

## Copper and its Compounds.

Ores: Copper pyrites (chalcopyrite)  $CuFeS_2$ , Cuprite (ruby copper)  $Cu_2O$ , Copper glance ( $Cu_2S$ ), Malachite [ $Cu(OH)_2 \cdot CuCO_3$ ], Azurite [ $Cu(OH)_2 \cdot 2CuCO_3$ ]

Extraction: Most of copper (about 75%) is extracted from its sulphide ore, copper pyrites.

Concentration of ore: Froth floatation process.

Roasting: Main reaction:  $2CuFeS_2 + O_2 \rightarrow Cu_2S + 2FeS + SO_2$ .

Side reaction:  $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ ;  $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$ .

Smelting:  $FeO + SiO_2 \rightarrow FeSiO_3$  (slag);  $Cu_2O + FeS \rightarrow FeO + Cu_2S$

Note: The mixture of copper and iron sulphides melt together to form 'matte' and the slag floats on its surface.

Conversion of matte into Blister copper (Bessemerisation): Silica is added to matte and a hot blast of air is passed  $FeO + SiO_2 \rightarrow FeSiO_3$  (slag). Slag is removed. By this time most of iron sulphide is removed.  $Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$

Note: Blister copper: Which contain about 98% pure copper and 2% impurities (Ag, Au, Ni, Zn etc.)

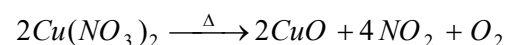
Properties of copper: It has reddish brown colour. It is highly malleable and ductile. It has high electrical conductivity and high thermal conductivity. In presence of  $CO_2$  and moisture Cu is covered with a green layer of  $CuCO_3 \cdot Cu(OH)_2$ .  $2Cu + H_2O + CO_2 + O_2 \rightarrow CuCO_3 \cdot Cu(OH)_2$ .

It undergoes displacement reactions with lesser reactive metals e.g. with Ag. It can displace Ag from  $AgNO_3$ . The finally divided Ag so obtained is black in color.

Compounds of copper

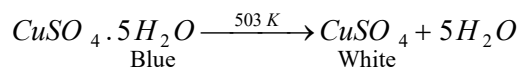
Cuprous oxide  $Cu_2O$ : It is a reddish brown powder insoluble in water but soluble in ammonia solution, where it forms diammine copper (I) ion.  $Cu^+ + 2NH_3 \rightarrow [Cu(NH_3)_2]^+$ . It is used to impart red colour to glass in glass industry.

Cupric oxide  $CuO$ : It is dark black, hygroscopic powder which is reduced to  $Cu$  by hydrogen, CO etc. It is used to impart light blue color to glass. It is prepared by heating copper nitrate.

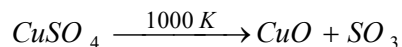


Copper sulphate  $CuSO_4 \cdot 5H_2O$  (Blue vitriol): It is prepared by action of dil  $H_2SO_4$  on copper scrap in presence of air.  $2Cu + 2H_2SO_4 + O_2 \xrightarrow{(air)} CuSO_4 + 2H_2O$

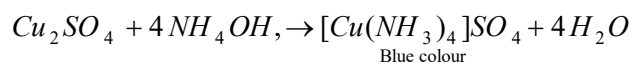
(i) On heating this blue salt becomes white due to loss of water of crystallization.



At about 1000 K,  $CuSO_4$  decomposes to give  $CuO$  and  $SO_3$ .

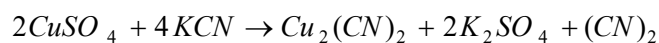


(ii) It gives a deep blue solution of tetrammine copper (II) sulphate with  $NH_4OH$ .

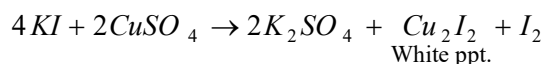


(iii) With  $KCN$  it first gives yellow precipitate of  $CuCN$  which decomposes to give  $Cu_2(CN)_2$ .

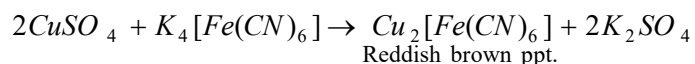
$Cu_2(CN)_2$  dissolves in excess of  $KCN$  to give  $K_3[Cu(CN)_4]$



(iv) With  $KI$  it gives white ppt. of  $Cu_2I_2$



(v) With  $K_4[Fe(CN)_6]$ ,  $CuSO_4$  gives a reddish brown ppt. of  $Cu_2[Fe(CN)_6]$



Uses: For electroplating and electro refining of copper. As a mordant in dyeing. For making Bordeaux mixture (11 parts lime as milk of lime + 16 parts copper sulphate in 1,000 parts of water). It is an excellent fungicide. For making green pigments containing copper carbonate and other compounds of copper. As a fungicide in starch paste for book binding work.

Cupric sulphide  $CuS$  : It is prepared as follows:  $Cu(NO_3)_2 + H_2S \rightarrow \underset{\text{Black ppt.}}{CuS} + 2HNO_3$ .

Cupric chloride  $CuCl_2$  : It is a dark brown solid soluble in water and its aqueous solution first changes to green and then to blue on dilution.

Cuprous chloride  $Cu_2Cl_2$  : It is a white solid insoluble in water and dissolves in conc. HCl due to formation of  $H[CuCl_2]$  complex.