# CHEMISTRY STUDY MATERIALS FOR CLASS 10
# (NCERT Based notes of Chapter -03)

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## METALS AND NON-METALS

### METHODS USED TO ENRICH THE ORE

#### Hand picking

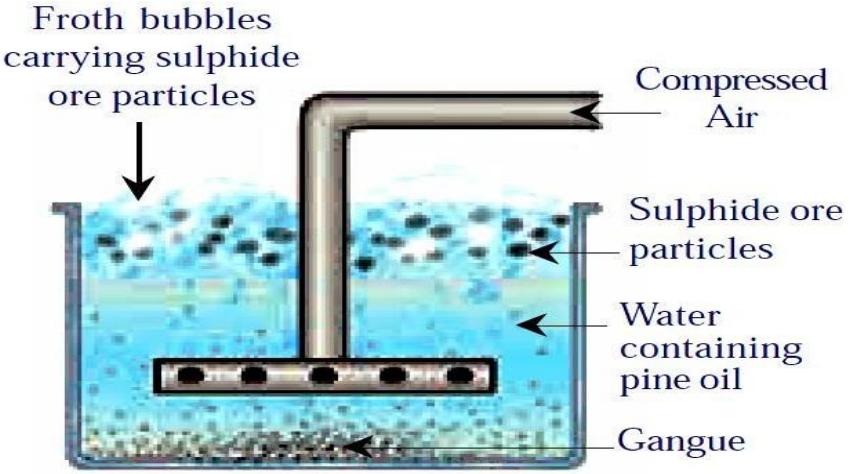
If the ore particles and the impurities are different in one of the properties like colour, size etc. Then using that property the ore particles are handpicked separating them from other impurities.

#### Washing

Ore particles are crushed and kept on a sloppy surface. They are washed with controlled flow of water. Less densive impurities are carried away by water flow, leaving the more densive ore particles behind.

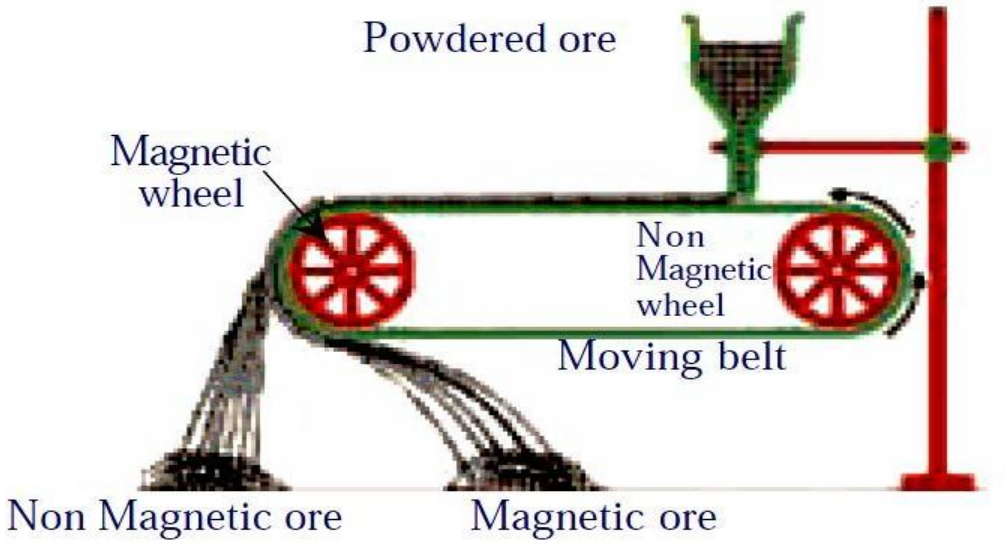
#### Froth floatation

This method is mainly useful for sulphide ores which have no wetting property, whereas the impurities get wetted. The ore with impurities is finely powdered and kept in water taken in a flotation cell. Air under pressure is blown to produce froth in water. Froth so produced, takes the ore particles to the surface whereas impurities settle at the bottom. Froth is separated and washed to get ore particles.



**Magnetic separation**

If the ore or impurity, one of them is magnetic and the other non-magnetic they are separated using electromagnets.




**EXTRACTION OF CRUDE METAL FROM THE ORE:**

After concentration and dressing of ore that obtained earth, we get a concentrated or enriched ore. To extract metal from this enriched ore it is converted into metallic oxide by reduction reaction. Then this metallic oxide further reduced to get a metal with certain impurities.

Extraction of the metal from its ores depends on the reactivity of the metal.

Arrange the metal in decreasing order of their reactivity is known as *activity series*. The classification of the metals on the basis of their reactivity:

**EXTRACTION OF METALS AT THE TOP OF THE ACTIVITY SERIES**:

(K, Na, Ca, Mg and Al). Simple chemical reduction methods like heating with C, CO etc to reduce the ores of these metals are not feasible. The temperature required for the reduction is too high and more expensive. To make the process economical, electrolysis methods are to be adopted.

Again the electrolysis of their aqueous solutions also is not feasible because water in the solution would be discharged at the cathode in preference to the metal ions.

The only method viable is to extract these metals by electrolysis of their fused compounds. For example to extract Na from NaCl, fused NaCl is electrolysed with steal cathode (-) and graphite anode (+). The metal (Na) will be deposited at cathode and chloride liberated at the anode.

At Cathode $2Na^+ + 2e^- \longrightarrow 2Na$;

and At Anode $2Cl^- \longrightarrow Cl_2 + 2e^-$

**B) EXTRACTION OF METALS IN THE MIDDLE OF THE ACTIVITY SERIES**:

(Zinc, iron, tin, lead and copper): The ore of these metals are generally present as Sulphides or Carbonates in native. Therefore prior to reduction of ores of these metals, they must be converted into metal oxides. **Sulphide** ores are converted into oxides by heating them strongly in excess of air. This process is known as *roasting.* Generally the sulphide ores are roasted to convert them into oxides before reducing them to metal.

Eg: $2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

The metal oxides are then reduced to the corresponding metal by using suitable reducing agent such as carbon

(i) **Reduction of metal oxides with carbon**: The oxides are reduced by coke in a closed furnace which gives the metal and carbon monoxide (CO).

Eg: $PbO + C \rightarrow Pb + CO$ at $1400^0C$

(ii) **Reduction of oxide ores with CO**. eg: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3O_2$ in blast furnace

(iii) **Auto (self) reduction of sulphide ores:** In the extraction of Cu from its sulphide ore, the ore is subjected partial roasting in air to give its oxide.

$$2Cu_2S + 3O_2 \rightarrow 2Cu2O + 2SO2$$

When the supply of air is stopped and the temperature is raised. The rest of the sulphide reacts with oxide and forms the metal and SO2.

$$2Cu_2O + Cu_2S \rightarrow 6Cu + 2SO_2$$

**(iv) Reduction of ores (compounds) by more reactive metals.**

Eg: $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$ at $850^0C$ $TiCl_4 + 4Na \rightarrow Ti + 4NaCl$ at $850^0C$

**Thermite process:** When highly reactive metals such as sodium, calcium, aluminium etc., are used as reducing agents, they displace metals of lower reactivity from the compound. These displacement reactions are highly exothermic. The amount of heat evolved is so large that the metals produced in molten state. This type of reaction is used in thermite process. The reaction of Iron (III) oxide (Fe2O3), with aluminium is used to join railings of railway tracks or cracked machine parts. This reaction is known as the **thermite reaction**.

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe + Heat$

$2Al + Cr_2O_3 \rightarrow Al_2O_3 + 2Cr + Heat$

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