



Unit- V

pH, Buffers and Isotonic solutions

pH determination:

There are two widely accepted methods for the determination of the pH of a solution

- ✓ Colorimetric method
- ✓ Electrometric method

Colorimetric method:

- ❖ This method based on the principle of **colour comparison of the test solution to that of the standard both treated with universal indicator**.
- ❖ This method is used to determine the pH of the solution in the **pH range of 3 to 11 ± 0.2 units**.
- ❖ Commercially available indicator strips of filter papers are used for identifying the pH.
- ❖ Otherwise several standard solutions can be prepared or procured which are mixed solution of buffer and indicator.
- ❖ Also **Capillators and Comparators** are commercially available for this purpose.

Capillators:

Standard solutions (mixture of buffer solution and universal indicator) of **small volume** placed in capillary tubes are called capillators.

Comparators:

Standard solutions (mixture of buffer solution and universal indicator) of **large volume** placed in capillary tubes are called comparators.

This is useful in examining **turbid and coloured solutions**.

Method:

Step-1: Standard buffer solutions of known pH ranging from 3.0 to 11.0 are prepared with 1.0 pH interval.

Step-2: A few drops of universal indicator solutions are added to the above solution that produce different colours. Similarly few drops of universal indicator are also added to the solution to be tested. It produce a colour depending upon its pH.

Step-3: The colour of the test solution is compared with the colour of the standard solutions. The pH of the standard solution that has nearly same colour as that of test is consider as the approximate pH of test solution.

Step-4: In a similar way the test solution is again compared with the colour of the indicator treated standard solution of narrow pH range with 0.2 pH interval.

Step-5: Step 2 and 3 are again repeated and the pH of the solution is reported.

Precautions:

- ✓ Standard solutions must be **protected from light to avoid colour fading**
- ✓ All tubes must have **same dimension**. i.e. tube diameter and thickness of glass.

Advantages:

- ✓ Less expensive
- ✓ Acid-base reaction of non-aqueous solution can be studied.
- ✓ Easy estimation of pH unless the drug shows buffer action.

Disadvantage:

- ✓ This method is less accurate and less convenient
- ✓ It is not useful for coloured or turbid solution.
- ✓ The indicators used may impart a deviation in pH to buffered solution.
- ✓ This is not useful in presence of salts, proteins etc.

Electrometric method Principle:

The magnitude in the potential difference between glass and a solution containing hydrogen ion varies with concentration of H^+ concentration. Hence the pH of the solutions are determined by means of the electrodes. Hydrogen electrode and glass electrodes are used for this purpose. However glass electrodes are commonly used.

The instrument used to determine the pH of unknown solution by this method is called pH meter.

Method:

A pH metre with its control knobs are presented in fig.1. The glass electrode is attached to the instrument.



Figure 1: The pH meter with glass membrane electrode.

Step-1: At first the instrument temperature is set to that of the solution temperature.

Step-2: The electrode is immersed into a standard buffer solution of pH 7.0. The potential control knob is adjusted till the pH reading in digital meter becomes 7.0.

Step-3: Then the instrument is calibrated using standard buffers of pH 4.0 (M/20 potassium hydrogen phthalate) or/and pH 9.14.

Step-4: The electrode is now rinsed with distilled water properly and re-immersed into the test solution. The pH value is obtained from the digital meter.

The pH of the test solution can be changed by the addition of slight amount acid or base solution (depending upon the desired direction of change) and the procedure is followed till the desired pH is obtained.

Advantages:

- ✓ It gives an accurate measurement of pH.
- ✓ Glass electrode is not affected by oxidation-reduction system.
- ✓ The electrode establishes equilibrium rapidly.
- ✓ The indicator need not required.
- ✓ The pH range of measurement is large.

Disadvantages:

- ✓ The cost of pH meter is high compared to colorimetric method.
- ✓ This method is not suitable for viscous solutions and gels because of poor ionic mobility.