SOMANY INSTITUTE OF TECHNOLOGY AND MANAGEMENT, REWARI

PRINTING TECHNOLOGY

SEMESTER-3

SUBJECT-BASIC SCIENCES FOR PRINTING

UNIT-1

DEFINITION OF Ph –

PH, quantitative measure of the acidity or basicity of aqueous or other liquid solutions. The term, widely used in chemistry, biology, and agronomy, translates the values of the concentration of the hydrogen ion—which ordinarily ranges between about 1 and 10^{-14} gram-equivalents per litre—into numbers between 0 and 14. In pure water, which is neutral (neither acidic nor alkaline), the concentration of the hydrogen ion is 10^{-7} gram-equivalents per litre, which corresponds to a pH of 7. A solution with a pH less than 7 is considered acidic; a solution with a pH greater than 7 is considered basic, or alkaline.

METHOD OF DETERMINIG pH –

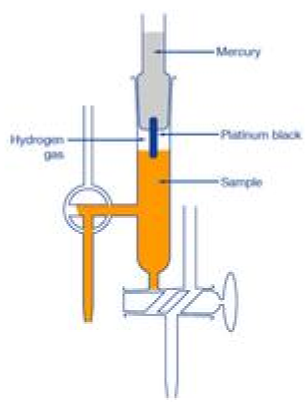
(1) Measuring pH Using an Indicator

This category basically includes two methods: One involves comparing the standard color corresponding to a known pH with the color of an indicator immersed in the test liquid using buffer solution. The other method involves preparing pH test paper which is soaked in the indicator, then immersing the paper in the test liquid and comparing its color with the standard color. This method is simple, but prone to error. A high degree of accuracy cannot be expected.

* Various errors include;
- Error due to high salt concentration in the test liquid
- Error due to the temperature of the test liquid
- Error due to organic substances in the test liquid

The indicator method cannot measure the pH of high-purity water, since the influence of the indicator itself is too large.

(2) Hydrogen-Electrode Method



A hydrogen electrode is made by adding platinum black to platinum wire or a platinum plate. It is immersed in the test solution and an electric charge is applied to the solution and the solution is saturated with hydrogen gas.The electrode potential is measured between platinum black electrode and silver chloride electrode. This potential is inversely proportional to pH of the solution.

The hydrogen-electrode method is a standard among the various methods for measuring pH. The values derived using other methods become trustworthy only when they match those measured using hydrogen electrode method.

However, this method is not appropriate for daily use because of the effort and expense involved, with the inconvenience of handling hydrogen gas and great influence of highly oxidizing or reducing substances in the test solution.

(3) Quinhydron-Electrode Method

When quinhydrone is added to a solution, it separates into hydroquinone and quinone. Because quinone's solubility varies depending on the pH value of the solution, pH can be determined from the voltage between a platinum and reference electrode.
Although this method is simple, it is seldom used today, because it does not work when oxidizing or reducing substances are involved, or when the test solution has a pH above 8 or 9.
Note: Quinhydron solution of a certain pH is sometimes used to check whether an ORP meter is operating normally. The principle of the quinhydron electrode is applied in such a case.

(4) Antimony-Electrode Method

This method involves immersing the tip of a polished antimony rod into a test solution, also immersing a reference electrode, and measuring pH from the difference in potential between them. This method was once widely used because the apparatus is sturdy and easy to handle. However, its application is now quite limited because results vary depending on the degree of polish of the electrode, and reproducibility is low.

Note: This method is now used only in cases where a high degree of accuracy is not required (only for industrial use) and the test solution contains F^-.

(5) Glass-Electrode Method

The glass electrode method uses two electrodes, a glass electrode and reference electrode, to determine the pH of a solution by measuring the voltage (potential) between them.
This method is the one most commonly used for pH measurement, since the potential quickly reaches equilibrium and shows good reproducibility, and because the method can be used on various types of solutions, with oxidizing or reducing substances having very little impact on the result.
The glass electrode method is widely used, not only in industry but also in many other fields.
In its "Methods of pH Measurement" section, JIS states, "Since measurement using a hydrogen electrode, as described in the definition section, is not necessarily appropriate, measurement using a glass electrode is recommended for industrial pH measurement."

（6）Semiconductor sensor methods

The semiconductor pH sensor, whose development started around 1970, replaces a glass electrode with a semiconductor chip. This sensor, known as an ion sensitive field effect transistor (ISFET), is not only resistant to damage but also easily miniaturized. Miniaturization allows the use of smaller amounts of sample for measurement, and makes it possible to perform measurements in very small spaces and on solid state surfaces. This sensor promises useful applications in measurement in the fields of biology and medicine.

IMPORTANCE OF PH IN PRINTING AND PACKAGING-

Water based inks for printing have gained traction as an environmentally friendly alternative printing ink. Instead of emitting volatilized chemical solvents, water evaporates from ink leaving behind pigments. Use of water-based inks has been limited due to compatibility with substrate materials, but they are successfully used in a number of applications including printing on paper, fabric, and some plastics.

Water based inks perform differently from other inks that rely on evaporation for drying. For instance, water-based inks incorporate into fabric and paper fibers more easily, thus making for thinner printing and a breathable final product. Due to the differences in application, some effort is required to alter process and handling when switching from solvent-based inks. Inks are designed to stay wet during the printing process and be dry enough before the next process, therefore drying can neither be too fast nor too slow. Water-based inks, especially, require high control over drying speed since water evaporates more slowly than chemical solvents.

Ink Stability Depends on pH

Ink is comprised of extremely small particles and the stability of those particles in a solution are dependent on the solution pH. A larger gradient between the solution pH and the surface charge result in more stable particles. Most commercial water based inks are stable at an alkaline pH. Inks that have particles stable under neutral pH conditions exist, but are costlier.

Amines, a relative of ammonia, are an additive that works to address several ink control parameters; amines are added to increase and maintain pH for stability, to control ink drying time through amine choice, and to increase solubility of other ink additives such as resins. Different amines and different pH values result in different drying times; types of amines used for ink formulations are often referred to as faster and slower amines.

Viscosity Tuning via pH

Previous ink formulations required stringent pH monitoring and knowledge of chemistry to keep inks stable during a printing process. Modern inks are less subject to pH shift, however, monitoring is not only important for ink stability. In water based inks, pH is strongly tied to viscosity, which affects the color and texture of printed material. Color consistency relies on maintaining a constant viscosity because thicker ink will deliver more colorant and thinner ink less colorant. Viscosity also affects solvent retention and thus plays a role in drying rates.

Even small viscosity shifts can result in printing variation, thus pH monitoring can result in a more consistent printing run. Lower pH increases the rate of evaporation and thus can result in a thicker ink. Conversely, higher pH results in a thinner ink than expected due to less evaporation. Effects are significant when large volumes of ink are used. Intuitively, using large volumes may seem to ensure color consistency, but it may also leave the process at risk for chemical shifts.

Though small pH changes can affect viscosity, fortunately, pH adjustment and correction is relatively simple. While viscosity can be adjusted by the addition of water, tuning by water addition only helps after viscosity has shifted. Instead, by monitoring and maintaining pH, viscosity shifts can be avoided. The more monitoring and correcting, the better the printing result. The result of improved ink stability and improved process control means that printing today is easier than ever to maintain consistent print and color quality

CONDUCTIVITY-

Conductivity is the measure of the ease at which an electric charge or heat can pass through a material. A conductor is a material which gives very little resistance to the flow of an electric current or thermal energy. Materials are classified as metals, semiconductors, and insulators. Metals are the most conductive and insulators (ceramics, wood, plastics) the least conductive.

Electrical conductivity tells us how well a material will allow electricity to travel through it. Many people think of copper wires as something that has great electrical conductivity.

Thermal conductivity tells us the ease upon which thermal energy (heat for most purposes) can move through a material. Some materials like metals allow heat to travel through them quite quickly. Imagine that with one hand you are touching a piece of metal and with the other, a piece of wood. Which material would feel colder? If you said, "metal," you would be correct. But, in fact, both materials are in fact the same temperature. This is relative thermal conductivity. Metal has a higher heat transferability, or thermal conductivity, than wood, letting the heat from your hand leave faster. If you want to keep something cold the best idea is to wrap it in something that does not have a high heat transferability, or high thermal conductivity, this would be an insulator. Ceramics, and polymers are usually good insulators, but you have to remember that polymers usually have a very low melting temperature. That means if you are designing something that will get very hot the polymer might melt, depending on its melting temperature.