



236 V Minerals and ores

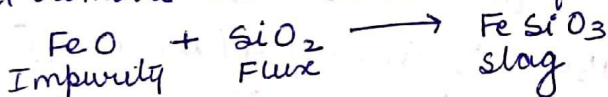
- (i) Minerals: The natural substances in which the metals or their compounds occur in the earth are called minerals.
- (ii) Ores: The minerals from which the metals can be conveniently and economically extracted are called ores.
All ores are minerals but all minerals are not ores.

(1) Role of depressant in Froth Floatation PROCESS

Its role is to prevent one type of sulphide ore particles from forming the froth with air bubbles. For example, NaCN forms a zinc complex is used as a depressant to separate lead sulphide (PbS) ore from zinc sulphide (ZnS) ore. It selectively prevent ZnS from coming to the froth but allows PbS to come with the froth.

(2) Role of Silica in metallurgy of copper

Silica acts as a flux in the metallurgy of copper and remove iron oxide as ferrous silicate slag.

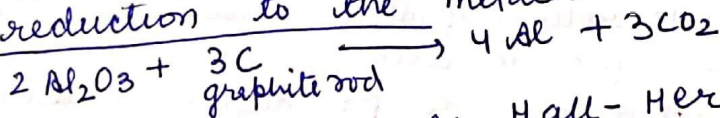


(3) Role of Cryolite in Metallurgy of Aluminium

In the metallurgy of Aluminium, purified Al_2O_3 is mixed with cryolite, Na_3AlF_6 which lowers the melting point of the mix and brings conductivity.

(4) Role of Graphite in Metallurgy of Aluminium.

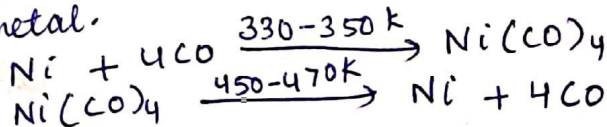
In the electrometallurgy of Aluminium, a fused mixture of alumina, cryolite (Na_3AlF_6) and fluor spar (CaF_2) is electrolysed using steel cathode and graphite anode. The graphite anode is useful here for reduction to the metal.



The process is known as Hall-Heroult process

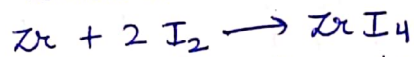
(5) Role of CO in Refining of crude Ni

In Mond process of Ni refining, Ni is heated in a steam of CO forming a volatile complex, nickel tetra carbonyl, which is subjected to higher temperature so that it is decomposed giving pure metal.



6. Role of Iodine in Refining of Zirconium/Titanium

Van Arkel method for refining Zirconium is very useful for removing all the oxygen and nitrogen present in the form of impurities. The crude metal is heated in evacuated vessel with iodine. The metal iodide being covalent volatiles.

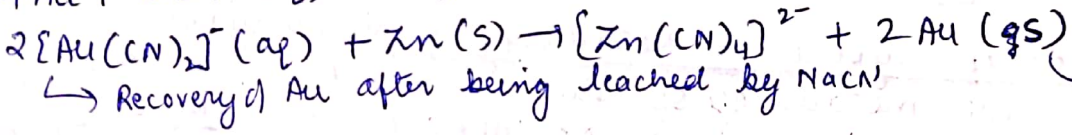
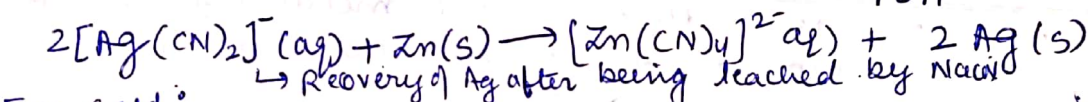
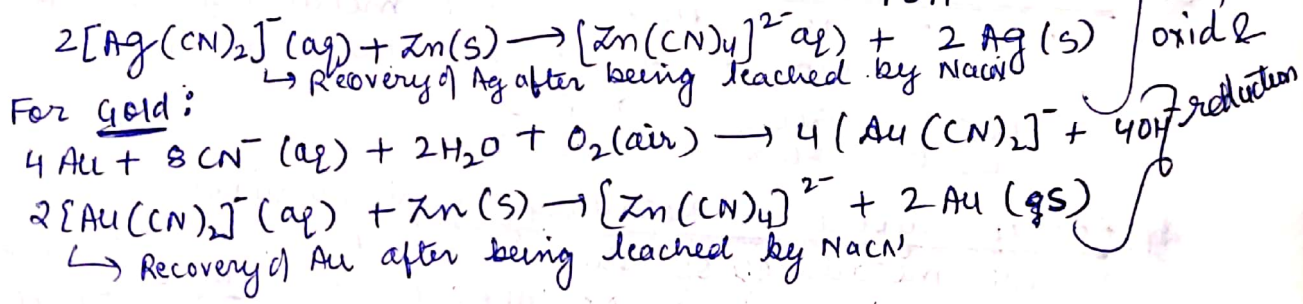
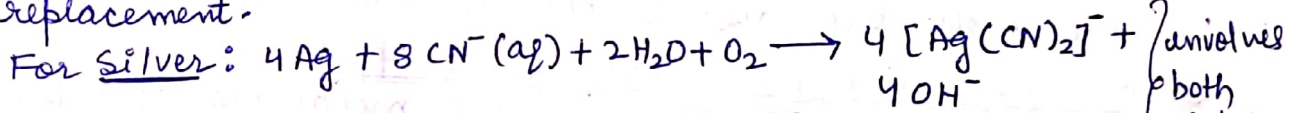


The metal iodide is decomposed on a tungsten filament where pure metal is deposited.



7. Role of NaCN in extraction of Ag and Au (Silver & gold)

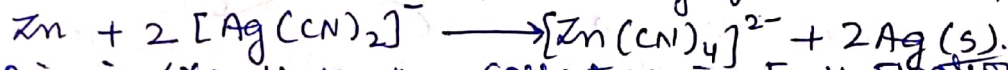
In the metallurgy of Silver and gold, the metal is leached with dilute solution of NaCN or KCN in presence of O_2 (air) from which metal is obtained later by replacement.



↑ involves both oxid & reduction

8. Role of Zn in extraction of silver

Zinc is cheaper as well as stronger reducing agent than Cu and replaces Ag from the complex



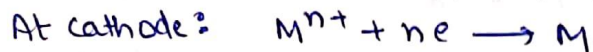
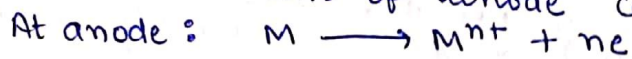
9. Role of Pine oil / Xanthates :- Collectors in Froth Flotation
COMMON METHODS OF EXTRACTION OF VARIOUS METALS

1. Aluminium: Electrolysis of Al_2O_3 dissolved in molten Na_3AlF_6
2. Iron: Reduction of oxide with CO and coke in Blast furnace.
3. Copper: ~~Roasting of sulphide partially and reduction~~ Electrolytic refining
4. Zinc: Roasting followed by reduction with coke
5. Nickel: Mond process
6. Titanium & Zirconium: Van Arkel method.
7. Silver and Gold: Leaching with NaCN/KCN
8. Germanium, Si, B, Ga, In: Zone refining

SHORT NOTES

Electrolytic refining

In this method, the impure metal is taken as anode and pure form of same metal is taken as cathode, soluble salt of metal is used as electrolyte. When electric current is passed, impure metal forms metal ions which are discharged at cathode forming pure metal and impurities settle at bottom of anode called anode mud.

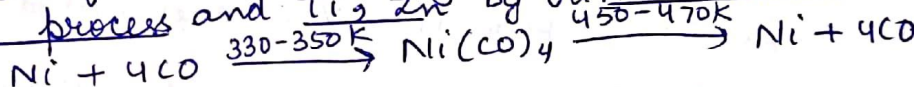


ZONE REFINING

This method is based on the principle that impurities are more soluble in the melt than in the solid state of metal. Therefore, on moving a circular heater along the rod of impure metal, the pure metal crystallises out of the melt and the impurities pass on to adjacent molten zone. The process is repeated several times in one direction thus impurities get concentrated at the end which is cut off. Method is useful for producing semiconductors & other metals of high purity eg Germanium, Si, B, Ga, In.

VAPOUR PHASE REFINING

Crude metal is freed from impurities by first converting into a volatile compound which decomposes into pure form on heating. Nickel is purified by Mond process and Ti, Zr by Van Arkel method.



FROTH FLOTATION METHOD

This method is used for the concentration of sulphide ores such as ZnS etc. It is based on the preferential wetting properties with the frothing agent and water.

The ore is wetted by oil but impurities are not. Thus the ore floats on the surface with froth while impurities settle down as gangue. The froth is skimmed off from the top.

COLUMN CHROMATOGRAPHY

It involves separation of a mixture over a column of adsorbent packed in a glass tube. The column is fitted with a stopcock at its lower end. The mixture adsorbed on adsorbent is placed on the top of the adsorbent column packed in a glass tube. Appropriate eluent which is a liquid or a mixture of liquids is allowed to flow down the column slowly. Depending on the degree to which the compounds are adsorbed, complete separation takes place. The most readily adsorbed substances are retained near the top and others come down to various distances in the column. This method is useful for purification of rare elements, available in ore etc.

Copper matte

Copper matte consist of cuprous sulphide (Cu_2S) with a little of Ferrous sulphide (FeS .)

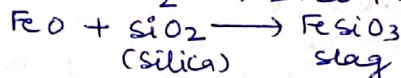
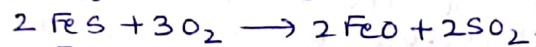
QUESTIONS

Q1. How is 'cast iron' different from 'Pig iron'?

Ans The iron obtained from blast furnace is called Pig iron. It contains 4% C and many other impurities in small amount. Cast iron on the other hand, is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content ($\sim 3\%$) & is extremely hard & brittle.

Q2. Why is copper matte put in silica line converter?

Ans The role of silica lined converter is to remove FeS in the matte as $FeSiO_3$.



Q3. What type of ores are separated by magnetic separation?

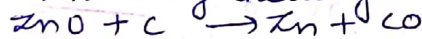
Ans of either the ore or the gangue is capable of being attracted by magnet.

Q4. Which elements are present in anode mud in electrolytic refining of Cu?

Ans Silver and gold becz they are less basic than copper. These are not ionised under the applied voltage and get deposited in the anode mud.

Q5. How can you purify

a) ZnO to Zn : By heating with carbon



b) Impure Ti to pure Ti : Van Arkel method discussed earlier

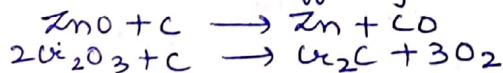
Q6. Give reasons

a) Alumina is dissolved in cryolite for electrolysis.

Ans ~~Alumina~~ Cryolite helps reduce MOP , improve conductivity and increase overall yield

b) ZnO can be reduced to Zn by heating with C but Cr_2O_3 cannot be

Ans Because Cr has affinity to react with C but not zinc



Q7. Method used for removing gangue from sulphide ores?

Ans Froth Floatation

Q8. What is diff between wrought iron & steel.

Ans Wrought iron is the purest form of iron with 0.2% to 0.5% C only but steel is produced from cast iron may contain 0.1 to 1.5% C & is widely used in making machine parts.

Q9. Out of C and CO , which is better reducing agent at the lower temp range in the blast furnace to extract Fe from Fe_2O_3

Ans CO : $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$