Chemical Concentration (Leaching)

it involve dissolution of metallic ore in a suitable solvent in which metallic ore is soluble and impurities are insoluble

$$Ag_2S + NaCN \underset{}{\overset{air\ (O_2)}{\rightleftharpoons}} \underbrace{Na[Ag(CN)_2]}_{\text{Soluble}} + Na_2S$$

$$Na_2S + H_2O + O_2 \longrightarrow Na_2SO_4 + NaOH + S\downarrow$$

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Conversion of Conc. ore into oxide ore

Calcination

Roasting

① **Calcination** :→ Process of Heating of metallic ore at high temp. but below its melting point in absence of air or limited supply of air is called Calcination

example ⇒ Carbonate ore and hydrated oxide ore

$$FeCO_3 \xrightarrow{\Delta} FeO + CO_2$$

$$Fe_2O_3 \cdot 3H_2O \xrightarrow{\Delta} Fe_2O_3 + H_2O$$

$$Al_2O_3 \cdot 2H_2O \xrightarrow{\Delta} Al_2O_3 + H_2O$$

Note ⇒ In this process volatile impurities and organic matter also removed, hydrated ore becomes anhydrous
So metallic ore become porous and surface area ↑
So Reduction becomes higher.

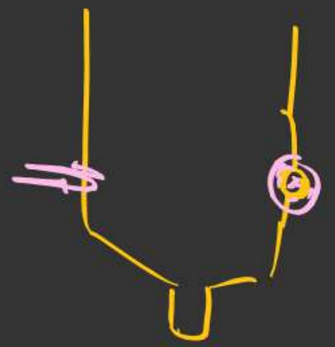
Roasting

Process of Heating of ore at high temp. but below its melting point in presence of air is called Roasting

$$\begin{cases} PbS + O_2 \longrightarrow \underset{\text{(maj.)}}{PbO} + SO_2 \\ PbS + O_2 \longrightarrow \underset{\text{(min.)}}{PbSO_4} \end{cases}$$

Note ⇒ In this volatile impurities and organic matter also removed. Hydrated ore becomes anhydrous So metallic ore becomes porus, surface area ↑ and Reduction becomes easy.

Note ⇒ Calcination and Roasting both carried out in Reverberatory furnace



SnO_2 (Roasting)

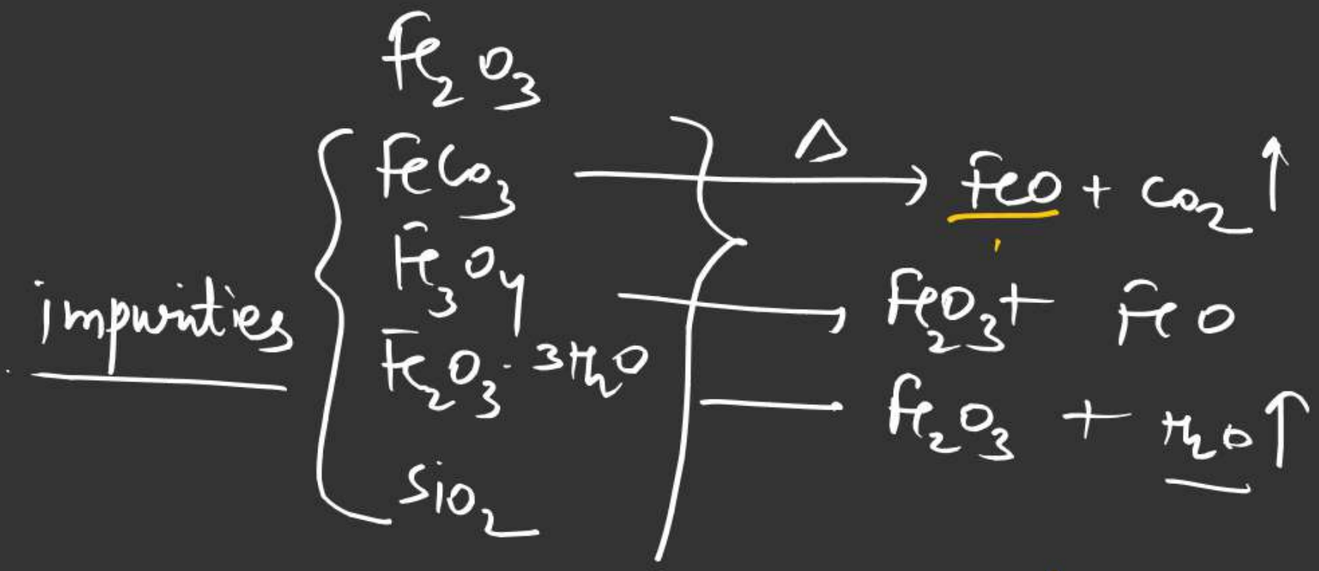
$S + O_2 \longrightarrow SO_2 \uparrow$

$As + O_2 \longrightarrow As_2O_3 \uparrow$

$Sb + O_2 \longrightarrow Sb_2O_3 \uparrow$

if impurities are non volatile but their oxides are volatile then Roasting required. (T)

$\longrightarrow$ Oxidisable volatile impurities also removed from Roasting. (T)



$FeO + SiO_2 \longrightarrow \underset{(slag)}{FeSiO_3}$

$FeO + O_2 \longrightarrow Fe_2O_3$

$Fe_2O_3 + SiO_2 \longrightarrow X$

lower oxidation state oxided converted in to higher oxidation state oxide.

Q/ Why roasting required?

$$MS_2 + C \longrightarrow MS + CS$$
$$MS + CS \longrightarrow M + CS_2$$

ΔG = +ive

$$MO_2 + C \longrightarrow MO + CO$$
$$MO + CO \longrightarrow M + CO_2$$

ΔG = -ive

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Roasting is Combustion Process (T)

Roasting is an exothermic Process (T)

$PbS + O_2 \longrightarrow PbO + SO_2$

Note ⇒ Sometimes Roasting may not bring about complete oxidation

$$CuFeS_2 + O_2 \longrightarrow Cu_2S + FeO + SO_2\uparrow$$

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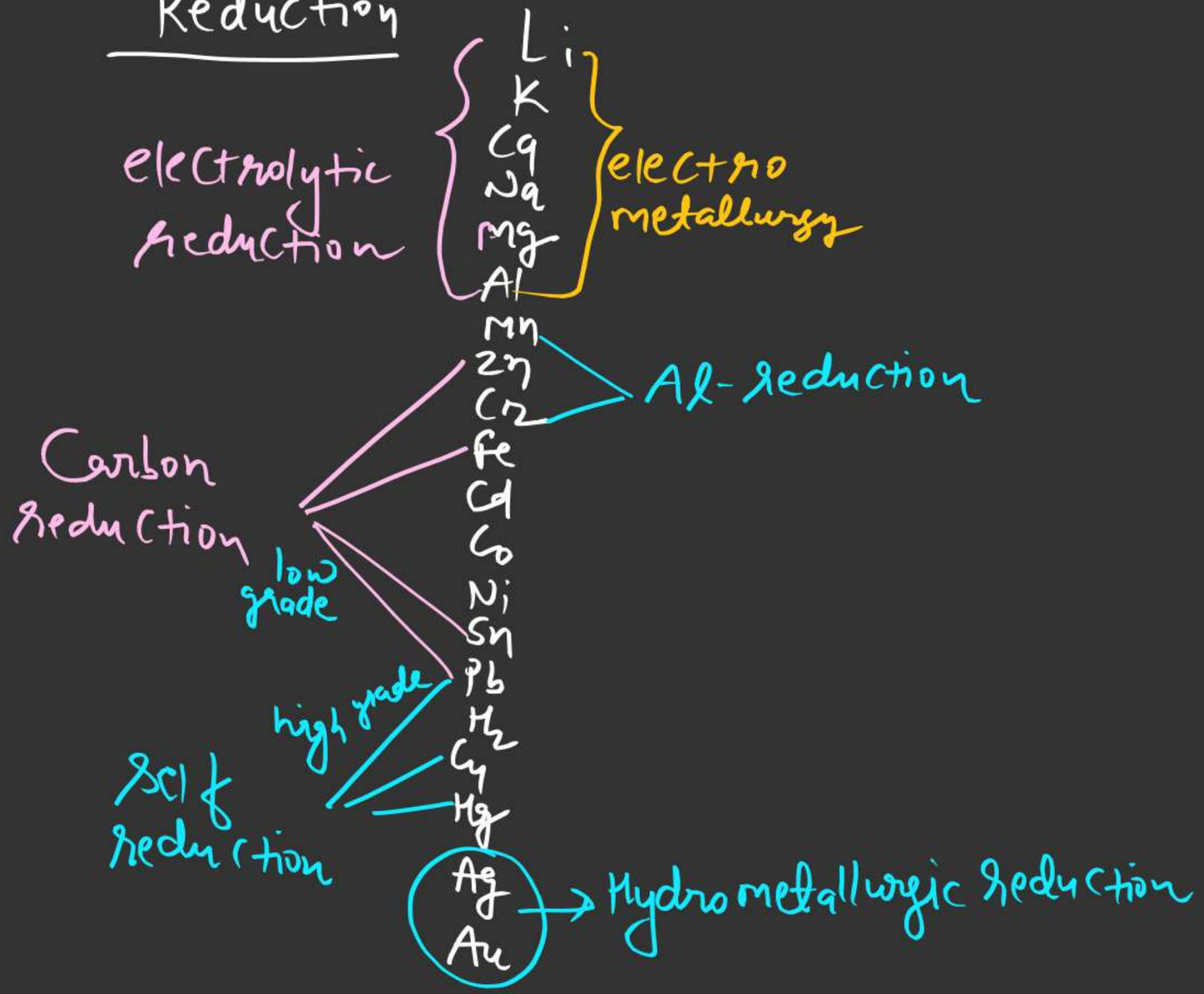
Reduction



Carbon reduction

Metal oxide + Coke powder + flux $\xrightarrow{\Delta}$ metal + Slag

$$MO_2 + C \longrightarrow M + CO$$

$$MO + CO \longrightarrow M + CO_2$$

Carbon Reduction method → Reducing agent ⇒ C and CO

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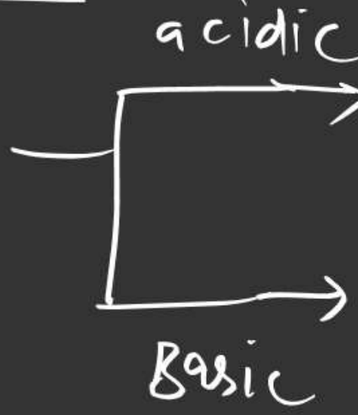
Flux — additional substance that are used to removal unwanted impurities.

type of flux



SiO_2, B_2O_3, $Na_2B_4O_7$

$FeCO_3$, $CaCO_3$, $MgCO_3$, $CaCO_3.MgCO_3$

FeO CaO BeO MgO

Slag / Cinder

Stable molten state which is formed in any step of extraction of metal.

it is immiscible in metallic ore

Slag have low M.P / low density

Slag is fusible mass

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Lux flood Concept

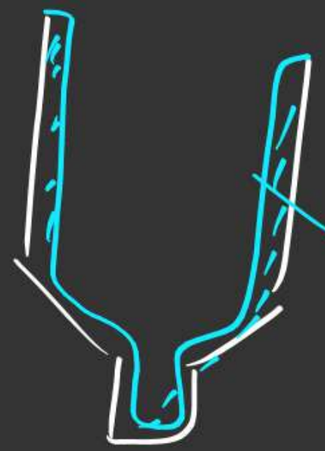
O^{-2} = donor = base

O^{-2} = acceptor = acid

$CaO + SiO_2 \longrightarrow CaSiO_3$

(Slag)

Ca^{+2} SiO_3^{-2}



refractory material

high M.P containing Substance

SiO_2 FeO CaO BeO

Carbon reduction (smelting)

Carbon reduction is called Called Smelting

Smelting ⇒ any stable molten form which formed in any step of extration metal

generally Carbon reduction and Smelting both occurs simultaneously but it is not always occurs example Cu

$$M + KCN + H_2O + O_2 \longrightarrow K[M(CN)_2] + KOH$$

M (Au / ~~Ag~~)

M (~~Ag~~ / Au)

Function of O_2 ⇒ Oxidising agent

Example ⇒ Ag, Au, low grade ore, Red bauxite