Chemistry Study Materials for Class 10
(NCERT Based notes of Chapter -03)

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METALS AND NON-METALS

EXTRACTION OF METALS AT THE BOTTOM OF THE ACTIVITY SERIES

(Ag, Hg etc) Metals at bottom of the activity series are often found in Free State. They reactivity with other atoms is very low. The oxides of these metals can be reduced to metals by heat alone and sometimes by displacement from their aqueous solutions.

(i) When cinnabar (HgS) which is an ore of mercury, heated in air, it is first converted into (HgO) then reduced to mercury on further heating.

Eg: $2HgS + 3O_2 \rightarrow 2HgO + 2SO_2$

$2HgO \rightarrow 2Hg + O_2$ on heating

(ii) Displacement from aqueous solutions:

Eg: $Ag_2S + 4CN^- \rightarrow 2[Ag(CN)_2]^- + S^{2-}$

$2[Ag(CN)_2]^-$ (aq) + Zn(s) $\rightarrow [Zn(CN)_4]^{2-}$ (aq) + 2Ag(s)

Here Ag_2S is dissolved in say KCN solution to get dicyanoargentate (I) ions.

From these ions Ag is precipitated by treating with Zn dust powder.

Metals	Action of Oxygen	Reaction with cold water	Reaction with steam	Reaction with dilute strong Acids	Reaction with chlorine on heating
K	Form Na_2O, K_2O in limited supply of O_2 but form peroxides in excess of O_2	K to Mg displace H_2 from coldwater with decreasing reactivity {K violently but Mg very slowly}	K to Fe displace H_2 with steam without decreasing reactivity. {K very violently but Fe very slowly}	K to Pb displace H_2 from dilute strong acids with decreasing reactivity. {K-explosively, Mg-very vigorously, Fe-steadily, Pb-very slowly}	All metals react with Chlorine on heating toform their respective Chlorides but with decreasing reactivity from top to bottom. This is understood from the heat evolved when the metal reacts with one mole of Chlorine gas to form Chloride. KCl, NaCl, $CaCl_2$, $MgCl_2$, Al_2Cl_3, $ZnCl_2$, $FeCl_3$, $PbCl_2$, $CuCl_2$, $HgCl_2$, AgCl, $PtCl_3$ and $AuCl_3$ are formed
Na					
Ca	Burn with decreasing vigour to form oxides CaO, MgO, Al_2O_3, ZnO, Fe_2O_3				
Mg					
Al		From Al to Au do not displace H_2 from cold water			
Zn					
Fe					
Pb	Don't burn, but only form a surface layer of oxide PbO, CuO, HgO		From Pb to Au donot displace H_2 from steam		
Cu				Cu to Au do not displace H_2 from dilute strong acids	
Hg					
Ag	Don't burn or oxidise even on the surface				
Pt					
Au					

PURIFICATION OF THE CRUDE METAL:

The metal obtained by the reduction of the ore is usually contaminated with impurities like unchanged ore, other metals present in the ore and non metals from the anions in the ore.

For example, the (blister) copper obtained from its sulphide ore is a compound of copper iron pyrites ($CuFeS_2$). It contains some copper sulphide, iron and sulphur. It is purified by suitable methods including electrolysis. The process of obtaining the pure metal from the impure metal is called refining of the metal. Refining of the metal involves several types of processes. Some refining methods are given below:

a) Distillation

b) Poling

c) Liquation

d) Electrolysis etc.

The process that has to be adopted for purification of a given metal depends on the nature of the metal and its impurities?

a) Distillation: This method is very useful for purification of low boiling metals like zinc and mercury whether contain high boiling metals as impurities. The extracted metal in the molten state is distilled to obtain the pure metal as distillate.

b) Poling: The molten metal is stirred with logs (poles) of green wood. The impurities are removed either as gases or they get oxidized and form scum (slag) over the surface of the molten metal. Blister copper is purified by this method. The reducing gases, evolved from the wood, prevent the oxidation of copper.

c) Liquation: In this method a low melting metal like tin can be made to flow on a slopy surface to separate it from high melting impurities.

d) Electrolytic refining: In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal.

The required metal gets deposited on the cathode in the pure form. The metal, constituting the impurity, goes as the anode mud.

The reactions are:

Anode: $M \rightarrow M^{n+} + ne^{-}$

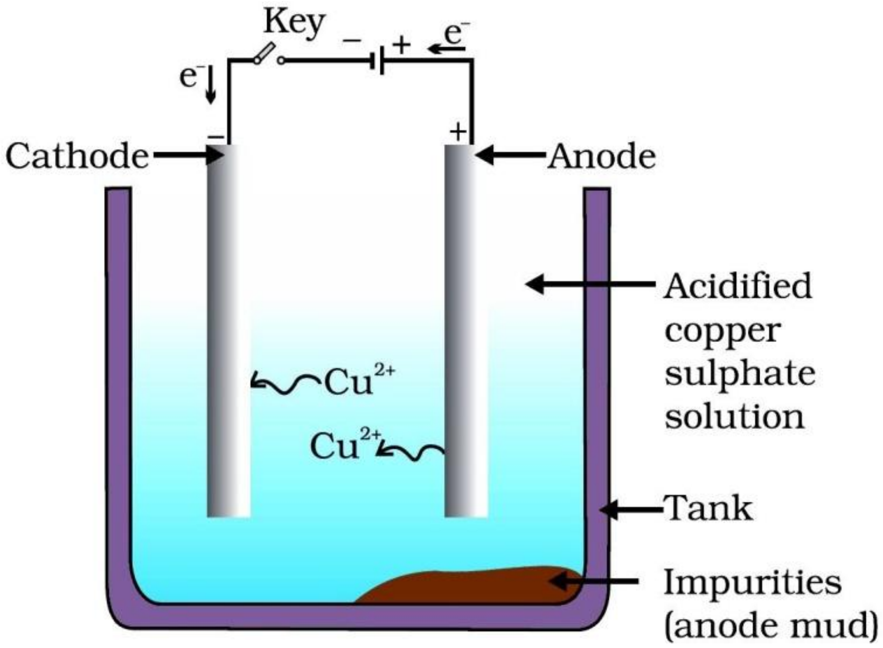
Cathode: $M^{n+} + ne^{-} \rightarrow M$ (M = pure metal) Where n = 1,2,3, ...

We use this electrolytic method to refine copper.

For this an impure copper is taken as anode and pure copper strips are taken as cathode. The electrolyte is a acidified solution of copper sulphate. As a result of electrolysis copper in pure form is transferred from the anode to the cathode.

Anode: $Cu \rightarrow Cu^{2+} + 2e^{-}$

Cathode: $Cu^{2+} + 2e^{-} \rightarrow Cu$



The suitable impurities go into the solution, where as insoluble impurities from the blister copper deposited at the bottom of anode as anode mud which contains antimony.

Selenium, tellurium, silver, gold and platinum; recovery of these elements may meet the cost of refining.

Zinc may also be refined this way.

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