Topics: Metals and Non-Metals
Subtopics: Occurrence of Metals

Occurrence of Metals

Minerals and Ores

Metals and their compounds are found in the earth's and are known as minerals. Ores are minerals from which metals are extracted profitably and conveniently. Ores contain metal compounds with a lower percentage of impurities. All the ores are minerals, but all minerals are not necessarily ores.

Extraction of Metals - Metallurgy

The various processes involved in the extraction of metals from their ores and their subsequent refining are known as metallurgy.

Extracting Metals Low in the Activity Series

Metals that are low in the activity series are very un-reactive. The oxides of these metals can be reduced to metals by heating alone. For example, mercury is obtained from its ore, cinnabar (HgS), by the process of heating.

Reduction Using Heat

$$2HgS + 3O_2 \xrightarrow{Heat} 2HgO + 2SO_2$$

$$2HgO \xrightarrow{Heat} 2Hg + O_2$$

Mercuric oxide

Extracting Metals in the Middle of the Activity Series

Metals such as iron, zinc, lead, copper, etc., are in the middle of the reactivity series. These are moderately reactive metals and are usually present as sulphides or carbonates.

These metals are obtained from their ores by the processes of reduction. In the reduction process, it is the oxide ore that is reduced.

It is easier to reduce an oxide ore as compared to its sulphides and carbonates.

Differences between Roasting and Calcination

Roasting	Calcination
Heating in the presence of air	Heating in the absence of air
Sulphide ores are roasted Sulphur dioxide is released $2ZnS+3O_2 \xrightarrow{\Delta} 2ZnO+2SO_2\uparrow$	Carbonate ores are calcined. Carbon dioxide is released $CaCO_3 \xrightarrow{\Delta} CaO+CO_2\uparrow$
Is done at high temperatures, sometimes higher that the melting point of the ore.	Is done at lower temperatures, generally below the melting point of the ore.
Purpose is to remove impurities as volatile oxides & to oxidize the ore and to remove any moisture that may be present.	Purpose is to remove impurities as volatile oxides and to remove the moisture present.

Extracting Metals towards the Top of the Activity Series

Metals such as sodium, magnesium, calcium, aluminum high up in the reactivity series are very reactive and cannot be obtained from their compounds by heating with carbon. This is because these metals have more affinity for oxygen than carbon. These metals are obtained by electrolytic reduction.

- **Electrolytic Reduction**

Reaction at cathode (negative electrode): $Na^+ + e^- \rightarrow Na$

Reaction at anode (positive electrode): $2Cl^- \rightarrow Cl_2 + 2e^-$

Net reaction: $2NaCl(l) \xrightarrow{\text{Electrolytic reduction}} 2Na(s) + Cl_2(g)$

Sodium chloride (Molten) — Sodium — chlorine

Refining of Metals

Most metals obtained by the reduction process are not very pure. These have to be further refined or purified. Purification of the metal is the last step in metallurgy. Refining is based on the difference between the properties of metals and their impurities. The following process we use for refining:

Electrorefining

Electrolysis can be used for both extractions of metal (which cannot be separated by chemical reduction process) as well as for further purification of metals obtained by any other method.

Electrolytic refining of metals

o Impure metal is made the anode and thin strip of pure metal is made cathode.

o A solution of metal salt is used as an electrolyte