

dissolving the ore in the suitable chemical reagent and subsequent precipitation of the metal by other more electropositive metal is called hydrometallurgy. This method is applied for the extraction of Ag, Au from their ores.

Minerals and ores:

The natural materials found in the earth crust in which the metal is present in the combined state are called minerals. Those minerals from which the metals can be extracted conveniently and economically are called ores. Thus, all the ores are minerals but all the minerals are not ores. For example, clay contains aluminium but it is not ore of aluminium because the extraction of aluminium metal from clay is difficult and expensive. For example, bauxite ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) is ore of aluminium but clay ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$) is mineral.



Alloys and amalgams:

Alloys: An alloy is a homogenous mixture of metals with metals or non-metals.

Their chemical properties remain same as component elements where as physical properties differ. E.g. Bronze ($\text{Cu} + \text{Sn}$), Brass ($\text{Cu} + \text{Zn}$), stainless steel ($\text{Cr} + \text{Ni} + \text{Fe} + \text{C}$), etc.

There are two types of alloys:-

- (i) **Ferrous alloys:** Alloys which contain iron as one of the constituents are called ferrous alloys. E.g. steel ($\text{Fe} + \text{C}$).
- (ii) **Non-ferrous alloys:** Alloys which do not contain iron as one of the constituents are called non-ferrous alloys. E.g. Brass ($\text{Cu} + \text{Zn}$)

Amalgams: Alloys of Mercury with other metals are called amalgams. Amalgams are named after the name of metals. E.g. Sodium-amalgam (Na-Hg), Silver-amalgam (Ag-Hg), Zinc-amalgam (Zn-Hg), etc. But, Fe, Co and Ni do not form amalgams because of strong metallic bonding.

General principles of extraction of metals:-

Extraction of metals involves the following steps:-

1. Crushing and pulverization:

Ores are obtained from the crust of earth in the form of huge lumps. These huge lumps of ore are broken into small pieces by jaw crushers, the process is called crushing. These crushed pieces are then changed into fine powder in a ball mill or stamp mill and the process is called pulverization.

2 Concentration: The pulverized ore contains the impurities like rock, sand, etc. These impurities present in the ore are called gangue or matrix. The removal of impurities from the pulverized ore is called concentration. Concentration of ore can be done by following methods:-

(i) Gravity separation: This method is applicable for the concentration of non-sulphide ores like oxides and



carbonates in which the ore particles are heavier than the impurities. The powdered ore is washed with running stream of water. The lighter impurities are washed away leaving behind the heavier ore particles in the container.

(ii) Froth floatation process:

This method is used for the concentration of sulphide ores. The finely powdered ore is mixed with water and pine oil. The mixture is agitated by the blast of air. As a result of agitation, the ore particles which are preferentially wetted by oil rise up to the surface with the froth. The gangue particles which are preferentially wetted by water remain at the bottom of the tank. The froth at the surface of the tank is transferred to the other tank where it is washed with water to recover the ore particles.

(iii) Electromagnetic separation: This method is usually employed for the separation of magnetic impurities from non-magnetic ore and vice-versa. The powdered ore is



dropped over the belt revolving around the magnetic rollers. The electromagnetic roller attracts the magnetic part of the ore and is collected in the form of a heap near it leaving behind non-magnetic components away from it.

(iv) Leaching: It is a chemical method for the concentration of ore. In this process, the powdered ore is dissolved selectively in acid, base or some other suitable reagent. The impurities remain undissolved as sludge. The solution is filtered and the ore is recovered by precipitation or crystallization.

3. Calcination:

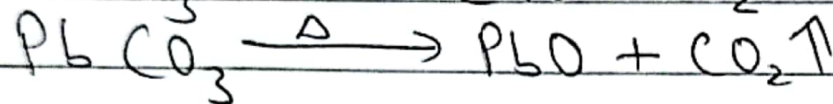
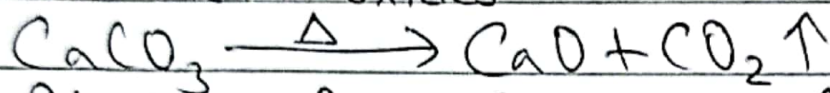
It is the process in which the concentrated ore is converted into its oxide. In this process, the concentrated ore is heated strongly in absence of air or limited supply of air below its melting point. It involves following three steps:-



(i) removes volatile impurities like SO_2 , CO_2 , etc.

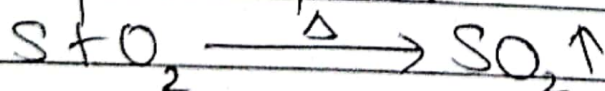
(ii) removes water of crystallization present in the ores.

(iii) removes CO_2 from carbonate ores to form metal oxides.



4. Roasting: It is also the process in which concentrated ore is converted into oxides. In this process, the concentrated ore is heated strongly in presence of excess of air below its melting point. It involves the following steps:-

(i) removes volatile impurities like sulphur, phosphorous, etc.



(ii) removes water of crystallization present in the ores.



(iii) The ore is converted into its oxide form in presence of oxygen

