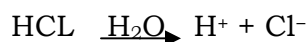


Acids :- acids are substances which dissociate in aqueous solution to give hydrogen ions E.g,

HCL, HNO₃, CH₃ COOH and H₂ So₄ are acids because they give hydrogen ions when dissolved in water.



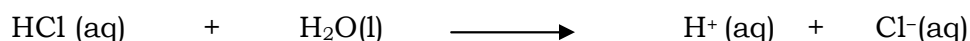
Acids are sour in taste and turn blue litmus solution red.

Bases :- Bases are substances which dissociate in aqueous solution to give hydroxide ions. E.g, substances such as NaOH, KOH, Ca (OH)₂ etc are bases because they give hydroxide ions when dissolved in water.

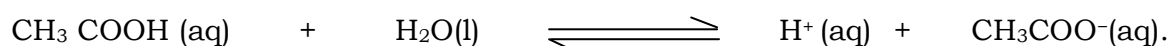


Bases have bitter taste and soapy touch and turn red litmus solution blue.

Strong Acids :- the acids which are completely ionised in water are called strong acids. for example, hydrochloric acid (HCl), nitric acid (HNO₃), sulphuric acid (H₂SO₄) are strong acids because they are fully ionized in aqueous solutions. For example,



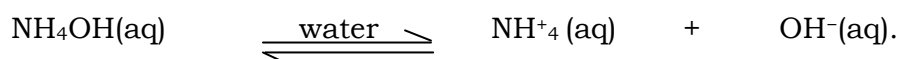
Weak Acids :- the acids which ionise to only a very small extent in water are called weak acids. For example, acetic acid (CH₃COOH), hydrocyanic acid (HCN), carbonic acid (H₂CO₃), phosphoric acid (H₃PO₄) are weak acids because they are only partially ionized in aqueous solutions. For example,



Strong Bases :- the bases which completely ionize to give hydroxide ions (OH⁻) are called strong bases. For example, sodium hydroxides (NaOH), potassium hydroxide (KOH), completely dissociate in aqueous solution and therefore, these are strong bases, water soluble bases are also called alkalies. For example,

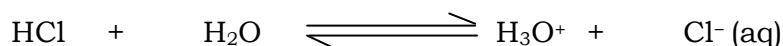


Weak bases :- the bases which ionize to only small extent in water to give hydroxide ions (OH⁻) are called weak bases. For example, ammonium hydroxide (NH₄ OH), calcium hydroxide (Ca(OH)₂) are weak bases because they only partially ionize in water. For example,



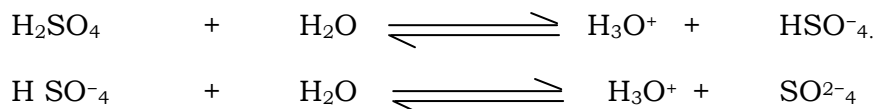
Classification of Acids :- the acids are classified on the basis of number of hydrogen (H⁺) or hydronium (H₃O⁺) ions produced by the ionization of one molecule of the acid in aqueous solution. On the basis of basicity, acids are classified as :

1. **Monobasic acids.** Acids which when dissolved in water produce one hydronium ion per molecule of the acid are called monobasic acids. Thus, the basicity of monobasic acids is one. For example, HCl. It dissociates in one step only as :



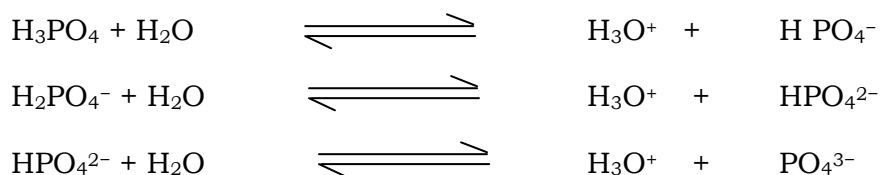
Since they have only one replaceable hydrogen atom, they form only one type of salts.

2. **Dibasic acids.** Acids which when dissolved in water produce two hydronium ions per molecule of the acid are called dibasic acids. Thus the basicity of a dibasic acid is 2. For example, sulphuric acid (H_2SO_4) is a dibasic acid. It dissociates in two steps as :



Since they have two replaceable hydrogen atoms, they form two types of salts.

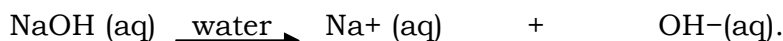
3. **Tribasic acids.** Acids which when dissolved in water produce three hydronium ions per molecule of the acid are called tribasic acids. Thus, their basicity is 3. For example, phosphoric acid, H_3PO_4 is a tribasic acid. It dissociates in three steps in aqueous solution as.



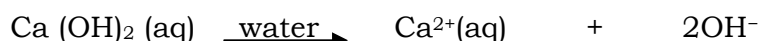
Since they have three replaceable hydrogen atoms, they form three series of salt.

Classification of Bases : - on the bases of acidity, the base may be classified as :

1. **Monoacidic bases.** Bases which when dissolved in water produce one hydroxide ion per molecule of the base are called monoacidic bases. For example, sodium hydroxide, Na OH is monoacidic base and its acidity is 1.



2. **Diacidic bases.** Bases which when dissolved in water produce two hydroxide ions per molecule of the base are called diacidic bases. For example, calcium hydroxide, Ca (OH)_2 is diacidic base and its acidity is 2.



3. **Triacidic bases.** Bases which when dissolved in water produce three hydroxide ions per molecule of the base are called triacidic bases. For example, aluminium hydroxide, Al(OH)_3 is triacidic base and its acidity is 3.

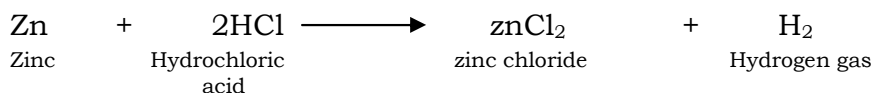


Chemical Properties of Acids And Bases :- acids and bases show the following chemical properties :

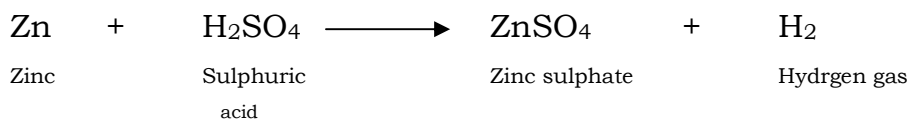
1. **Reaction of acids and bases with metals** :- acids react with metals to liberate hydrogen gas. For example, reactive metals such as zinc and magnesium displace hydrogen from acids in the form of hydrogen gas. The metal combines with the remaining part of the acids and forms a compound called salt. Thus, the reaction of a metal with an acid may be written as :



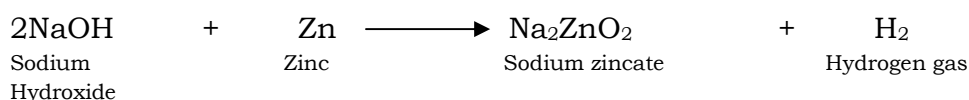
For example, the reaction of zinc with dilute hydrochloric acid is represented as :



Zinc metal also reacts with dilute sulphuric acid as :



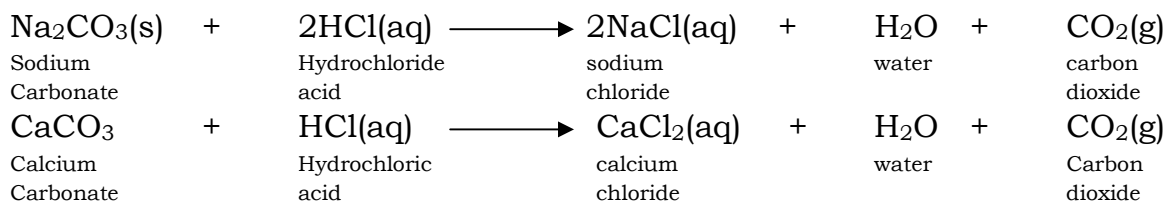
Reaction with Bases. Some metals also react with bases to form hydrogen gas. For example, zinc reacts with sodium hydroxide and hydrogen gas is evolved. The reaction may be written as :



Reaction of acids with metal carbonates and metal hydrogen carbonates :-

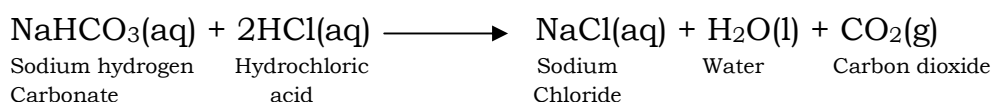
Acids react with metal carbonates and metal hydrogen carbonates (also called bicarbonates) to form the respective salts, water, and carbon dioxide. Carbon dioxide gas is evolved with brisk effervescence.

Metal + Acid \longrightarrow metal salt + water + carbon dioxide
Carbonate



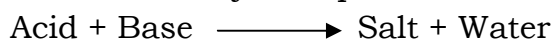
Similarly, metal hydrogen carbonates (or bicarbonates) give carbon dioxide.

Metal hydrogen + Acid \longrightarrow Metal salt + Water + Carbon dioxide
Carbonate

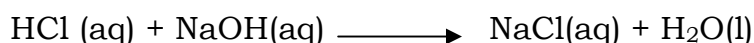


Reaction of acids and bases with each other :

Acids and bases react with each other to give salt and water. In all acid-base reactions both acids and bases lose their character. In other words, their acidity and basicity is destroyed and therefore, such reactions are called neutralization reactions. In general, a neutralization reaction may be represented as :

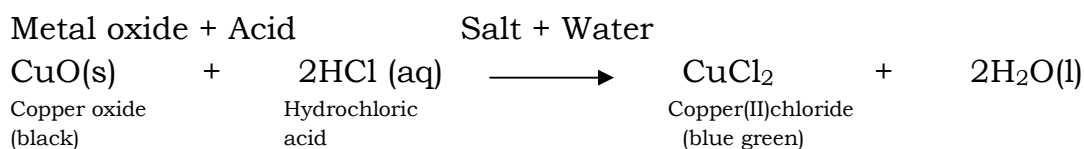


For example, the reaction between hydrochloric acid and sodium hydroxide may be written as :

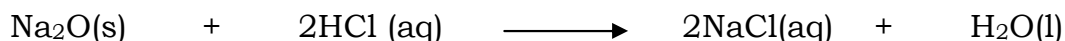


Reaction of metallic oxides with acids :

Acids react with merallic oxides to form their respective salts and water. The general reaction between metal oxide and acid can be written as :

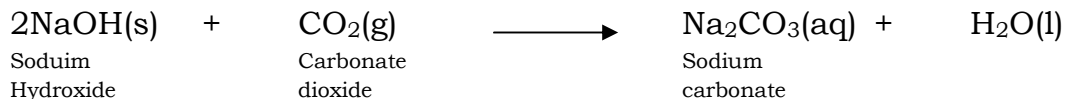


Similarly,

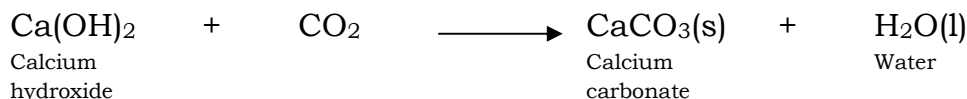


Reaction of non-metallic oxides with bases :

Bases react with non-metallic oxides such as carbon dioxide to give salt and water. For example, sodium hydroxide reacts with carbon dioxide to form sodium carbonate and water as :

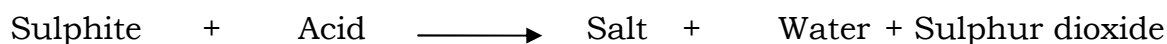


Calcium hydroxide solution is basic and it reacts with carbon dioxide to give salt and water.

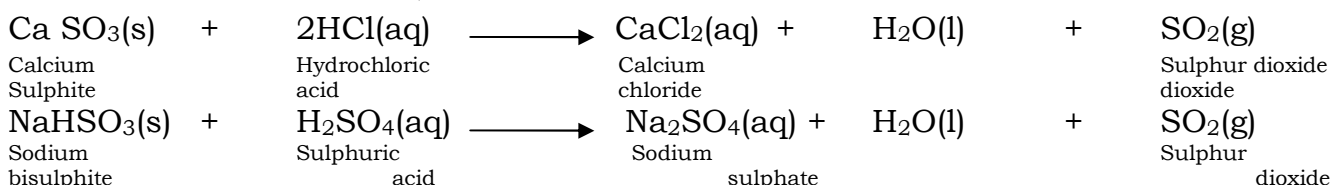


Reaction with sulphites and bisulphites (hydrogen sulphites) :

Dilute acids react with sulphites and hydrogen sulphites (bisulphites) to give sulphur dioxide as :

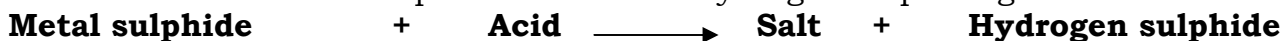


Some of the reactions are ;

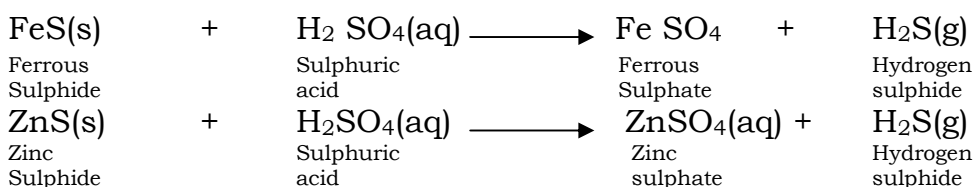


Reaction of acid with metal sulphides :

Acids react with metal sulphides to liberate hydrogen sulphide gas.



Hydrogen sulphide has the smell of rotten eggs. For exsample,



pH SCALE

The strength of an acid is a measure of its hydrogen ion $[\text{H}^+]$ concentration. In 1909, Sorensen suggested a new term for expressing the hydrogen ion concentration known as pH or pH scale, which in Danish language stands for Protentz and hydrogen (means Power of 10^{++} ion).

pH may be defined as a number by which negative power of 10 has to be raised in order to express the concentration of hydrogen ion of the solution in moles per litre.

$$[\text{H}^+] = 10^{-\text{pH}}$$

Where the concentration of H^+ ions is expressed as moles/litre and is written as $[\text{H}^+]$.

pH may also be defined as :

Negative logarithm (base 10) of the hydrogen ion concentration in moles per litre. Mathematically, it may be expressed as :

$$\text{pH} = -\log_{10}[\text{H}^+]$$

Since H^+ ions are always associated with water molecules, we may also write H_3O^+ for H^+ and hence pH may be expressed as :

$$pH = -\log[H_3O^+]$$

On the pH scale, we may measure pH from 0 (very acidic) to 14 (very basic). The pH may simply be thought as a number which indicates the acidic or basic nature of the solution.

pH of solutions :

pH of a solution gives information regarding acidic, basic or neutral character of the solution.

1. pH of neutral solutions :

Pure water is neutral. It has equal concentration of H_3O^+ and OH^- ions. It has been calculated that the concentration of both H_3O^+ and OH^- ions in a neutral solution or pure water are :

$$[H_3O^+] = 10^{-7} \text{ mol L}^{-1} \text{ and } [OH^-] = 10^{-7} \text{ mol L}^{-1} \text{ at } 298 \text{ K}$$

Therefore, pH of water or neutral solution may be written as :

$$\begin{aligned} pH &= -\log[H_3O^+] \\ &= \log [\quad] \end{aligned}$$

$$= 7$$

Thus, pH of all neutral solutions or pure water is 7. For example, a sodium chloride solution or a sugar solution are neutral, each having pH of 7.

2. pH of basic solutions :

All basic solution have pH more than 7. In other words, whenever a solution has pH more than 7, it will be basic (or alkaline) in nature and it will turn red litmus blue. As the pH increases from 7 to 14, the basic character increases.

3. pH of acidic solutions :

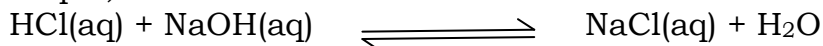
An acid solution having low pH value will be stronger acid than another solution having higher pH value solutions, having pH between 0 to 2 are strongly acidic while those having pH between 5 to 7 are weakly acidic. The solutions having pH between 2 to 5 are moderately acidic.

Salts :

A salt is a compound formed by complete neutralization of a base by an acid or an acid by a base.



For example,



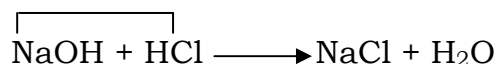
A salt is an ionic compound which contains a positive ion (cation) other than hydrogen ion and a negative ion (anion) other than hydroxyl ion.

Classification of salts :

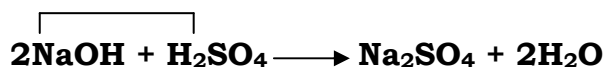
The salts may be classified in the following ways :

1. **Normal salts.** A normal salt is one which does not contain any ionisable or replaceable hydrogen atoms in its molecule. These salts are generally formed by complete replacement of all the replaceable hydrogen atoms of an acid by a metallic or electropositive radical such as ammonium ion.

For example, a normal salt sodium chloride ($NaCl$) is formed by replacement of hydrogen from hydrochloric acid by sodium metal.

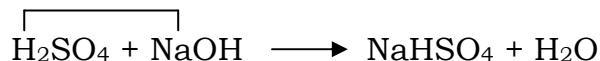


Similarly, a normal salt sodium sulphate is formed by the replacement of both the hydrogen atoms of H_2SO_4 by sodium atoms.



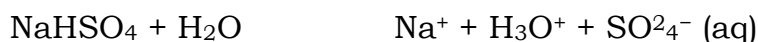
2. **Acidic salts.** These salts formed by partial replacement of replaceable hydrogen ion are called acidic salts. These contain replaceable hydrogen ions.

For example,



In this case, the metal sodium replaces only one hydrogen ion from sulphuric acid. Therefore, acid salt ionises in aqueous solution giving hydronium ion (H_3O^+) and hence gives all the properties of acids.

For example,



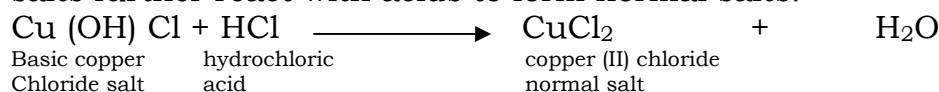
Acid salts further react with bases to form normal salts. Since these salts contain hydrogen ion.

3. **Basic salts.** The salts formed by the partial neutralization of a base by an acid are called basic salts.

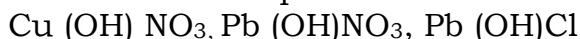
For example,



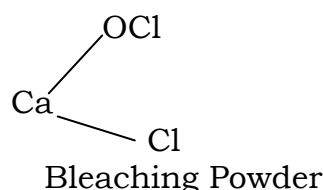
Basic salts further react with acids to form normal salts.



Some other examples of basic salts are :



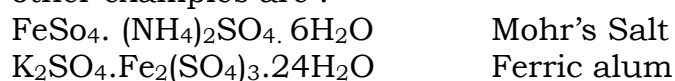
4. **Mixed Salts.** The salts containing more than one cation or anion other than H^+ or H^- ions are called mixed salts. For example, bleaching powder, CaOCl_2 which contains two anions Cl^- and OCl^- .



Some other examples are : NaKCO_3 , $\text{NaNH}_4\text{HPO}_4$ (microcosmic salt).

5. **Double salts.** These salts are formed from two simple salts in their equimolar proportions, when they are slowly crystallized out from a mixture of their saturated salt solutions. For example, potash alum, $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ is obtained by mixing K_2SO_4 and $\text{Al}_2(\text{SO}_4)_3$ in molar ratio in water solution followed by crystallisation.

Some other examples are :



pH of Salts :

The salts may be acidic, basic or neutral depending upon the acid or base from which they are formed. Therefore, the salts have different pH values.

In general,

- Salts of strong acids and strong bases are neutral with pH value of 7. E.g NaCl, KNO₃.
- Salts of strong acids and weak bases are acidic with pH values less than 7. E.g. CuSO₄, NH₄Cl.
- Salts of weak acids and strong bases are basic with pH value more than 7. E.g. Na₂CO₃.

(1) Common Salt (or sodium chloride)

Common salt is a compound of sodium and chlorine.

Occurrence. Common salt is obtained mainly from the sea water. At some places it is mined from salt rocks.

Formula: Common salt is an ionic compound. Its simplest formula corresponds to NaCl. In fact, it exists as an aggregate represented by the formula (Na⁺Cl⁻)_n.

Properties: (i) common salt is deliquescent i.e., it absorbs moisture from the atmosphere. This is due to the presence of small quantity of magnesium chloride (MgCl₂) in it. (ii) Common salt is thermally very stable

(iii) Common salt is soluble in water. Its solubility increases with a rise in temperature.

Uses: Sodium chloride although cheap, but is very important chemical compound. It is used extensively for the following purposes.

a) Common salt is used for manufacturing a large number of useful chemical compounds such as caustic soda, soda ash (Washing soda), baking soda, hydrochloric acid, chlorine gas etc.

b) Common salt forms an essential ingredient in our food.

c) Common salt is used in freezing mixtures (Mixtures containing ice and solid granular common salt) producing low temperature.

d) Common salt is used as a preservative for meat and fish

e) Is used in the manufacture of soaps.

Manufacture. Common salt is generally obtained from the sea water by evaporation method and is purified further before use.

Some common examples of materials obtained from common salts are :

1. Sodium hydroxide.
2. Baking soda
3. Washing soda
4. Bleaching Powder

1. Sodium hydroxide, NaOH :

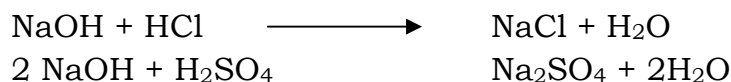
Sodium hydroxide is manufactured by passing electricity through an aqueous solution of sodium chloride (called brine), which decomposes to form sodium hydroxide. The process is called the chlor-alkali process because of the products formed, chlorine and alkali for sodium hydroxide.



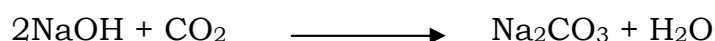
During electrolysis, chlorine gas, Cl_2 is liberated at anode while hydrogen gas, H_2 is evolved at cathode. Sodium hydroxide solution is formed near the cathode.

Properties :

- i) Sodium hydroxide is a white crystalline, deliquescent solid.
- ii) It is readily soluble in water to give alkaline solution. It also neutralises acids forming salt and water.

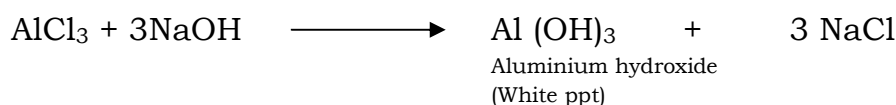


- iii) The crystals of sodium hydroxide are deliquescent i.e., they absorb moisture from air. On prolonged exposure, sodium hydroxide absorbs CO_2 resulting in the formation of white crust of solid hydrated Na_2CO_3 at the surface.



- iv) Its aqueous solution is soapy to touch and has a strong corrosive action on the skin.
- v) An aqueous solution of sodium hydroxide contains large concentration of hydroxyl ion (OH^-) and precipitates insoluble metal hydroxides from solutions containing metallic ions.

For example,



Uses of sodium hydroxide :

- (I) Sodium hydroxide is used in the manufacture of soaps and detergents, paper, artificial silk and a number of chemicals.
- (II) It is used in the petroleum refining.
- (III) It is used in the purification of bauxite (ore of aluminium).
- (IV) It is used in the textile industry for mercerising cotton fabrics. i.e., Making unshrinkable.
- (V) It is used as cleansing agent for machines and metal sheets. It is also used for degreasing metals.
- (VI) It is used for the preparation of pure fats and oils.
- (VII) It is used for the preparation of artificial silk.

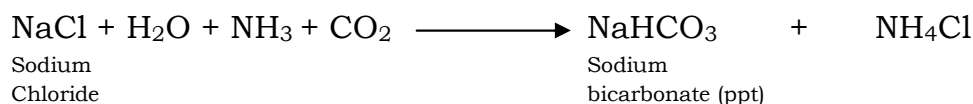
(2) Washing Soda $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (Sodium Carbonate)

Chemically, washing soda is sodium carbonate decahydrate. The molecular formula of washing soda is $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$, (Sodium carbonate decahydrate). Commercially, anhydrous sodium carbonate (Na_2CO_3) is called soda ash.

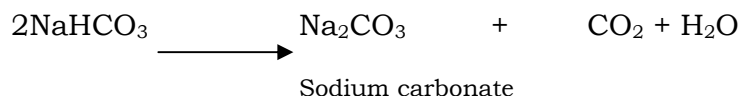
Manufacture :

Sodium carbonate is manufactured by solvay process (also known as ammonia soda process) as discussed below

- (i) When carbon dioxide gas is passed through a brine solution (about 28% NaCl), saturated with ammonia, it gives sodium bicarbonate.

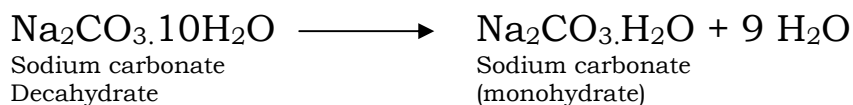


The participated sodium bicarbonate is filtered and dried. It is ignited to give sodium carbonate :

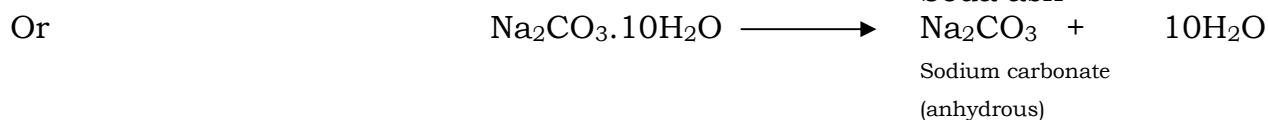
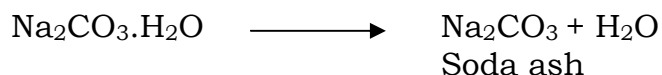


Properties :

1. (i) sodium carbonate is a transparent crystalline solid. It exists as a decahydrate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) containing 10 molecules of water of crystallisation.
2. It is readily soluble in water. It dissolves in water to form an alkaline solution, which turns red litmus solution blue. This shows that an aqueous solution of sodium carbonate is alkaline.
3. **Action of air :** when crystals of washing soda are left open in air they lose nine molecules of water of crystallization and form a white powder of sodium carbonate monohydrate. This process of loss of water of crystallisation from a hydrated salt to the atmosphere, on keeping it exposed to air is called efflorescence. Thus, washing soda is efflorescent.



4. Action of heart. On heating, above 373K, washing soda does not decompose but loses all its water of crystallisation to form anhydrous salt. Thus, the monohydrate becomes completely anhydrous and changes to white powder called soda ash.



Uses of Washing Soda (or sodium carbonate).

Some important uses of Washing Soda are.

1. Washing Soda is used for washing clothes (laundry purposes).
2. Washing soda is used for softening hard water.
3. Sodium carbonate (soda ash) is used for the manufacture of detergents.
4. Sodium carbonate is used for the manufacture of many important compounds such as borax.
5. Sodium carbonate is also used in paper and paint industries.

(3) **Baking soda, NaHCO_3 (Sodium Bicarbonate)**

The chemical name of baking soda is sodium hydrogen carbonate or sodium bicarbonate. Baking soda is represented by the formula NaHCO_3 .

Preparation: In laboratory, sodium bicarbonate can be prepared by saturating a cold solution of sodium carbonate with carbon dioxide.



Sodium carbonate

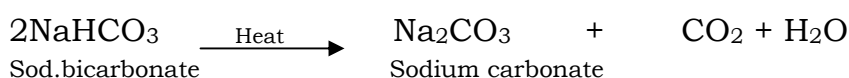
carbon dioxide

Sodium bicarbonate (white crystals)

Sodium bicarbonate being less soluble separates out as white crystals.

Properties :

1. Sodium bicarbonate is white crystalline solid.
2. It is soluble in water and its aqueous solution is alkaline in nature having pH greater than 7. Therefore, it is used to neutralize an acid.
3. It is a mild non-corrosive base.
4. Action of heat. On heating, sodium bicarbonate gets converted into sodium carbonate with the evolution of carbon dioxide gas.



Uses of sodium bicarbonate: Some typical uses of sodium bicarbonate are given below.

- (i) Sodium bicarbonate is used for preparing baking powder and effervescent drinks.
- (ii) Sodium bicarbonate is used as an antacid. It corrects the acidity in the stomach.
- (i) Sodium bicarbonate is used in old-type fire extinguishers.

What is baking powder?

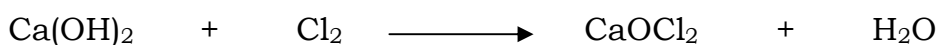
Baking powder is used to prepare porous, fluffy cakes, bread etc. Baking powder is a mixture containing sodium bicarbonate (NaHCO_3) and an acidic compound such as potassium hydrogen tartrate or citric acid. During the preparation of cake / bread, sodium bicarbonate reacts with the acidic compound to liberate carbon dioxide.

The CO_2 so released makes the cake / bread porous and fluffy (light weight and soft).

4. Bleaching powder, (CaOCl_2)

Chemically, bleaching powder is calcium oxychloride, CaOCl_2 or $\text{Ca}(\text{OCl})\text{Cl}$.

Preparation: Bleaching powder is prepared by the action of chlorine on dry slaked lime.

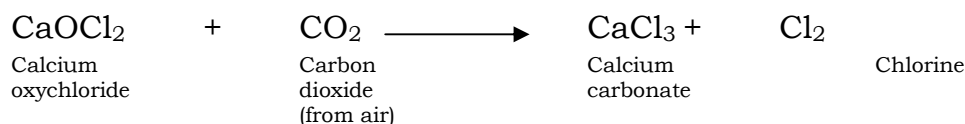


slaked lime

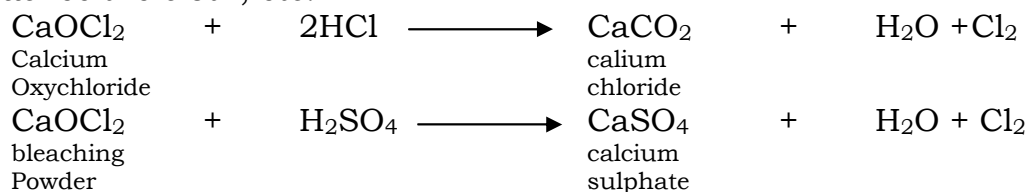
bleaching powder

Properties :

1. Bleaching powder is a yellowish white powder.
2. It gives strong smell of chlorine.
3. It is soluble in cold water giving a milky solution due to free lime present in it.
4. **Reaction with carbon dioxide :** when exposed to air, bleaching powder deteriorates giving off chlorine. This is due to the fact that it reacts with carbon dioxide present in air to produce calcium carbonate and chlorine gas.



5. **Reaction with dilute acids :** when bleaching powder is treated with an excess of a dilute acid (like HCl or H₂SO₄) all the chlorine present in it is liberated. This chlorine bleaches the cloth, etc.



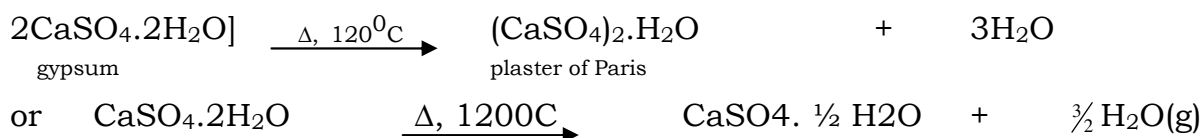
Uses: Bleaching powder is used

- For bleaching cotton fiber/fabrics in textile industry, and wood pulp in paper industry
- As a disinfectant and germicide.
- For sterilizing water.
- As an oxidizing agent.

Plaster of Paris, (CaSO₄.1/2 H₂O)

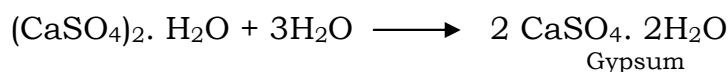
Plaster Of Paris is hemi-hydrate sulphate of calcium. Its molecular formula is CaSO₄.½ H₂O or (CaSO₄)₂.H₂O

Preparation: Plaster of Paris is obtained by heating gypsum (CaSO₄.2H₂O) at 120 – 125°C.



Properties :

- It is a white powder.
- It absorbs water with evolution of heat.
- When mixed with water, it forms a paste which sets into a hard mass. This is called setting of Plaster of Paris. The setting of Plaster of Paris is due to its hydration into gypsum.



Uses : Plaster of Paris is used for,

- sealing air gaps
- making casts for statues, toys and decorative objects.
- Plastering the fractured bones to keep the joints in a fixed position
- Making black board chalks

Water of Crystallisation:

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. The water which combines chemically with the crystals of a salt and becomes part of it is called water crystallisation. For example, five water molecules are present in one formula unit of copper sulphate, so the chemical formula of hydrated copper sulphate is CuSO₄.5H₂O. Similarly ten water molecules are present in one formula unit of washing soda. The chemical formula of hydrated salt is gypsum which has two molecules of water of crystallisation, it has the formula CaSO₄. 2H₂O.

