
pH Meter

Introduction of pH Meter :

A **pH meter** is an analytical instrument used to measure the **hydrogen ion concentration** in a solution, which determines its **acidity or alkalinity**. The pH value ranges from **0 to 14**

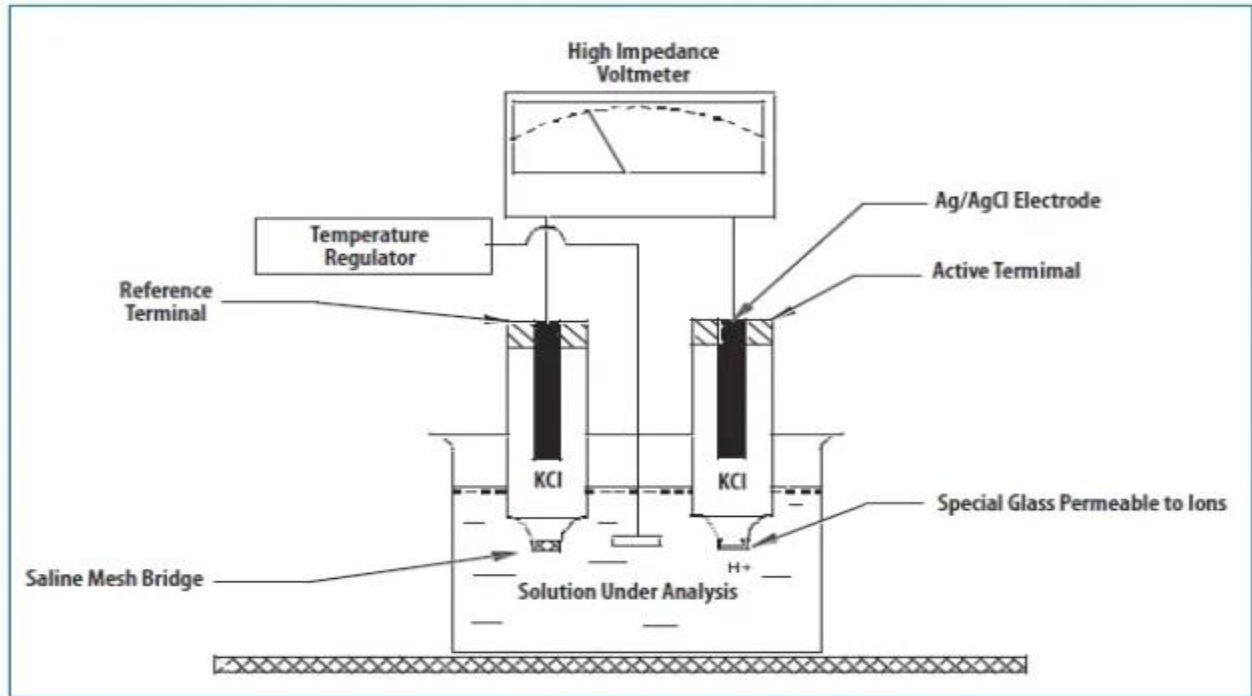
- **pH < 7** → Acidic solution
- **pH = 7** → Neutral solution
- **pH > 7** → Alkaline (basic) solution

It measures the difference in electrical potential between the pH electrode and the reference electrode. Thus, the calculated difference in electrical potential relates to the pH of the solution. an increase in acidity, and a decrease in pH value.

Principle of pH Meter

The primary working mechanism of the pH meter is based on the exchange of ions from the sample solution to the inner solution (pH seven buffer) of the glass electrode through the glass membrane that generates electric voltage.

Therefore, the result of the pH meter is based on the combined relation between electric voltage, ion concentration, and pH reading.



During pH measurement, when a pair of the glass electrode and reference electrode (or combined electrode) of a pH meter is immersed in a solution, hydrogen ions in a test solution move towards the glass electrode, replacing some metal ions inside the glass electrode. Meanwhile, some hydrogen ions also disperse into the solution being tested. This swapping of ions is known as

the ion exchange phenomenon. This ion exchange phenomenon creates a small voltage (or electrical potential) across the glass electrode that is picked up by the silver electrode and passed to the electrometer/voltmeter. As a result, the voltmeter measures the voltage generated by the solution, which is equivalent to the pH value according to the **Nernst equation**. Apart from it, the potential difference in the reference electrode remains constant, that only helps to complete the circuit of the pH meter.

In conclusion, it infers that a decrease in voltage means fewer hydrogen ions, a reduction in acidity, an increase in alkalinity, and an increase in pH value. In the same way, an increase in

voltage means more hydrogen ions, an increase in acidity, and a decrease in pH value.

↓ voltage = less H⁺ /more OH⁻ = ↓ acidity =
↑pH

↑Voltage= more H⁺/ less OH⁻ = ↑ acidity = ↓pH

Types of pH Meter :

1.Pen tester pH meter: These types of pH meters are designed with a pH meter, display, and electrode all in one form, making them easy to transport and use. They are pocket size and usually the cheapest pH meter.

2.Handheld/Portable pH meter: They are usually slightly larger than pen tester and

consist of a separate electrode from the meter. Depending on pH measuring needs, its electrode can be changed.

3. Benchtop/Desktop pH meter: These types of pH meters have more accuracy than other pH meters. Therefore, they are well-suited to laboratories or professionals. Similarly, they can be fitted on a desk or wall.

Calibration of pH Meter

- Regular calibration is necessary for **accuracy**.
- Typically done using **buffer solutions** of known pH (e.g., pH **4.00**, **7.00**, and **10.00**).

- The pH meter is adjusted to match the known values of the buffers.

Applications of pH Meters

- 1. Chemical & Pharmaceutical Industry** – Quality control of drugs and chemicals.
- 2. Agriculture & Soil Testing** – Measuring soil pH for crop suitability.
- 3. Water Quality Testing** – Monitoring pH in drinking water, wastewater, and swimming pools.
- 4. Food & Beverage Industry** – Maintaining pH in fermentation, dairy, and brewing processes.

5. Biological & Medical Research – pH regulation in biological fluids and culture media.

Limitations of pH Meter

- **Electrode Fouling** – Contamination affects accuracy.
- **Temperature Sensitivity** – pH values vary with temperature.
- **Storage Issues** – Glass electrodes must be stored properly to prevent drying.

Conclusion

A pH meter is a crucial instrument for measuring acidity and alkalinity in various fields. Regular **calibration, proper maintenance, and**

understanding its working principle ensure
precise and reliable pH measurements.