METALLURGY

PHYSICS WALLAH

01 CONCENTRATION

LEVIGATION

Hydraulic washing/Gravity separation

Cassiterite(tin stone - SnO_2)

02 CONCENTRATION

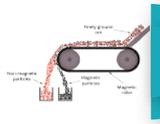
MAGNETIC SEPARATION

Cassiterite

Pyrolusite (MnO_2)

Chromite (FeO. Cr_2O_3)

Magnetite (Fe_3O_4)



03 CONCENTRATION

FROTH FLOATATION METHOD

Concentration of sulphide ore

Frothers - Pine oil, Eucalyptus oil

Collectors - Pine oil, Xanthates

Stabilisers - Cresol, Aniline

04 CONCENTRATION

LEACHING

Based on solubility in solvents

Bauxite ($Al_2O_3.2H_2O$) - Bayer's process (NaOH is leaching agent)

Silver & Gold ores (NaCN/KCN - leaching agent)

05 OXIDATION

CALCINATION

Heating in absence of air

Hydroxides, Carbonates, Hydrates are calcined

$ZnCO_3 \longrightarrow ZnO + CO_2$

$Al_2O_3.2H_2O \longrightarrow Al_2O_3 + 2H_2O$

06 OXIDATION

ROASTING

Heating in presence of air

Sulphides ores are roasted

$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

$2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$

07 REDUCTION

SMELTING

Heating before with coke or CO in presence of flux

Done in Blast furnace

Flux + Gangue $\longrightarrow$ Slag

SiO_2 FeO/CaO/MgO

FeO SiO_2/P_2O_5

08 REDUCTION

ELECTROLYTIC REDUCTION

Oxides of highly reactive metals

Alkali metals

Alkaline earth metals

Aluminium

9 REFINING

DISTILLATION

For low boling metals

Zn, Cd & Hg

10 REFINING

LIQUATION

For low melting metals

Sn, Pb & Bi

11 REFINING

ELECTROLYCTIC REFINING

Anode : Impure metal

Cathode : Pure metal

Electrolyte : Metal salt solution

Cu, Sn, Pb, Zn, Mn, Cr, Ni, Ag & Au

Au, Ag, Pt, etc are obtained from anode mud of Cu

12 REFINING

ZONE REFINING

To prepare semi-conductors & metals of high purity

Si, Ge, Ga, B & In

13 REFINING

VAPOUR PHASE REFINING

For Zr, Ni, Ti & Th

Mond process

$Ni + 4CO \xrightarrow{330-350K} Ni(CO)_4$

$Ni(CO)_4 \xrightarrow{450-470K} Ni + 4CO$

van Arkel method

$Zr + 2I_2 \longrightarrow ZrI_4$

$ZrI_4 \xrightarrow{1800K} Zr + 2I_2$

14 REFINING

CHROMATOGRAPHY

Based on adsorption

Al_2O_3 is the adsorbent in coloumn chromatography

FE

Ore - Fe_2O_3

Concentration: Froth Floatation

Extraction is done in blast furnace

Raw Materials: Ore + lime stone + coke

Pig Iron (4% Carbon)

↓

Cast Iron (3% Carbon)

↓

Steel (0.2 - 2% Carbon)

↓

Wrought Iron (0.2% Carbon)

Alloys

Stainless Steel (Fe + Cr + Ni + C)

1. Combustion Zone
   $C + O_2 \longrightarrow CO_2 + Heat$
2. Fusion Zone
   $CO_2 + C \longrightarrow 2CO - Heat$
3. Slag Formation Zone
   $CaCO_3 \longrightarrow CaO + CO_2$
   $CaO + SiO_2 \longrightarrow CaSiO_3$
4. Reduction Zone
   $Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$
   $Fe + CO \longrightarrow Fe + CO_2$

04 extraction of iron

HOTS ore

Bauxite - $Al_2O_3.2H_2O$

Cryolite - Na_3AlF_6

Kaolinite (a form of clay) - $[Al_2(OH)_4Si_2O_5]$

Haematite - Fe_2O_3

Magnetite - Fe_3O_4

Siderite - $FeCO_3$

Iron pyrites - FeS_2

Copper pyrites - $CuFeS_2$

Malachite - $CuCO_3.Cu(OH)_2$

Cuprite - Cu_2O

Copper glance - Cu_2S

Zinc blende or Sphalerite - ZnS

Calamine - $ZnCO_3$

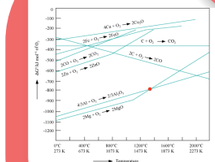
Zincite - ZnO

Q. Which one is malachite from the following?

(a) $Cu(OH)_2$ (b) Fe_3O_4

(c) $CuCO_3.Cu(OH)_2$ (d) $CuFeS_2$

HOTS ellingham diagram



Element represented by lower line can reduce compound represented by upper line

Q. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?

(a) Mg (b) Zn (c) Fe (d) Cu

ZN 01 extraction of zinc

Ore - ZnS

Concentration : Gravity separation

Froth floatation method

ZnS —Roasting→ ZnO —Producer gas Δ→ ZnO+C → Zn+CO

Refining : Distillation

Alloys : Brass (Cu+Zn)

German silver (Ni+Cu+Zn)

Q. Extraction of gold and silver involves leaching with CN^- ion. Silver is later recovered by

(a) Liquation (b) Distillation

(c) zone refining (d) displacement with Zn

CU 02 extraction of copper

Ore - $CuFeS_2$

Concentration : Froth floatation method

$CuFeS_2$ —Roasting→ Cu_2S+FeS (Molten matte) —Bessemerisation, Self reduction→ Cu (Impure (Blister Cu))

Refining : Electrolysis

Alloys : Constantan (Cu+Ni)

Monel metal (Ni+Cu+Fe)

Bell metal (Cu+Sn) 80%

Bronze (Cu+Sn) 90%

Q. Which can be used to obtain highly pure metal which is liquid at room temperature?

(a) Electrolysis (b) Chromatography

(c) Distillation (d) Zone refining

AL 03 extraction of aluminium

Ore - $Al_2O_3.2H_2O$

Concentration : Leaching (Baeyer's)

$Al_2O_3.2H_2O$ —Calcination→ Al_2O_3 —Hall Heroult, Electrolysis→ Al (Impure)

Electrolyte : $Al_2O_3 + Na_3AlF_6 + CaF_2$

Anode : Graphite rod

Cathode : Carbon lining

Alloys: Aluminium bronze (Al+Cu)

Duralumin (Al+Cu+Mg+Mn)

Alnico (Al+Ni+Co+Fe)

Q. The maximum temperature that can be achieved in blast furnace is

(a) Upto 1200 K (b) Upto 2200 K

(c) Upto 1900 K (d) Upto 5000 K