Furnaces:

In the extraction of metal different types of furnaces are used. Each furnace has its own characteristics. Some principal furnaces have been described below,

(1) **Blast furnace :** It is a special type of tall cylindrical furnace, about 100 feet high with a diameter of 15-28 feet. It is made of steel sheets lined inside with fire-proof bricks. The charge is added through a cup and cone arrangement at the top. At the upper part of the furnace there is a hole for the escape of the waste gases of the furnace. There are two outlets in the hearth of the furnace, one for tapping the molten metal and the other above it for the slag. The waste gases are heated and a hot air blast under pressure is blown into the furnace by means of bellows or fans through water cooled nozzles ortuyers. The temperature of the furnace varies from

250_oC

to

1500_oC

. Thus the charge descends slowly into zone of increasing temperatures. The blast furnace is used for the extraction of metal like **copper and iron**.



(2) **Reverberatory Furnace :** In this furnace fuel burns in a separate part and does not mix with the charge. The furnace may be divided into 3 parts,

(i) *Fire Grate* : It is on one side where the fuel burns.

(ii) *Flue or Chimney* : It is on the other side of the fire grate. The waste gases escape through it.

(iii) *Hearth* : It is the middle part of the furnace where the charge is heated with the flames and hot gases.

The material to be heated is placed on the hearth or bed of the furnace and is heated by the hot gases or flames produced by the burning of fuel. The waste gases escape out of the chimney. Since the fuel does not come in contact with the charge, the furnace is very suitable for calcination and roasting and is employed for both oxidising and reducing purposes. For oxidation, the material is heated by the current of hot air while for reduction the material is mixed with coke and heated. The furnace find wide application in the extractive metallurgy.



(3) **Electric Furnace :** The fuel burnt furnaces described in this chapter produce temperature in the range of

$1000 - 1500 \circ C$

. Although these furnaces have the great utility in the extraction of metals yet these are unsuitable where higher temperatures are needed. One commonly used electric furnace is **Heroult's furnace** shown in fig. It consists of a steel shell lined inside with dolomite or magnesite. It is provided with movable water jacketed electrodes suspended from the roof or from the sides. Heat is generated by striking an arc between the electrodes, thereby, a temperature of over

3000oC

may be reached. The charge melts and the impurities e.g., *Si*, *Mn*, *P* and *S* etc. present in the ore combine with the basic lining to form slag, which is free from sulphur or gas bubbles. **Steel** of very fine quality is prepared by this method. Electric furnaces are largely used where,

(i) Cheap power supply is available. (ii) High temperature are required. (iii) Pure product are required.

As such they find wide applicability in a number of industries such as metallurgy, ceramices plastics chemical and also in the research laboratories. These furnaces are easily operated and involve the problem of the storage of fuel and disposal of fuel waste.

(4) **Muffle Furnace :** In this furnace the material to be heated does not come in the contact with the fuel or flames. A muffle is a chamber made of refractory material and is surrounded by flames and hot gases on all sides. The products of combustion are removed through a door provided in the furnace. Muffle furnace is used for the extraction of **zinc**, preparation of red lead,

Pb₃O₄

and for testing the purity of precious metals like **silver** and **gold**. In an electric muffle furnace the chamber is surrounded by resistance coils.



(5) **Bessemer Converter :** A Bassemer converter is a pear–shaped 10 or more feet high, open at the top, lined with a refractory material such as silica or magnesia which also acts as a flux. The converter is mounted on trunnions, so that it can be tilted to collect the products formed. There is an arrangement of introducing a hot blast of air from a number of small openings in the bottom of the furnace. The converter is used mostly for manufacturing of **copper of steel from pig iron**. Passing a current of hot air into the molten metal taken in the converter, the impurities are oxidised and escaped as gases or from slag. The Bessemer process is rapid one and does not take more than 15 minutes in the production of one bath.

(6) **Regenerative Furnace :** These are furnaces in which the heat of the gases escaping out from the chimney is utilized. Most of the furnaces particularly blast furnaces are fitted up with regenerated system which means an economy of the fuel. A flowing column of air is heated by the hot flue gases, it is then brought back to the fire and returned to the furnace. This furnace is largely used in the production of **steel**.