

part 1 stv

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Unit - II [B]

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B. General Principles of Metallurgy

Metallurgy:

The process of extraction of pure metal from its ore is called as metallurgy.

Gangue OR Matrix:

The impurities or unwanted materials like, rock stones, sand, lime stone, mica, other silicates present in the ore are called as gangue.

Steps in metallurgy

For the extraction of pure metals, following steps are involved

- (i) Crushing and pulverization of the ore
- (ii) Dressing OR concentration of ore
- (iii) ~~Calcination~~ Roasting
- (iv) ~~Roasting~~ calcination
- (v) Smelting
- (vi) Refining

(1) Crushing and pulverization of the ore.

The ore occurs in nature in the form of huge lumps as big pieces. They are broken to small pieces with the help of crushers or grinders. These pieces are then reduced to fine powder with the help ball mill. This process is called as pulverisation.

(2) Dressing OR concentration of ore: (Gangue)

- The process of removal of impurities, from the ore is called as concentration of ore or dressing of ore.
- In this process, the percentage of desired metal increases
- It involves different method and selection of there

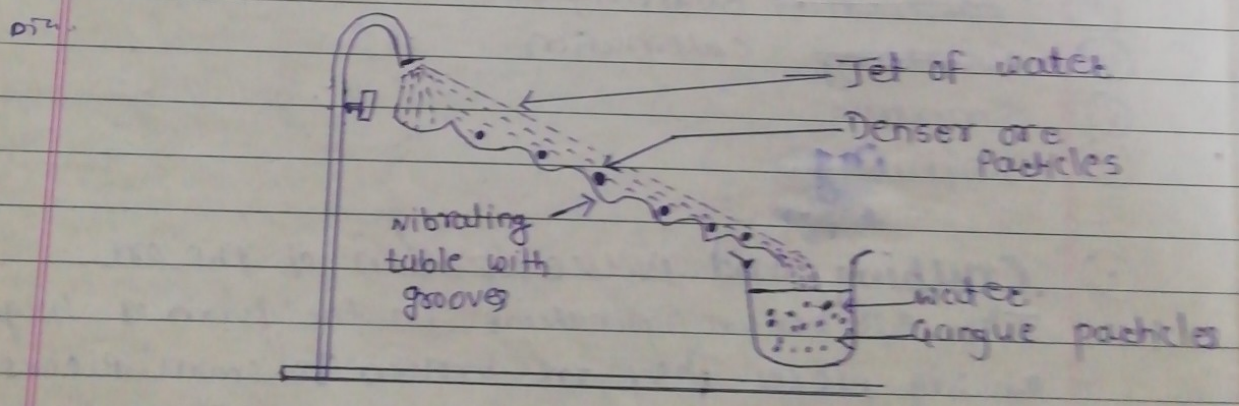
method depends upon the physical properties of ore nature of gangue, following common methods are used.

- a) Gravity separation method (Hydraulic classifier method)
- b) Magnetic separation method.
- c) Froth flotation method
- d) Leaching method

① Gravity separation method:

This method is used if lighter impurities are present in the ore.

- In this process, powdered ore is placed on the top of hydraulic classifier which is kept vibrating.
- The floor of table is fixed.
- The running water is passed across the table.
- The lighter gangue particles are carried away by water and heavier ore particles are settle between the wooden cleats or wedges on the floor of the table.



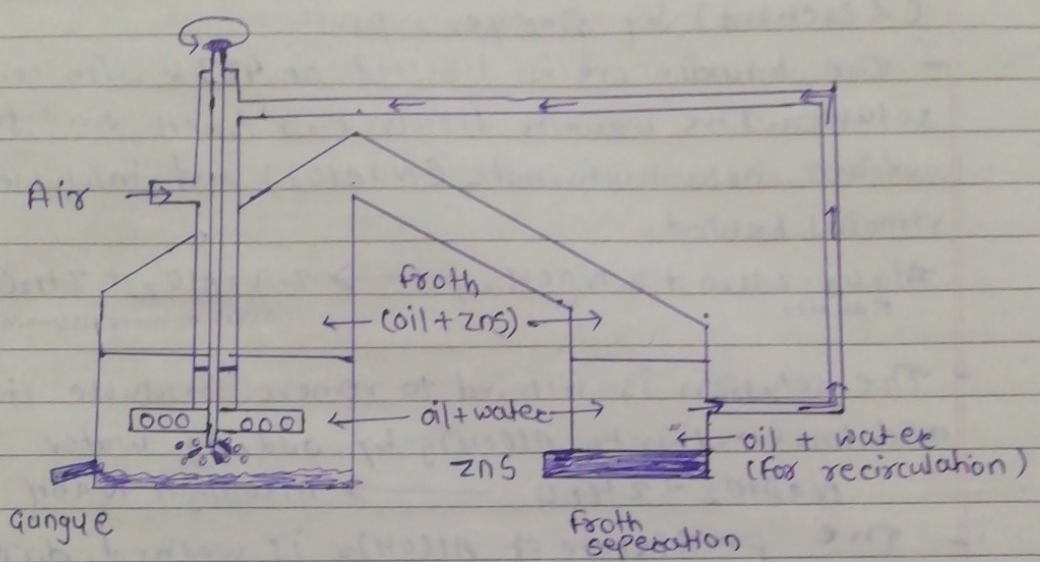
② Froth flotation method:

This method is used if ore is of sulphide type.

- In this method, The powdered ore is added to the mixture pine oil and water in flotation tank.
- The pine oil (or detergent) is used as foaming agent.
- The compressed air is passed through the mixture of pine oil and water and froth is formed.
- The ore particles are wetted by (reacts with) pine oil

white gangue are wetted by water and forms froth and goes the surface and another small container.

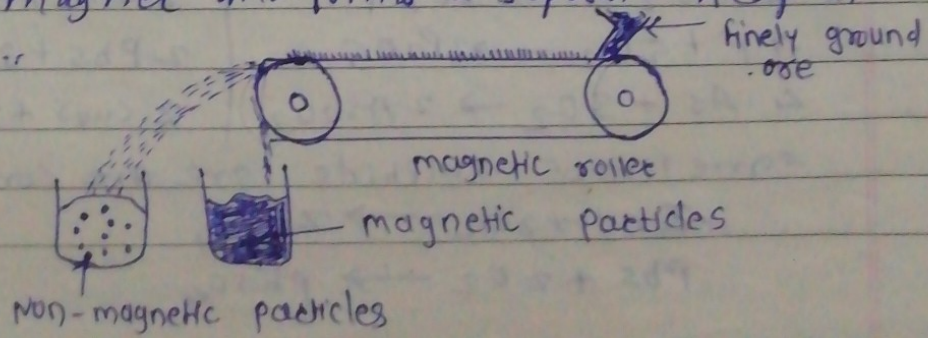
- The gangue particles are wetted by water and settle down at the bottom.



© Magnetic separation method:

This method is used if magnetite type of impurities are present in the ore (particularly hematite)

- This method is carried out by using electromagnetic separator.
- The electromagnetic separator consist of leather or brass belt moving over two rollers, one of which is magnetic and other is non magnetic roller.
- The powdered ore is dropped on the belt at ~~the~~ one end and passes over the roller.
- The magnetic part of ore ^{particles} clings to the belt for longer distance and forms a heap near the magnet and non magnetic ~~particles~~ part of ore is not attracted by the magnet and forms a separate heap at a certain distance.



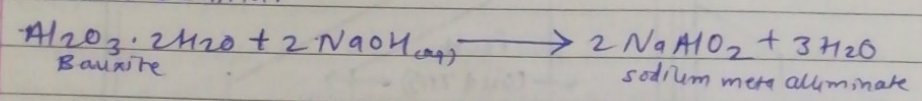
diag.

(i) Leaching process

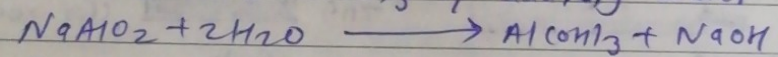
This method is used if the ore is completely soluble in solvent.

- A typical example of concentration of ore by leaching process is the purification of bauxite using NaOH solution (leachant) by Bayer's process.

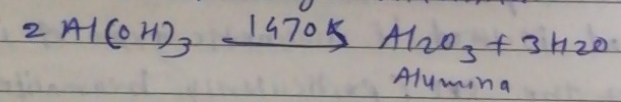
- The bauxite ore is digested at ~~473K~~ with conc. NaOH solution. The bauxite dissolves in NaOH and forms sodium meta aluminate (NaAlO₂) and insoluble impurities remain behind.



- The solution is filtered to remove insoluble impurities and converted into Al(OH)₃ by adding water



- The precipitate of Al(OH)₃ is washed, dried and ignited (heated) to get Alumina.



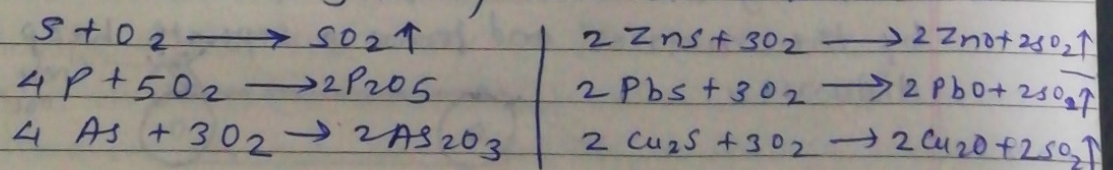
(ii) Roasting:

The process of heating of ore at ~~very~~ high temp. below its melting point in excess of air is called as roasting.

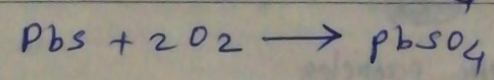
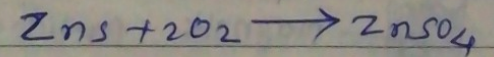
- In this process, moisture is given out and impurities like sulphur, Arsenic, Phosphorus are oxidised to their volatile oxides.

- It is carried out in a reverberatory furnace

- This method is generally used for sulphide ores.



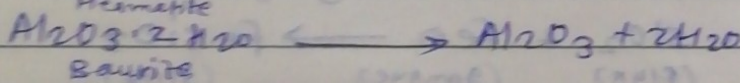
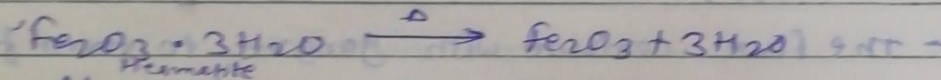
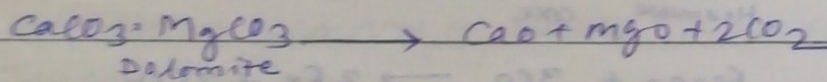
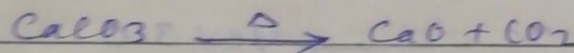
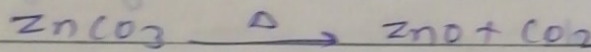
sometimes sulphide ore are converted into sulphate



(4) Calcination:

The process of heat of ore at very high temp. below its melting point in absence of air or limited supply of air is called calcination.

- In this process, the organic matter, moisture, volatile matter, CO_2 , SO_2 are given out from the ore.
- This process is generally used carbonate and hydrated type of ore.
- The hydrated ore loses its water of hydration.



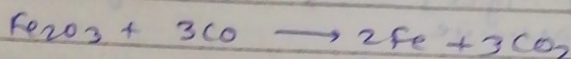
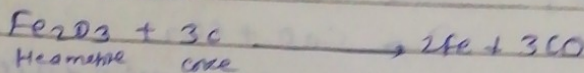
Distinguish betⁿ calcination and Roasting

Roasting	Calcination
1. The process of heating of ore Def ⁿ	Def ⁿ
2. It is used to convert sulphide ore into their oxides and sulphate	It is used to convert carbonate and hydrated ore into their oxide
3. This process is used to remove moisture and carry out oxidation of ore.	This process is used to remove moisture and volatile impurities present in ore
4. The impurities are oxidised and then evaporate.	4. The impurities are evaporated on heating
5. Oxidation reaction takes place during roasting	5. Decomposition reaction takes place during calcination

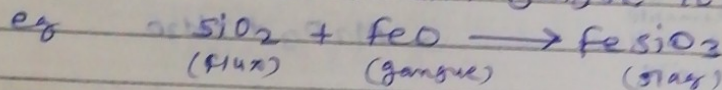
⑤ Smelting

The process of extraction of impure metal from its ore at high temperature by using suitable flux and reducing agent is called as smelting.

- In this process, the roasted ore is mixed with suitable quantity of carbon (C) and flux.
- The mixture is heated in the blast at high temp. above M.P. of the metal.
- C and CO are used ~~as~~ as reducing agent and reduces to metal.



- The flux combine with gangue to form fusible slag



① Flux:

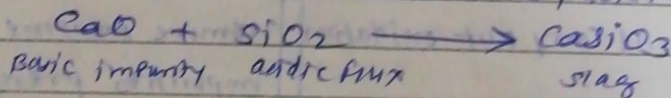
The chemical substance which is added to the concentrated ore during smelting to remove gangue is called flux.

- Flux removes gangue in the form of fusible slag.

- There are two types of flux

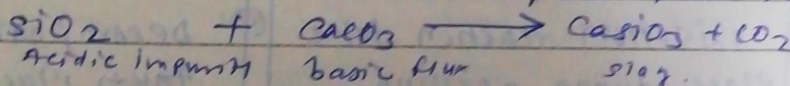
(i) Acidic Flux:

for basic impurities like lime, acidic flux is used.



(ii) Basic Flux:

for acidic impurities like silica, basic flux is used

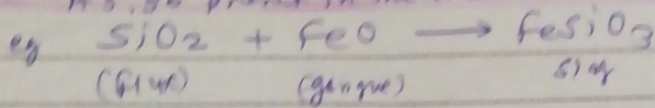


② Slag:

The waste product formed by the combination of flux and gangue during ~~extracting~~ smelting is called as slag.

- slag is insoluble in molten metal and float over the surface of molten metal.

Cupellation → It is the refining process in which ore is treated ~~with~~ under high temp. and separate noble metals like Ag, Au and from base metals like lead, Cu, Zn 7
As, Sb present in the ore



- Selection of flux depends on nature of gangue present in ore
- Slag prevents the oxidation of metal by air
- It forms separate layer above molten metal.

⑥ Refining and purification:

The metal obtained by smelting or reduction method contains small ~~impure~~ quantity of amount of impurities like silica or other metals. and

The process of removal of ~~soluble~~ impurities is called as refining.

The various methods are used for refining.

- (a) Lignation process
- (b) Distillation process
- (c) Cupellation
- (d) Poling
- (e) Electrolytic refining

But electrolytic refining is very important and gives 99.9% pure metal.

Electrolytic Refining: 8



Pyrometallurgy & Hydrometallurgy Difference,

Read book of Prakash Prakash Page No 52 & 53