

3.2 RESISTANCE HEATING

This method is based upon the I^2R effect and has wide applications such as heat treatment of metals (e.g., annealing, normalizing, hardening, tempering, etc), drying and baking of potteries, domestic cooking, etc. In oven where wire resistances are employed for heating, temperature to the tune of 1000°C can be obtained. Whenever current is passed through a resistive material heat is produced because of I^2R loss. There are two methods of resistance heating. They are

- a. Direct Resistance Heating
- b. Indirect Resistance Heating

DIRECT RESISTANCE HEATING

In this method of heating the material or charge to be heated is taken as a resistance and current passed through it. The charge may be in the form of powder pieces or liquid. The two electrodes are immersed in the charge and connected to the supply. In case of D.C or single-phase A.C supply, two electrodes are required but there will be three electrodes in case of three phase supply. When metal pieces are to be heated a powder of high resistivity material is sprinkled over the surface of the charge to avoid direct short circuit. But it gives uniform heat and high temperature. One of the major applications of the process is salt bath furnaces having an operating temperature between 500°C to 1400°C . An immersed electrode type medium temperature salt bath furnace is shown in figure 3.2.1. The bath makes use of supply voltage across two electrodes varying between 5 to 20 volts. For this purpose, a special double wound transformer is required which makes use of 3Φ primary and 1Φ secondary. This speaks of an unbalanced load. The variation in the secondary voltage is done with the help of an off-load tapping switch of the primary side. This is necessary for starting and regulating the bath load. Salt bath furnace is employed for hardening steel tools and prevents oxidation during hardening.

Advantages:

High efficiency and uniform heat and high temperature.

Applications:

Direct resistance heating is applied in

- ✓ Salt bath furnace
- ✓ Water heaters

- ✓ Resistance welding
- ✓ Electrode boiler, etc

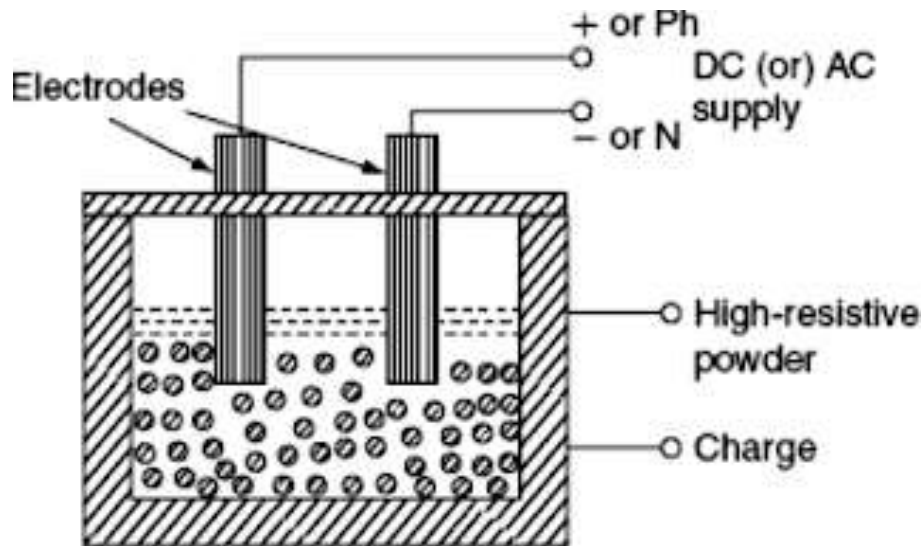


Figure 3.2.1 Direct resistance heating

[Source: "Generation and Utilization of Electrical Energy" by Sivanagaraju, Balasubba Reddy, Srilatha, Page: 150]

INDIRECT RESISTANCE HEATING

In this method the current is passed through a highly resistance element which is either placed above or below the over depending upon the nature of the job to be performed. The heat proportional to I^2R losses produced in heating element delivered to the charge either by conduction or radiation or convection. Sometimes in case of industrial heating the resistance is placed in a cylinder which is surrounded by the charge placed in the jackets. The arrangement provides uniform temperature. Also, automatic temperature control can be provided in this case.

Applications:

This method is used in

- ✚ Room heater
- ✚ Bimetallic strip used in starters
- ✚ Immersion water heaters
- ✚ Various types of resistance ovens used in domestic and commercial cooking
- ✚ Salt bath furnace

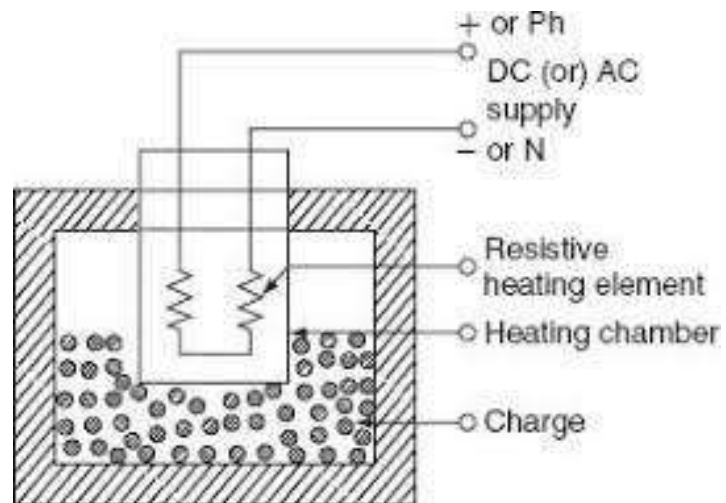


Figure 3.2.1 Indirect resistance heating

[Source: "Generation and Utilization of Electrical Energy" by Sivanagaraju, Balasubba Reddy, Srilatha, Page: 151]

