

# ISOLATION OF ELEMENTS

\* Minerals :- Naturally occurring chemical substances on the earth's crust.

\* Ores :- is a mineral from which metal can be extracted conveniently and economically.

All ores are minerals but reverse is not true

Like Clay is a mineral of Aluminium but ores are bauxite and ~~quartz~~ cryolite.

\* Generally ore requires enrichment before extraction because it is usually contaminated with earthy or undesired materials known as gangue.

The extraction and isolation of metals from ores involve the following major steps:-

- ① Concentration of the ore,
- ② Isolation of the metal from its concentrated ore
- ③ Purification of the metal.

\* Metallurgy :- The entire scientific process used for isolation of the metal from its ores is known as metallurgy.

## Occurrence of Metals

- Among metals, aluminium is the most abundant element.  $\rightarrow$  The third most abundant element in earth's crust (8.3% by weight)

- Iron - 2nd most abundant metal in the earth's crust.

<u>Metal</u>	<u>Ore</u>	<u>Composition</u>
Aluminium	Bauxite	$Al_2O_3 \cdot (OH)_3 \cdot 2x$ [ $0 < x < 1$ ]
Zinc	Zinc blende	$ZnS$
	Calamine	$ZnCO_3$
	Zincite	$ZnO$
Copper	Copper pyrites	$CuFeS_2$
	Malachite	$CuCO_3 \cdot Cu(OH)_2$
	Cuprite	$Cu_2O$
	Copper glance	$Cu_2S$
Iron	Haematite	$Fe_2O_3$
	Magnetite	$Fe_3O_4$
	Siderite	$FeCO_3$
	Iron pyrites	$FeS_2$

Isolation of metal from ore steps:-

① Concentration of Ores

Removal of the unwanted materials (eg. sand, clays, etc.) from the ore is known as concentration, dressing or benefaction.

Some important procedures of these steps are:

## i) Hydraulic Washing

- This is based on the differences in gravities of the ore and the gangue particles.
- It is therefore a type of gravity separation.

~~An upward stream of running water is used to wash the powdered ore.~~

- An upward stream of running water wash away lighter gangue particles leaving behind the heavier ores.

## ii) Magnetic separation

- Differences in magnetic properties of the ore components.
- One or the gangue should be attracted by a magnetic field.
- The ground ore is carried on a conveyor belt which passes over a magnetic roller.

## iii) Froth-Flotation Method

- Removes gangue from sulphide ores.
- In this process, a suspension of the powdered ore is made with water.
- To this process, collectors and froth stabilisers are added.

- Collectors - enhance non-wettability of the mineral particles.  
(Eg, pine oils, fatty acids, xanthates, etc)
- Froth stabilisers - Stabilise the froth.  
(Eg, cresols, aniline)

\* The mineral particles become wet by oils while the gangue particles by water.

\* A rotating paddle agitates the mixture and draws air in it, then the froth is formed which carries the mineral particles.  
The froth is light and is skimmed off, then collected for recovery of the ore particles.

↑  
Process of Froth floatation.

Q Is it possible to separate two sulphide ores?

Ans - Yes, by adjusting proportion of oil to water or by using depressants.

For ex, An ore containing ZnS + PbS, the depressant used is NACN.

It selectively prevents ZnS from coming to the froth but allows PbS to come with the froth.

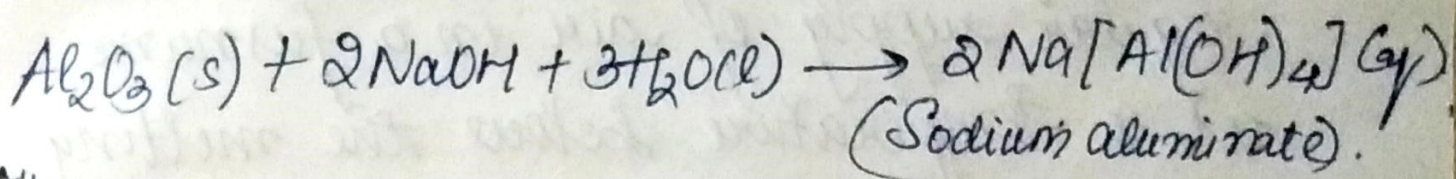
## 1) Leaching

If ore is soluble in suitable solvent it is an effective method of enrichment.

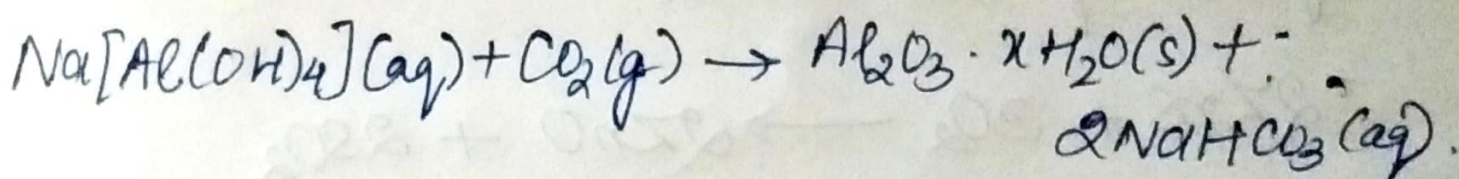
### a) Leaching of alumina from bauxite

The principal ore of Al, bauxite usually contains SiO<sub>2</sub>, iron oxides and titanium oxide (TiO<sub>2</sub>) as impurities.

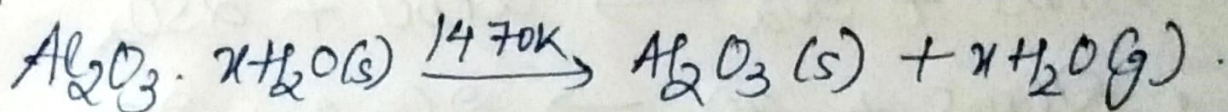
Powdered ore is digested with a concentrated sol<sup>n</sup> of NaOH (473-523K) and 35-36 bar pressure.



Then,



Then,



## 2) Extraction of Crude Metal from concentrated Ore

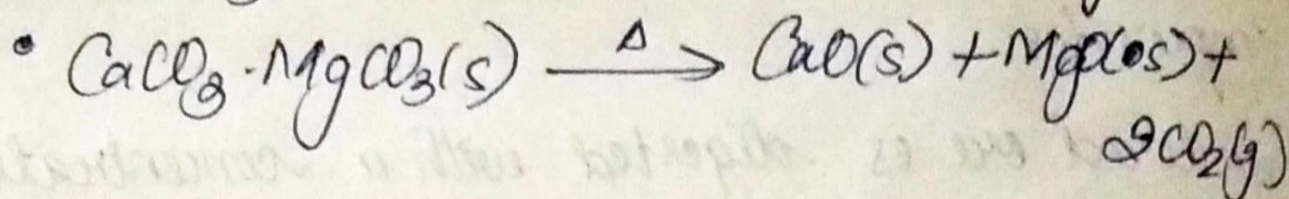
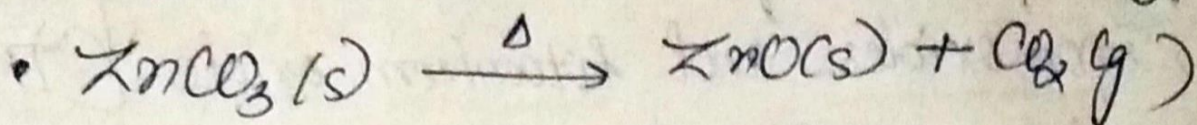
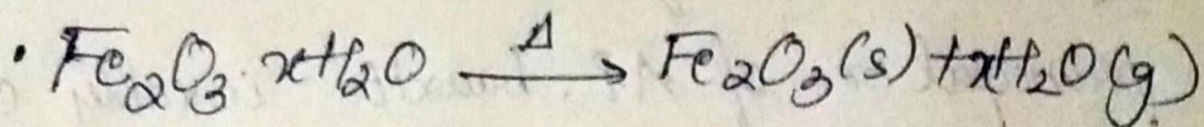
Extraction = Conversion to oxide + reduction of oxide.

Non-oxide ore is first converted to oxide

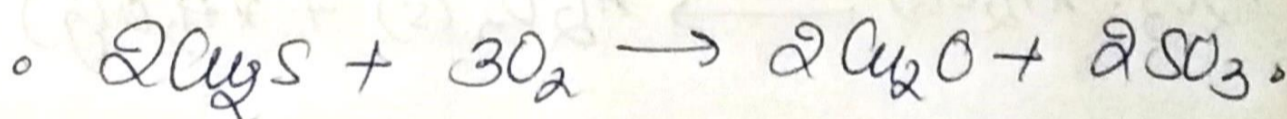
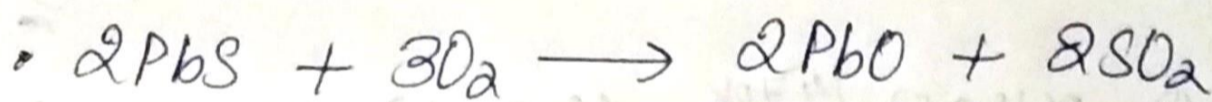
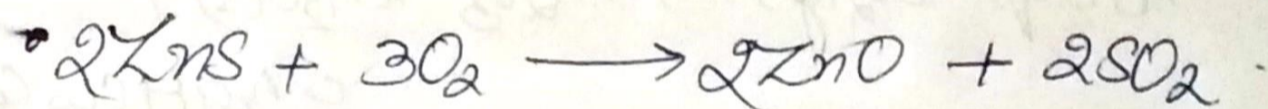
\* Isolation or extractions is done mostly by oxide because oxides are easy to reduce.

## a) Conversion to oxide

(i) Calcination :- It involves heating when the volatile escapes leaving behind the metal oxide.

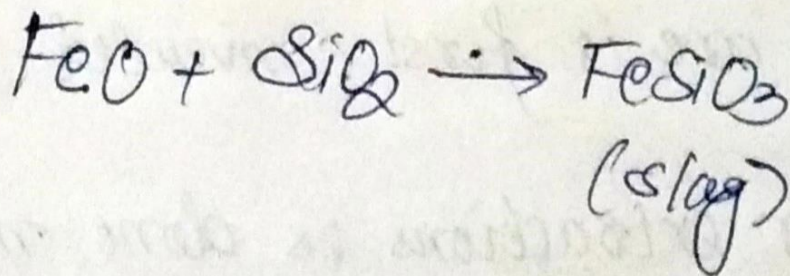


(ii) Roasting :- The ore is heated in a regular supply of air in a furnace at a temperature below the melting point of the metal.



\* The sulphide ores of copper are heated in reverberatory furnace.

If the ore contains iron, it is mixed with silica before heating.



## b) Reduction of oxide to the metal.

It usually involves heating it with some other substance acting as a reducing agent (C or CO or even another metal).

The reducing agent combines with O<sub>2</sub> of the metal oxide.

