

# General Principles and Processes of Isolation of Elements

**1. Minerals:** The natural substance in which the metals or their compounds occur in the earth is called minerals.

**2. Ores:** The minerals from which the metals can be conveniently and economically extracted are called ores.

**3. Native ores:** These ores contain metals in the free state, e.g., silver, gold, platinum, etc.

**4. Metallurgy:** The whole process of obtaining a pure metal from one of its ore is known as metallurgy.

**5. Gangue or matrix:** Ores usually contain soil, sand, stones and others useless silicates. These undesired impurities present in ores are called gangue or matrix. ,

**6.** The removal of unwanted earthy and silicious impurities from the ore is called ore-dressing or concentration of ores and the process used to concentrate an ore is called the beneficiation process.

**7.** Concentration of ore is achieved by

- (a) physical methods, and
- (b) chemical methods

**8. Physical methods are:**

**(a) Hand-picking:** It is used in the case when the impurities are quite distinct from the ore so that these may be differentiated by naked eye.

**(b) Hydraulic washing or Levigation or Gravity separation:** The separation is based on the difference in the specific gravities of the gangue particles and the ore particles.

**(c) Electromagnetic separation:** When one component either the ore or impurity is magnetic in nature, this method can be used for separation.

**(d) Froth floatation process:** This method is used for the concentration of sulphide ores.

**9. Chemical method (Leaching)** involves the treatment of the ore with a suitable reagent as to make it soluble while impurities remain insoluble. The ore is recovered

from the solution by suitable chemical method.

**10. Extraction** process used to obtain metals in free state from concentrated ores is called extraction. **11. Extraction of crude metal from the concentrated ore**

**involves following chemical processes.**

**(a) Conversion of ore into metallic oxides.**

(i) Calcination involves heating the ore below its fusion temperature in the absence of air. It can remove moisture from hydrated oxide or  $\text{CO}_2$  from carbonates. It makes the ore porous.

(ii) Roasting is the heating of the ore in the presence of air below its fusion temperature!

**(b) Reduction to free metal:**

**(i) Smelting:** This involves the reduction of the ore to the molten metal at a high temperature. For the extraction of electropositive metals such as Pb, Fe, Sn, powerful reducing agent like C,  $\text{H}_2$ , CO, Al, Mg, etc., are used.

**(ii) Self reduction process:** These processes are also called auto-reduction process.

**(iii) Electrolytic process:** The oxides' of highly electropositive metals like Na, K, Mg, Ca, Al, etc., are extracted by electrolysis of their oxides, hydroxides or chlorides in fused state. For example, Al is obtained by the electrolysis of alumina mixed with cryolite.

**12. Refining** is the process of purifying the extracted metals is called refining.

**13. Chromatography** is based on the principle that the different components of a mixture are adsorbed to different extents on an adsorbent.