Acids

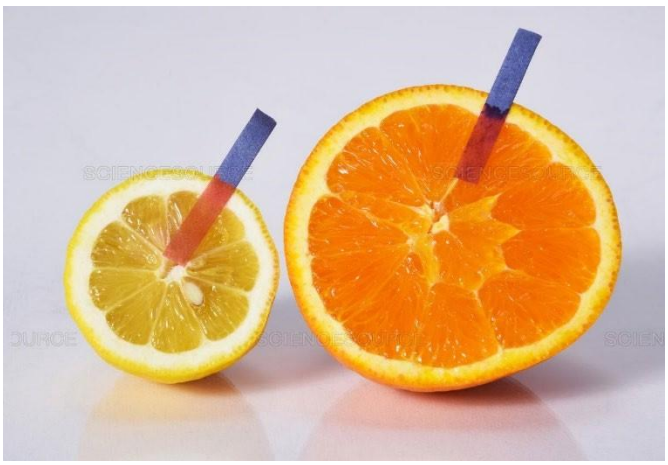
- Acids have sour taste.
- They turn blue litmus to red.
- They give positive hydrogen (H^+) ions in water solution.

Strong Acids – HCl (Hydrochloric Acid), H_2SO_4 (Sulphuric Acid), HNO_3 (Nitric Acid)

Weak Acids – CH_3COOH(Acetic acid), Oxalic Acid, Lactic Acid

Concentrated Acids – More amount of acid + Less amount of water

Dilute Acids - More amount of water + Less amount of Acid



Litmus turns Red in Sulphuric Acid and Lemon/Orange

Chemical properties of acids:

1. Reaction of acid with base:

Acid + Base → Salt + Water

Acid and base together react to produce salt and water. This reaction is called Neutralization reaction.

Examples -

$KOH + HCl \rightarrow KCl + H_2O$

2. Reaction of acid with metal:

Acid + Metal ⟶ Salt + Hydrogen gas

Examples -

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

3. Reaction of Metallic Oxides with Acids:

Metal oxide + Acid → Salt + Water

Examples -

$CuO + HCl \rightarrow CuCl_2 + H_2O$

4. Reaction of acid with metal carbonate and metal hydrogen carbonates:

Acid + Metal carbonate /Metal hydrogen Carbonate → Salt + CO_2 + H_2O

When an acid reacts with a metal carbonate (MCO_3) or metal hydrogen carbonate ($MHCO_3$), it gives the corresponding salt, carbon dioxide (CO_2) gas and water.

Examples -

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$

5. Conduction of electricity:

Acidic solutions in water conduct electricity because they produce hydronium ions. Hydrogen ions cannot exist alone, but they exist after combining with water molecules. Thus hydrogen ions must always be shown as $H^+(aq)$ or hydronium ion (H_3O^+). i.e. $H^+ + H_2O \rightarrow H_3O^+$.

Strength of Acid

We can test the strength of Acid by using a scale called the pH scale.

pH value of acids is always less than 7

Bases

- Bases are bitter in taste and soapy in touch.
- They turn red litmus to blue.
- They give negative (OH^-) ions in water solution.

Strong Bases - NaOH (Sodium Hydroxide), KOH (Potassium hydroxide), $Ca(OH)_2$ (Calcium hydroxide)

Weak Bases - NH_4OH

Alkalis - These are bases which are soluble in water.

Litmus turns Blue in Sodium Hydroxide and Soap/ Colgate

Chemical properties of Bases:

1. Reaction of Base with Metal:

Base + Metal ⟶ Salt + Hydrogen gas

Examples –

$$2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$$

Only Some Metals react with Base

2. Base in water:

Bases generate hydroxide (OH–) ions in water.

Water soluble bases are called alkalis.

Examples -

$$Mg(OH)_2 + H_2O \rightarrow Mg^{+2} + 3OH^-$$

3. Reaction of a Non-metallic Oxide with Base:

Non-Metal oxide + Acid → Salt + Water

Examples –

$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$$

From this reaction, it is clear that Non-metallic oxides are acidic in nature.

4. Conduction of electricity:

Bases in water also conduct electricity as the acids do. As bases also dissociate into hydroxide ions in water thus conducts electricity. The process of dissolving a base in water is a highly exothermic one.

Strength of Base

pH value of Base is always less than 7

More the value of pH is stronger the Base will be.

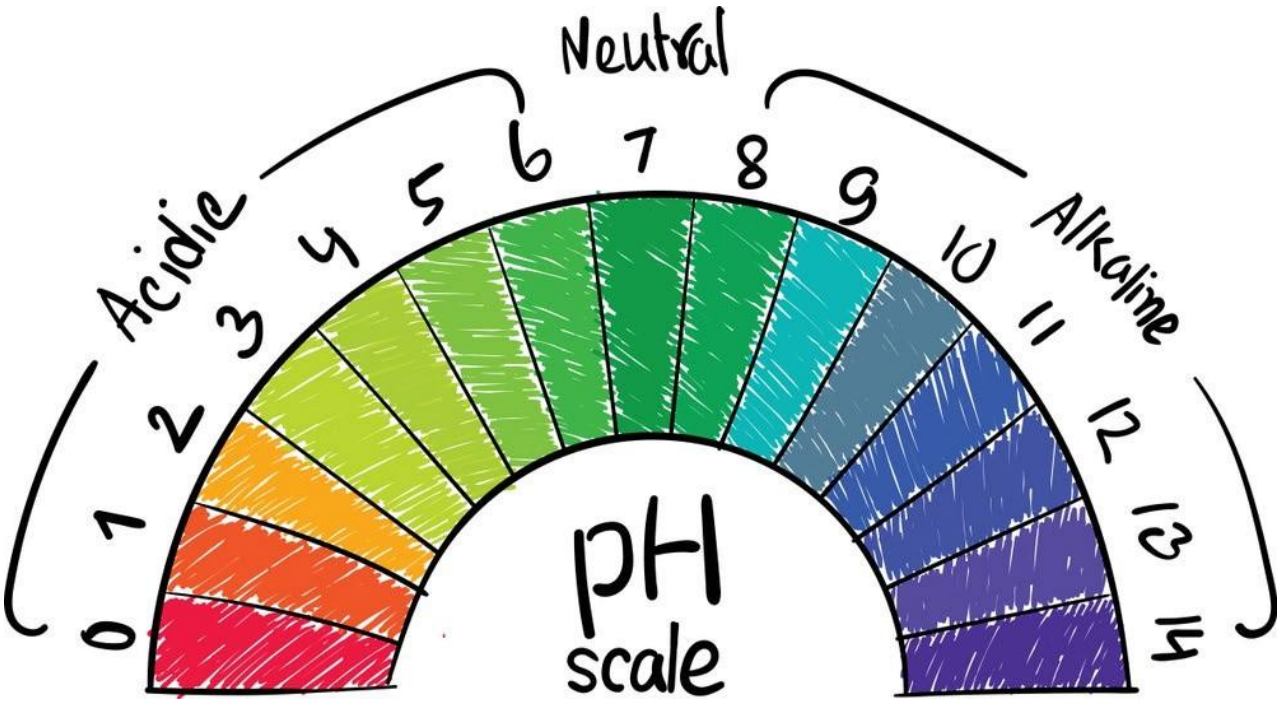
pH Scale:

- A Scale to measure the strength of an Acid or a Base.
- The pH scale is marked with numbers 0 to 14, The pH varies from 0 (very acidic) to 7(neutral) and 14 (very alkaline).
- Higher the pH value then it will be Basic
- Lower the pH value then it will be Acidic.

pH < 7 → Acidic

pH = 7 → Neutral

pH > 7 → Basic



Importance of pH in everyday life:

1) Self Defence by Animals & Plants –

When insects like honeybee, Ant etc. bite, they inject an acid into the skin, that causes pain and irritation. If a mild base like Baking Soda is applied on affected area, it gives relief.

2) pH of the Soil –

Every Plant requires a specific pH range for healthy growth. It is also suitable for selecting the Fertilizer for a particular crop by knowing pH of the Soil.

3) pH of our Digestive System –

HCl is present in our stomach which helps in digestion of food. As during digestion, the stomach produces too much acid, it causes pain and irritation. To correct the disturbed pH range, Milk of Magnesia (a mild base) is used as a medicine, also called Antacid as it reduces the effect of Acid (or Acidity).

4) pH Change leads to Tooth Decay –

When our mouth has pH less than 5.5 then our tooth decay starts. After eating, some food particles and sugar left in the mouth and with the help of its bacteria present in our mouth releases acid. Thus cause tooth decay. The best way to prevent this is to clean the mouth after eating food.
To prevent tooth decay, toothpastes (basic) are used which neutralize the excess acid.

Salts

- When an acid reacts with a base then it neutralizes to form salt and water. This reaction is called neutralization reaction.

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water}$$

- The salt we eat is Sodium Chloride. It is formed by the combination of hydrochloric acid and sodium hydroxide solution.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

- Salts of a strong acid and weak base are acidic with pH valve less than 7. Salts of strong base and weak acid are basic in nature with pH valve more than 7.

Types of Salts:

1. Rock salt

Salt when present in its natural form as a crystalline mineral is rock salt. When seas of bygone ages dried up, beds of rock salt were formed in the form of large brown crystals.
(Brown due to impurities present in it).

(काला नमक/ चाट मसाले वाला नमक)

2. Common salt

Salt whose chemical composition is mainly NaCl is common salt.

(Tata Salt - देश का नमक 😜😜)

Chlor-Alkali Process

When we pass electricity through an aqueous solution of sodium chloride (called brine), it decomposes to form sodium hydroxide.

$$2NaCl + 2H_2O \longrightarrow 2NaOH + Cl_2 + H_2$$

- After this process chlorine gas will be present at Anode, and Hydrogen gas at Cathode.
- Sodium Hydroxide solution is formed near Cathode.

Bleaching Powder (Calcium Oxychloride, $CaOCl_2$)

Preparation:

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

(Slaked lime) — (Bleaching Powder)

Uses of Bleaching Powder:

- To bleach cotton and linen in the textile industry.
- Many chemical industries use it as an oxidizing agent.
- To make drinking water free of germs by disinfecting it.
- Used for making Chloroform.

Baking Soda (Sodium Hydrogen Carbonate, $NaHCO_3$)

Preparation:

When common salt is treated with Ammonia in the presence of water and carbon dioxide then baking soda ($NaHCO_3$) is formed.

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$$

(NH_3): (Ammonia)

(NH_4Cl): (Ammonium chloride)

($NaHCO_3$): (Sodium hydrogen carbonate)

Uses of Baking Soda:

- It is used for making baking powder (baking soda + mild edible acid).
- Baking soda is also used in making antacids.
- Used in Soda-acid fire extinguishers.

Washing Soda (Sodium Carbonate, $Na_2CO_3.10H_2O$)

Preparation:

When we heat baking soda ($NaHCO_3$) it forms sodium carbonate (Na_2CO_3). When it combines with the excess of water than washing soda is obtained.

$$2NaHCO_3 + \text{Heat} \longrightarrow Na_2CO_3 + H_2O + CO_2$$

(Baking Soda) (Sodium Carbonate)

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3 \cdot 10H_2O$$

(Sodium Carbonate) (Washing Soda)

Uses of Washing Soda:

- Washing soda is used in making Glass, Paper and Soap.
- Used in making borax and many other sodium compounds.
- Used in washing Clothes
- Used for removing permanent hardness of water.

Plaster of Paris ($CaSO_4.½\ H_2O$)

Preparation:

When we heat gypsum at 373K, it loses water molecules and becomes calcium sulphate hemihydrate ($CaSO_4 . \frac{1}{2} H_2O$). This is Plaster of Paris.

$$CaSO_4 . 2H_2O \longrightarrow CaSO_4 . \tfrac{1}{2} H_2O + 1\tfrac{1}{2} H_2O$$

(Gypsum) (P.O.P)

It is a white powder but on mixing with water, it changes to hard solid mass i.e gypsum again.

$$CaSO_4 . \tfrac{1}{2} H_2O + 1\tfrac{1}{2} H_2O \longrightarrow CaSO_4 . 2H_2O$$

(P.O.P) (Gypsum)

Uses of POP:

- Doctor uses as Plaster for supporting fractured bones.
- Making Toys and Sculpture
- Used for making Surfaces Smooth