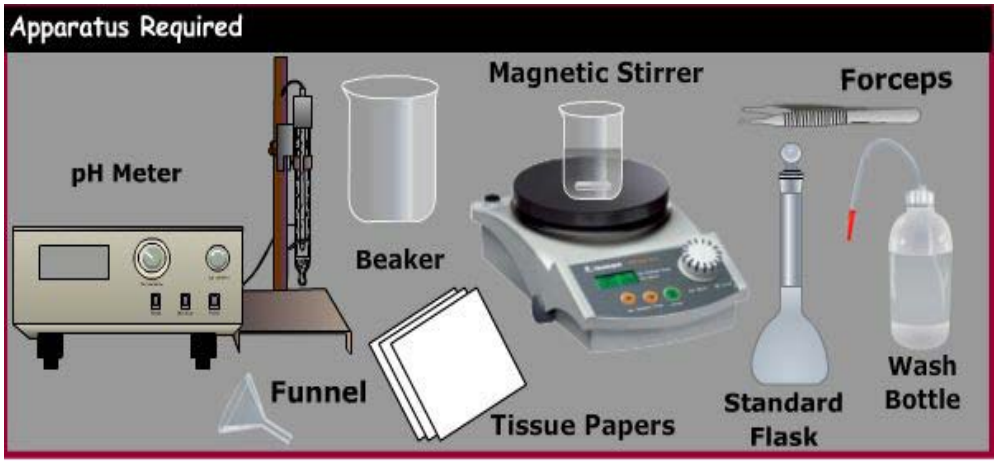
1.3 PRINCIPLE

The pH electrode used in the pH measurement is a combined glass electrode. It consists of sensing half cell and reference half cell, together form an electrode system. The sensing half cell is a thin pH sensitive semi permeable membrane, separating two solutions, viz., the outer solution, the sample to be analyzed and the internal solution, enclosed inside the glass membrane and has a known pH value. An electrical potential is developed inside and another electrical potential is developed outside, the difference in the potential is measured and is given as the pH of the sample.

1.4 MATERIALS REQUIRED

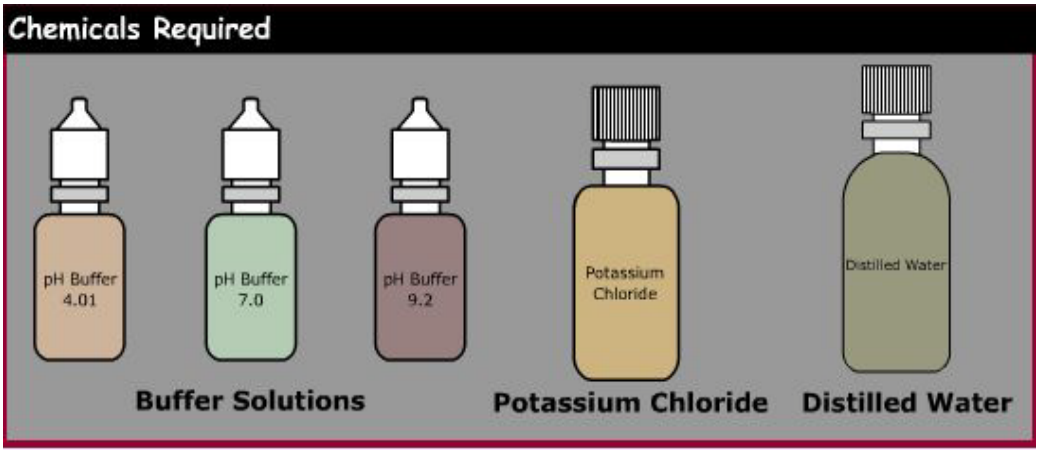
1.4.1 APPARATUS REQUIRED

1. pH meter
2. Standard flasks
3. Magnetic Stirrer
4. Funnel
5. Beaker
6. Wash Bottle
7. Tissue Paper
8. Forceps

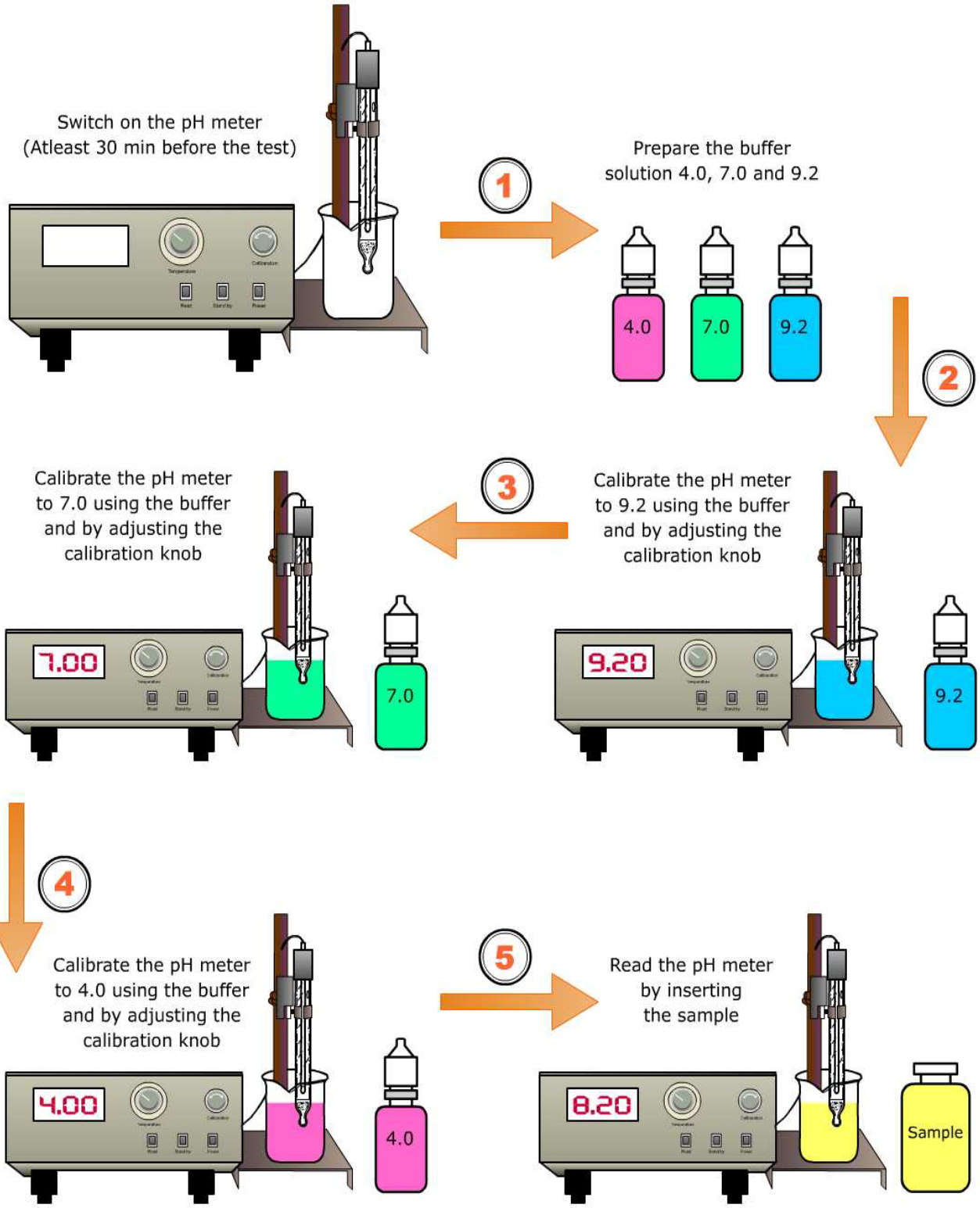


1.4.2 CHEMICALS REQUIRED

1. Buffers Solutions of pH 4.01, 7.0 and 9.2
2. Potassium Chloride
3. Distilled Water



PROCEDURE CHART



1.5 SAMPLE HANDLING AND PRESERVATION

Preservation of sample is not practical. Because biological activity will continue after a sample has been taken, changes may occur during handling and storage.

The characteristics of the water sample may change.

To reduce the change in samples taken for the determination of pH, keep samples at 4^0 C. Do not allow the samples to freeze.

Analysis should begin as soon as possible.

1.5.1 PRECAUTIONS

The following precautions should be observed while performing the experiment:

i. Temperature affects the measurement of pH at two points. The first is caused by the change in electrode output at different temperatures. This interference can be controlled by the instruments having temperature compensation or by calibrating the electrode-instrument system at the temperature of the samples. The second is the change of pH inherent in the sample at different temperatures. This type of error is sample dependent and cannot be controlled; hence both the pH and temperature at the time of analysis should be noted.

ii. In general, the glass electrode, is not subject to solution interferences like color, high salinity, colloidal matter, oxidants, turbidity or reductants.

iii. Oil and grease, if present in the electrode layer, should be removed by gentle wiping or detergent washing, followed by rinsing with distilled water, because it could impair the electrode response.

iv. Before using, allow the electrode to stand in dilute hydrochloric acid solution for at least 2 hours.

v. Electrodes used in the pH meter are highly fragile, hence handle it carefully.

1.6 PROCEDURE

Three major steps are involved in the experiment. They are

1. Preparation of Reagents
2. Calibrating the Instrument
3. Testing of Sample

1.6.1 PREPARATION OF REAGENTS

1. Buffer Solution of pH 4.0

- Take 100 mL standard measuring flask and place a funnel over it.
- Using the forceps carefully transfer one buffer tablet of pH 4.0 to the funnel.
- Add little amount of distilled water, crush the tablet and dissolved it.
- Make up the volume to 100 mL using distilled water.

2. Buffer Solution of pH 7.0

- Take 100 mL standard measuring flask and place a funnel over it.
- Using the forceps carefully transfer one buffer tablet of pH 7.0 to the funnel.
- Add little amount of distilled water, crush the tablet and dissolved it.
- Make up the volume to 100 mL using distilled water.

3. Buffer Solution of pH 9.2

- Take 100 mL standard measuring flask and place a funnel over it.
- Using the forceps carefully transfer one Buffer tablet of pH 9.2 to the funnel.
- Add little amount of distilled water, crush the tablet and dissolved it.
- Make up the volume to 100 mL using distilled water.

1.6.2 CALIBRATING THE INSTRUMENT

Using the buffer solutions calibrate the instrument.

Step 1

In a 100 mL beaker take pH 9.2 buffer solution and place it in a magnetic stirrer, insert the teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.

If the instrument is not showing pH value of 9.2, using the calibration knob adjust the reading to 9.2.

Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue.

Step 2

In a 100 mL beaker take pH 7.0 buffer solution and place it in a magnetic stirrer, insert the teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.

If the instrument is not showing pH value of 7.0, using the calibration knob adjust the reading to 7.0.

Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue.

Step 3

In a 100 mL beaker take pH 4.0 buffer solution and place it in a magnetic stirrer, insert the teflon coated stirring bar and stir well.

Now place the electrode in the beaker containing the stirred buffer and check for the reading in the pH meter.

If the instrument is not showing pH value of 4.0, using the calibration knob adjust the reading to 4.0.

Take the electrode from the buffer, wash it with distilled water and then wipe gently with soft tissue.

Now the instrument is calibrated.

1.6.3 TESTING OF SAMPLE

- In a clean dry 100 mL beaker take the water sample and place it in a magnetic stirrer, insert the teflon coated stirring bar and stir well.
- Now place the electrode in the beaker containing the water sample and check for the reading in the pH meter. Wait until you get a stable reading.
- The pH of the given water sample is 8.84
- Take the electrode from the water sample, wash it with distilled water and then wipe gently with soft tissue.

1.7 CALCULATION

To determine the value of pH of the given water sample the readings obtained are required to be tabulated

1.7.1 TABLE

Sample No	Temperature of Sample (ºC)	pH
1.		
2.		
3.		

For sample 1 the temperature of the measurement is 27° C and as obtained the value of the pH is 7.84.

For sample 2 the temperature of the measurement is 27° C and as obtained the value of the pH is 7.43.

For sample 3 the temperature of the measurement is 27° C and as obtained the value of the pH is 8.84.

1.7.2 DATA SHEET

DETERMINATION OF pH
DATA SHEET

Date Tested : August 30, 2010

Tested By : CEM Class, Group A

Project Name : CEM, NITTTR Lab

Sample Number : BH1, BH2, BH3

Sample Location BH1 : Perungudi (Lat 12' 57" 31.74 & Long 80'14" 8.82)

Sample Description : Surface water

Sample Location BH2 : Pallikarnai (Lat 12' 56" 31.02 & Long 80'12" 47.99)

Sample Description : Ground water

Sample Location BH2 : Thiruvanmiyur (Lat 12' 59" 0.84 & Long 80' 16" 8.21)

Sample Description : Sea water

TABULATION

Sample No	Temperature of Sample (°C)	pH
1	27	7.84
2	27	7.43
3	27	8.14

Result:-

The pH of the given sample 1 = 7.84

The pH of the given sample 2 = 7.43

The pH of the given sample 3 = 8.14

1.8 INTERPRETATION OF RESULTS

The pH of the given water sample is **8.84.**

1.9 INFERENCE

pH is a measure of the hydrogen ion concentration in water. Values lower than 7 indicate acidity and values higher than 7 indicate alkalinity. Drinking water with a pH between 6.5 and 8.5 is generally considered satisfactory. Acidic waters tend to be corrosive to plumbing and faucets, particularly if the pH is below 6. Alkaline waters are less corrosive. Waters with a pH above 8.5 may tend to have a bitter taste.

The pH of the water samples are well within the limit of the drinking water standards. The pH of the ground water is slightly towards the alkaline side because of some soil and rocks chemicals might have dissolved in it. In case of the pH of the fresh water, aquatic plants uses up hydrogen molecules for photosynthesis, which causes the concentration of hydrogen ions to decrease and therefore the pH is towards the alkaline side. The sea water is mostly alkaline in nature because of the presence of different type of salts.

1.10 EVALUATION

1. pH is defined as_____.

    a) Logarithm of Hydrogen ions concentration
    b) Negative logarithm of Hydrogen ions concentration
    c) Hydrogen ion concentration
    d) OH ion concentration

2. pH of neutral water is_____.

    a) less than 7
    b) more than 7
    c) 7.0
    d) 0.0

3. The acceptable value of pH of potable water is_____.

    a) 7.0 to 8.5
    b) 6.5 to 9.5
    c) 6 to 8.5
    d) 6.5 to 10

4. The inner solution present in the glass electrode of pH meter is_____.

    a) HCl
    b) KCl
    c) NaCl
    d) MgCL

5. The buffer solution can be stored for a minimum period at room temperature.

    a) True
    b) False

6. Possible reasons for a relatively low pH value in a river water sample is due to ___.

    a) Organic material decomposition to form acidic substances
    b) Running long distances
    c) Presence of fishes
    d) Presence of aquatic plants

7. Possible reasons for a relatively high pH value in a river water sample is due to ___.

    a) Running over clay
    b) Running long distances
    c) Running of fishes
    d) Presence of aquatic plants

8. A weak acid is one that ionize incompletely in aqueous solution.

    a) True
    b) False

9. A strong base is one that ionizes incompletely in aqueous solution.

    a) True
    b) False

10. The measurement of pH made by determining the e.m.f of the_____.

    a) cell constant
    b) solution
    c) electrode cell
    d) calomel electrode

KEY TO ITEMS:

1) b
2) c
3) a
4) b
5) False
6) a
7) d
8) True
9) False
10) c