

Complete
CHEMISTRY

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CLASS 11 & 12th



Learning Inquiry
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CLASS 12th

**General Principles &
Isolation of Elements**

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01. Introduction

- (i) **Minerals** : Naturally occurring solid substances having metals in combined state or native state are called minerals. Minerals do not contain NO_3^- ion because all nitrate salts are water soluble.
- (ii) **Ore** : A mineral is an ore from which one or more metals can be extracted easily and profitably.
- (iii) **Matrix or Gangue** : Minerals are always associated with earthy impurities known as matrix or gangue.
- (iv) **Flux** : It is a substance used to decrease the melting point of an ore or a substance used to react with impurities to form slag.
- (a) **Acidic flux** : It converts basic impurities to slag. For example, SiO_2 is used in the metallurgy of copper to remove FeO as FeSiO_3 (slag).
Other acidic fluxes are $\rightarrow \text{B}_2\text{O}_3, \text{P}_4\text{O}_{10}$ etc. $\text{FeO} + \text{SiO}_2 \rightarrow \text{FeSiO}_3$
- (b) **Basic flux** : It converts acidic impurities to slag. For example, CaO is used in the metallurgy of iron to remove SiO_2 as CaSiO_3 (slag).
Other basic fluxes are $\rightarrow \text{CaCO}_3, \text{MgCO}_3, \text{MgO}$ etc. $\text{SiO}_2 + \text{CaO} \rightarrow \text{CaSiO}_3$
- (v) **Slag** : The low fusible substance produced by the reaction of flux with impurities during extraction of metals, is called slag. The process is called slagging operation.
- (vi) **Alloy** : It is a homogeneous mixture of a metal with one or more elements that may be metals or non-metals.
- (vii) **Metallurgy** : The complete scientific and technological process employed for the extraction of a metal from its ore is called metallurgy.

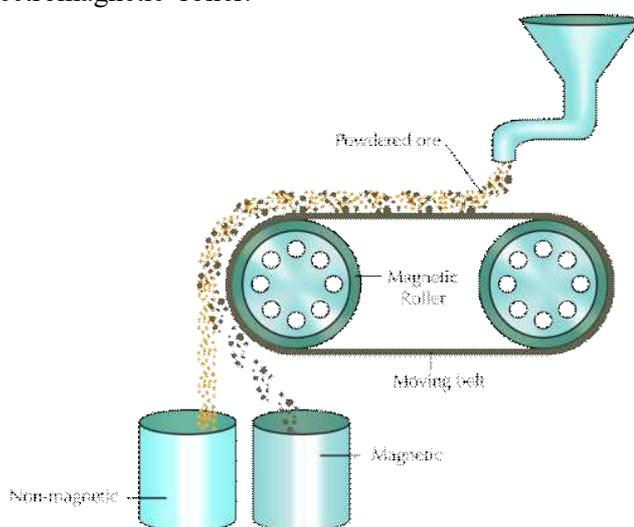
02. Occurrence of Metals

Metal	Mineral	Average composition
Iron	Haematite	Fe_2O_3
	Magnetite	Fe_3O_4
	Iron pyrites	FeS_2
	Siderite	FeCO_3
	Chromite	$\text{FeO} \cdot \text{Cr}_2\text{O}_3$
Copper	Chalcopyrites or copper pyrites (Fool's gold)	CuFeS_2 [Actual form : $\text{Cu}_2\text{S} \cdot \text{Fe}_2\text{S}_3$]
	Copper glance	Cu_2S
	Cuprite	Cu_2O
	Malachite	$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
	Azurite	$2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
Aluminium	Bauxite	$\text{AlO}_x(\text{OH})_{3-2x}$ [$0 < x < 1$] major form is $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
	Cryolite	Na_3AlF_6
	Kaolinite (a clay)	$[\text{Al}_2(\text{OH})_4 \cdot \text{Si}_2\text{O}_5]$
	China clay	$\text{Al}_2\text{O}_3 \cdot \text{SiO}_2 \cdot 2\text{H}_2\text{O}$

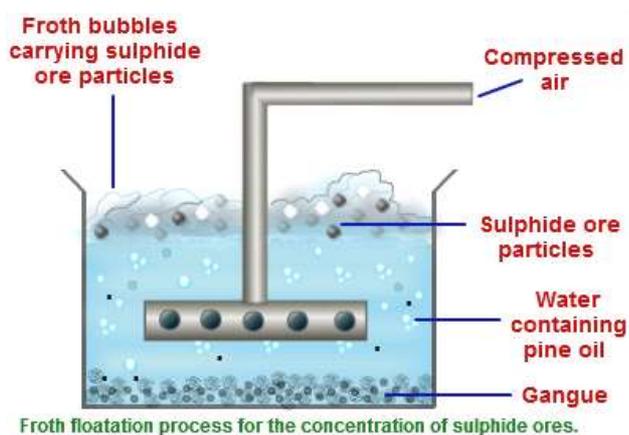
Metal	Mineral	Average composition
Zinc	Sphalerite or Zinc Blende Zincite Smithsonite or Calamine	ZnS ZnO ZnCO ₃
Silver	Argentite or Silver galnce Horn silver	Ag ₂ S AgSl

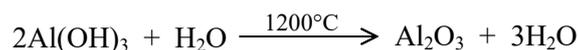
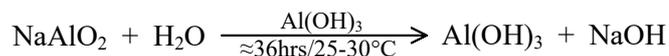
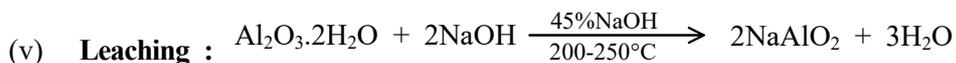
03. Extraction of Metals and Non-metals (General)

- (i) **Pulverisation** : The lumps of ore are converted to small pieces by using jaw crushers and to powder by employing stamp mill or ball mill.
- (ii) **Magnetic separation** : This method is employed to separate the magnetic and non-magnetic components present in the ore by carrying the powdered ore on a conveyer belt passing over an electromagnetic roller.



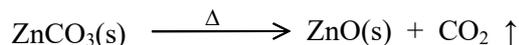
- (iii) **Hydraulic washing** : This method is employed to purify heavier ore such as oxides (e.g., haematite, tin stone etc.), carbonates (e.g., calamine, malachite, etc), native gold, etc.
- (iv) **Froth floatation process** : This method is employed to purify/concentrate sulphide ores.



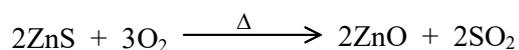


(vi) **Conversion of Ore to Oxide Form** :

(a) **Calcination** : Conversion of hydrated oxides, carbonates, basic carbonates and hydroxide ores to their oxides by heating in the absence of O_2 below their melting point is known as calcination.

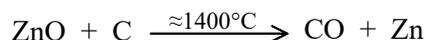


(b) **Roasting** : Sulphide ores are generally roasted in reverberatory furnace in free supply of air below melting point.



(vii) **Reduction of oxide to metal** :

(a) **Smelting : Carbon reduction method**



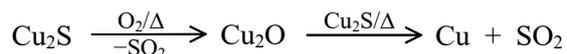
(b) **Reduction by H_2**



(c) **Metals as reducing agents**



(d) **Auto reduction or self reduction or air reduction method**



04. Ellingham Diagrams

