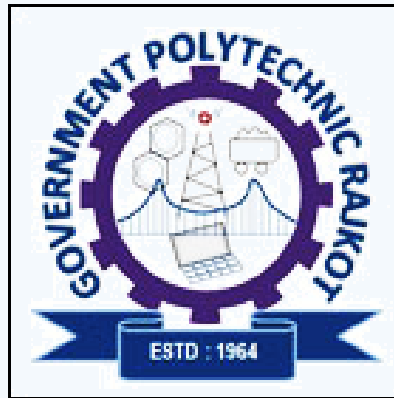


Utilization of Electrical Power

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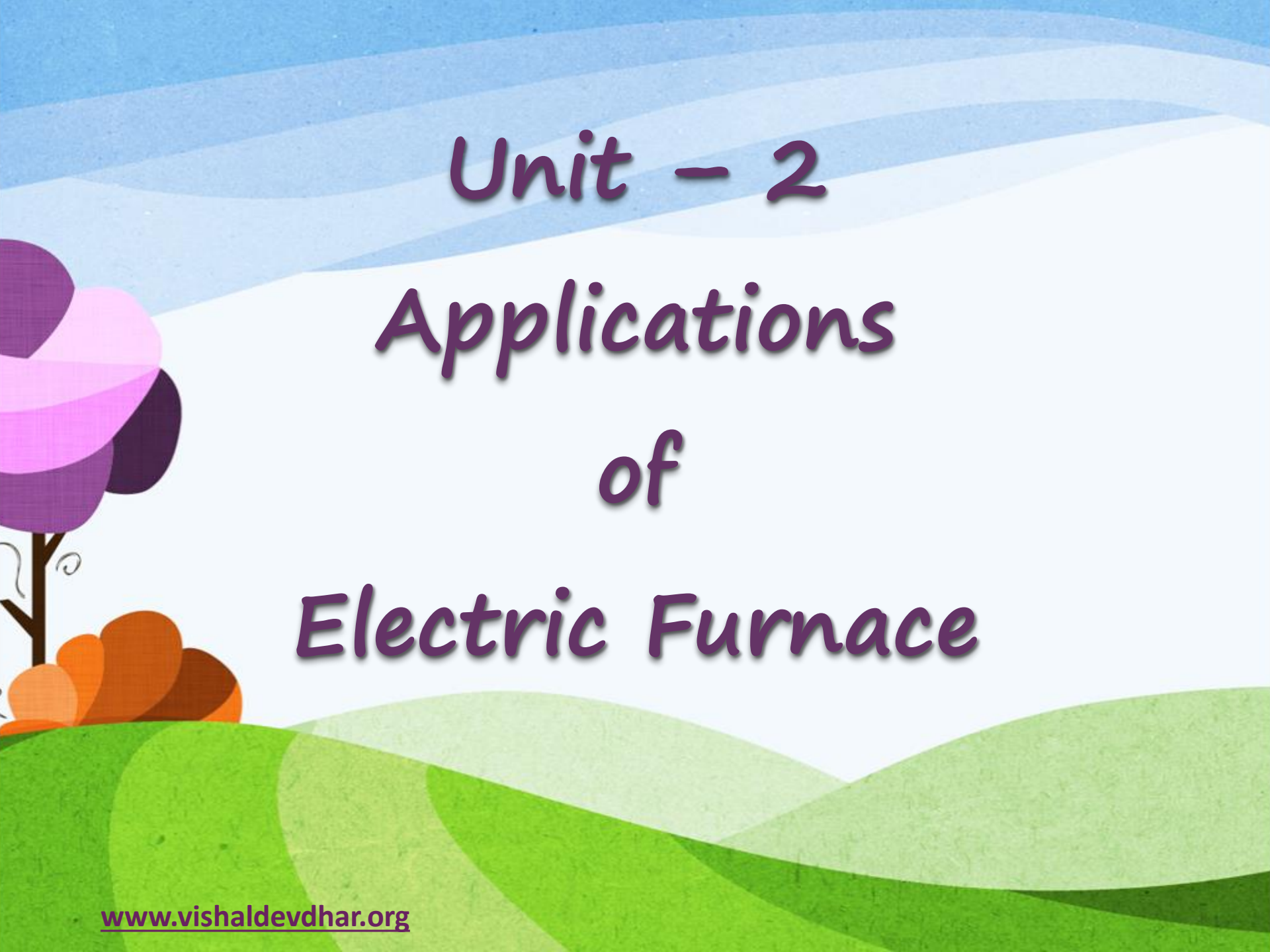


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Unit – 2

Applications of Electric Furnace

Advantages of Electric Heating

- ❖ Cleanliness
- ❖ Absence of flue gases
- ❖ Uniform heating
- ❖ Ease of control
- ❖ Quick process
- ❖ Efficiency
- ❖ Low maintenance
- ❖ Heating non-conductive material
- ❖ Heating in other medium
- ❖ Better working condition
- ❖ Suitability
- ❖ Less space
- ❖ Cheap
- ❖ Safe

Applications of Electrical Heating

- Domestic
 - Cooking
 - Room Heater
 - Water Heater
 - Electric Toaster
 - Electric Iron
 - Electric Oven
 - Induction Plate
 - Hair Dryer
 - Hair Straightener



Applications of Electrical Heating

- Industrial
 - Melting of Metals
 - Hardening & Tempering
 - Moulding of Glass
 - Heat Treatment Process
 - Drying
 - Welding



Mode of Heat Transfer



Conduction

One molecule of the substance gets heated and transfer the heat to adjacent molecule



Convection

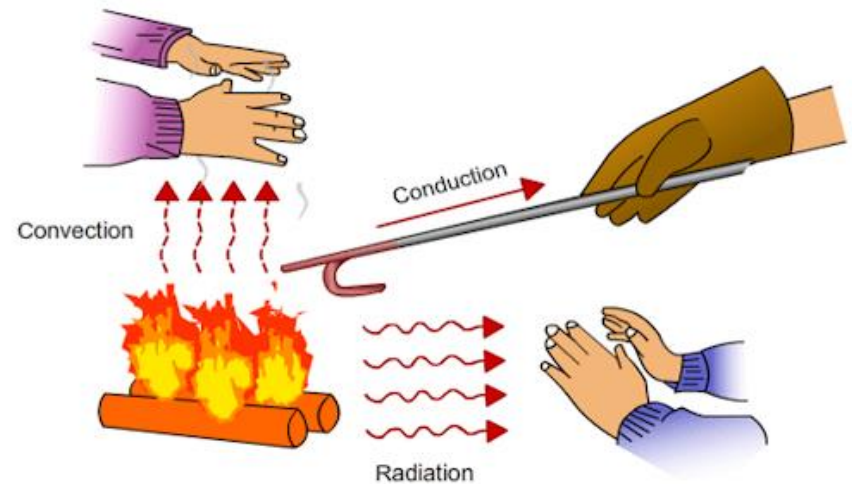
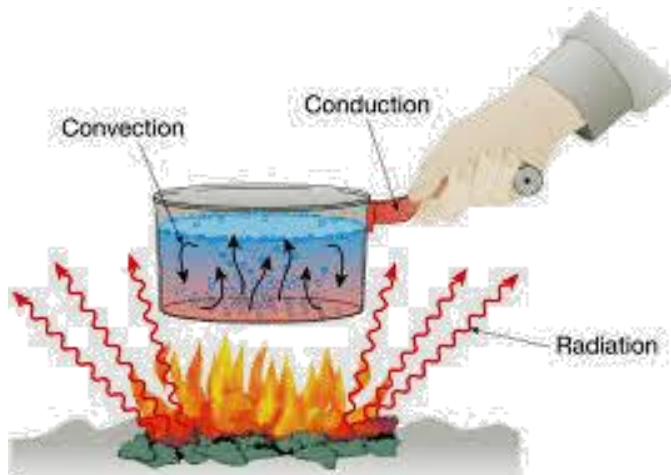
heat transfer due to the bulk movement of molecules within fluids such as gases and liquids



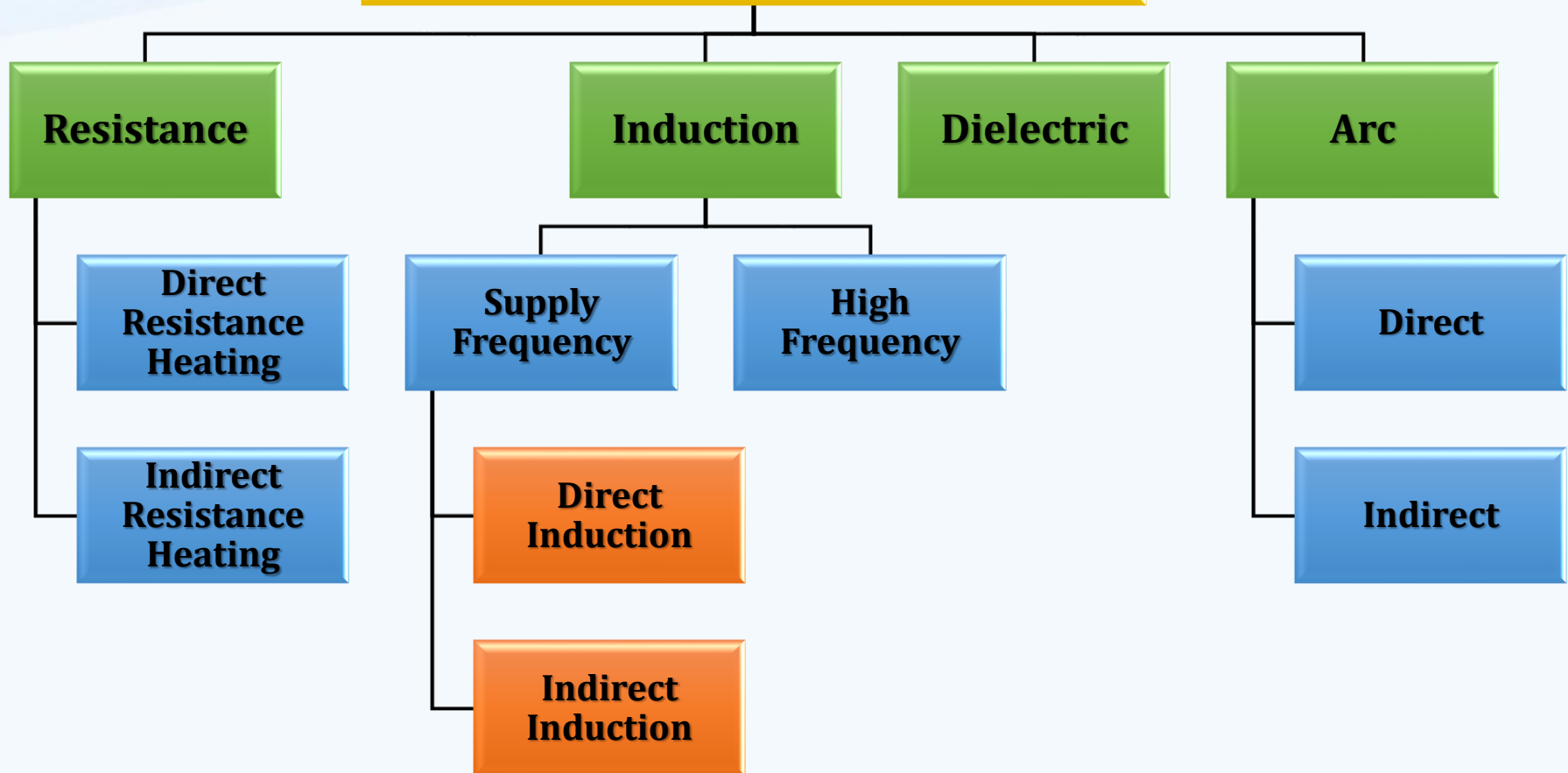
Radiation

radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium

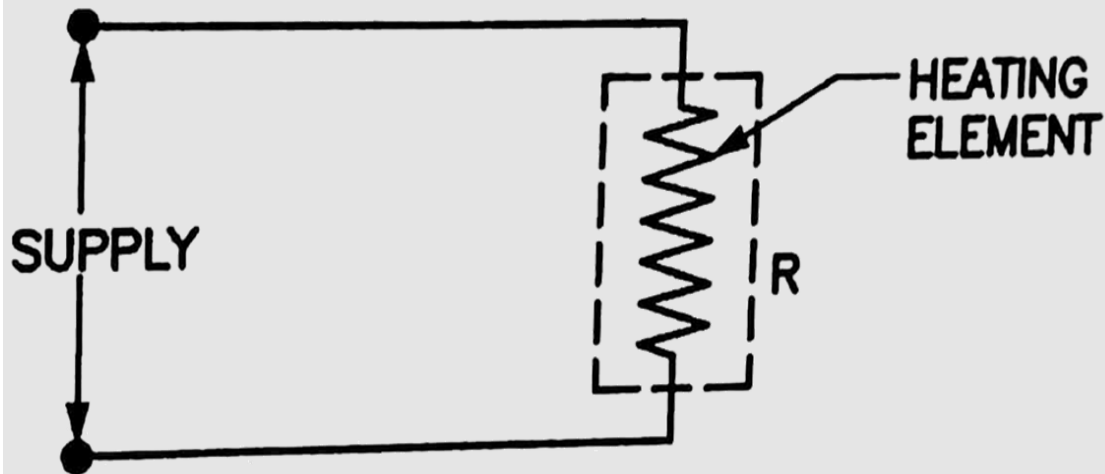
Mode of Heat Transfer



Electric Heating



Resistance Heating



❖ *Working*

$$P = I^2 R$$

$$P = \frac{V^2}{R}$$

Resistance Heating

Requirements of Heating Material

- + High Resistivity

small length of wire is required to produce a given amount of heat

- + High melting point

high temperature may be obtained

- + High mechanical strength



Resistance Heating

Requirements of Heating Material

- + **Free from oxidation**
ensure long life
- + **Low temperature coefficient**
resistance remains appreciably constant even with increase of temperature
- + **Non-corrosive**
- + **Economical**



*Resistance
Heating*

*Heating
Materials*

Nichrome

Kanthal

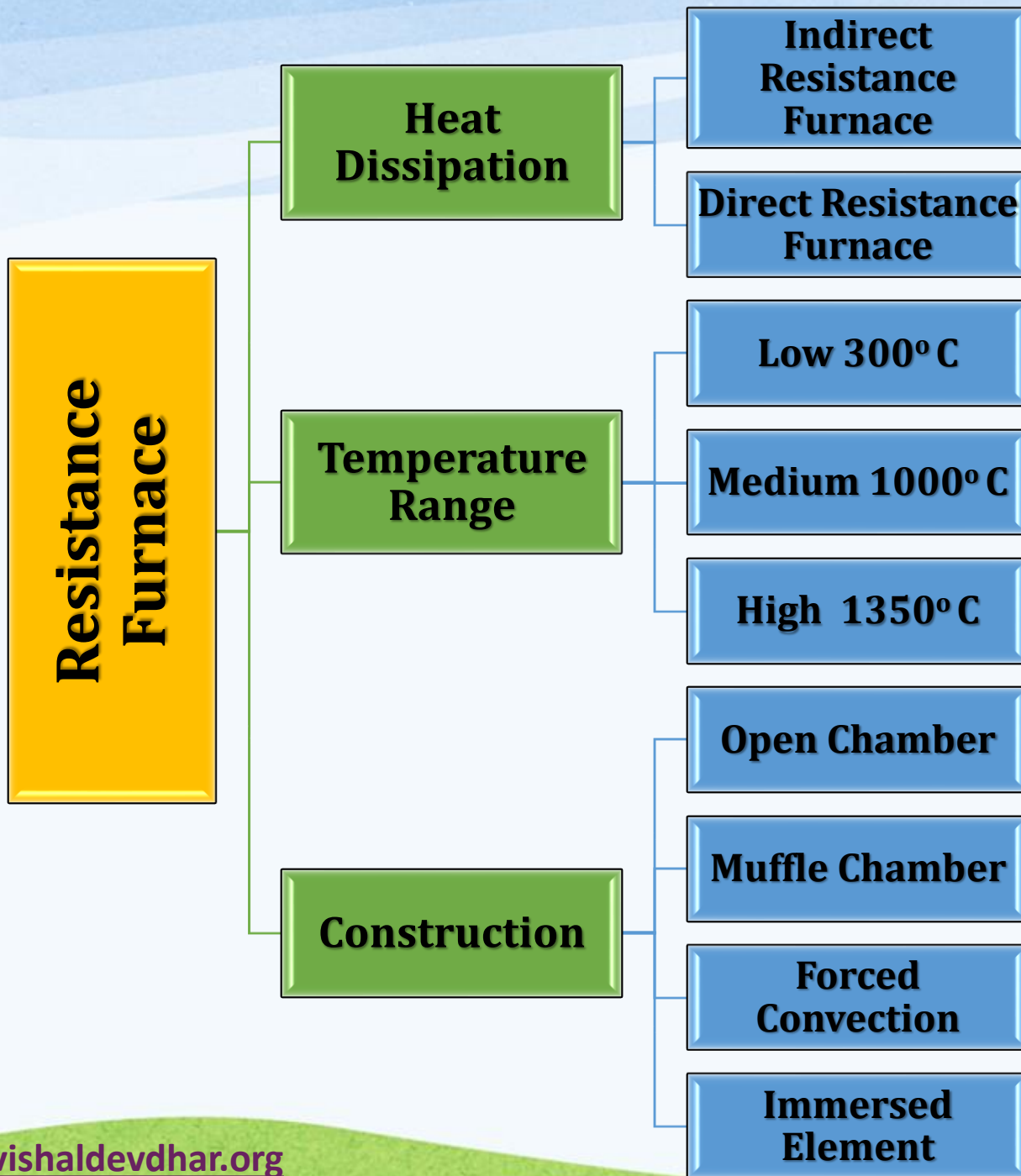
Cupronickel

Platinum

Resistance Heating

Heating Materials

No.	Name of Material	Composition	Maximum Operating Temperature	Specific Resistance at 20° C	Specific Gravity
1.	Nickel – Chromium (Ni - Cr) (Nichrome)	Ni – 80 % Cr – 20 %	1150° C	109 $\mu\text{-}\Omega/\text{cm}^3$	8.36
2.	Nickel – Chromium – Iron (Ni – Cr – Fe)	Ni – 60 % Cr – 16 % Fe – 24 %	950° C	110 $\mu\text{-}\Omega/\text{cm}^3$	8.28
3.	Nickel – Copper (Ni – Cu) Eureka or Constantan	Ni – 45 % Cu – 55 %	400° C	49 $\mu\text{-}\Omega/\text{cm}^3$	8.88
4.	Iron – Chromium – Aluminum (Fe – Cr – Al) Kanthal	Fe – 70 % Cr – 25 % Al – 5 %	1200° C	140 $\mu\text{-}\Omega/\text{cm}^3$	7.2



Resistance Heating

Direct

- Current passed through body
- Direct heat

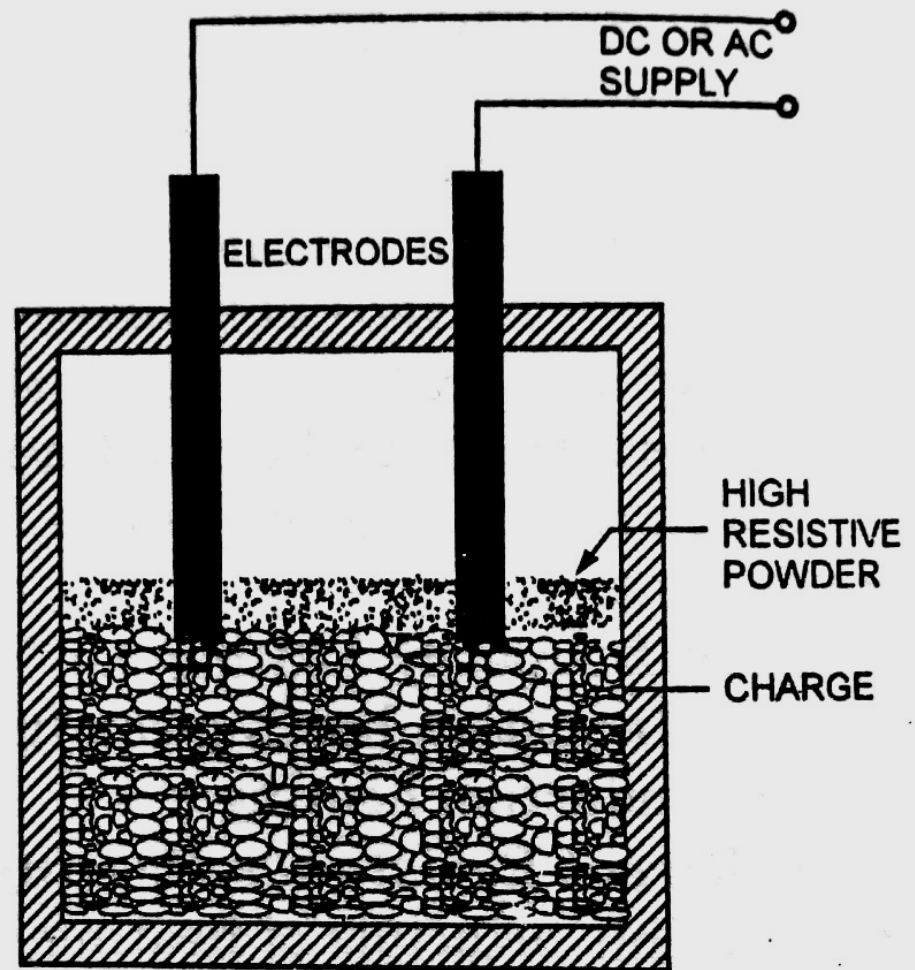
Indirect

- Current passed through resistive element
- Heat transmitted

Resistance Heating

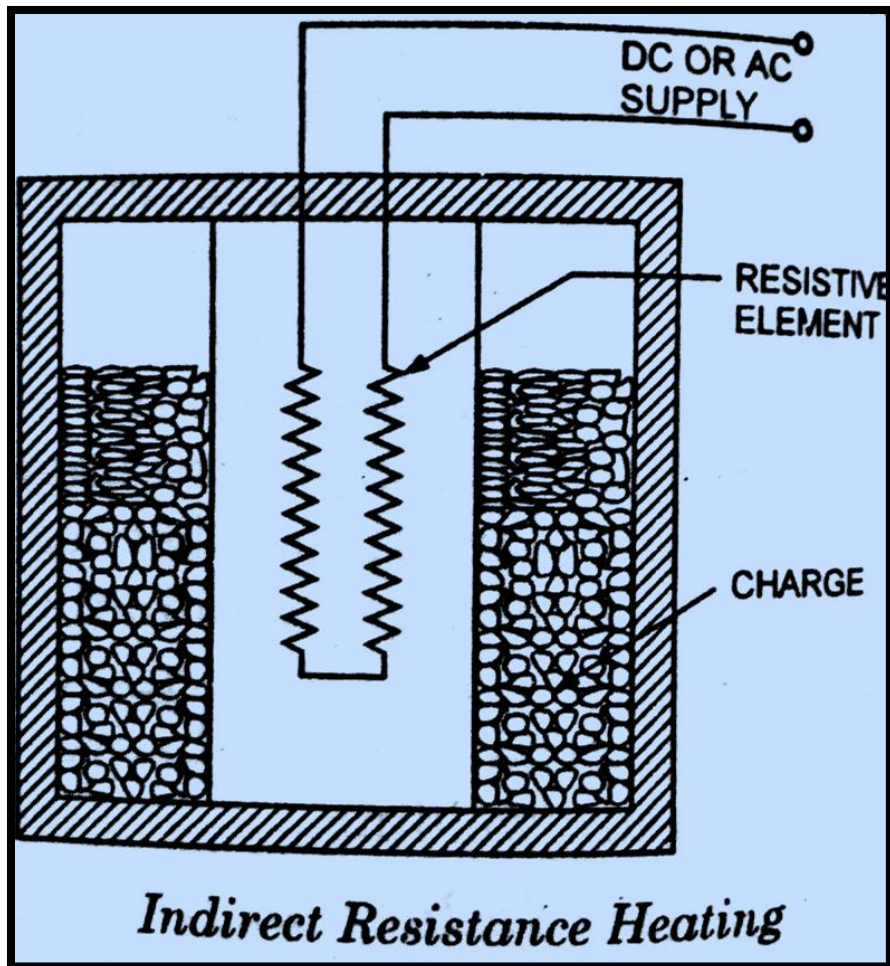
Direct Resistance Heating

- Material/charge is taken as resistance and current is passed through it



Direct Resistance Heating

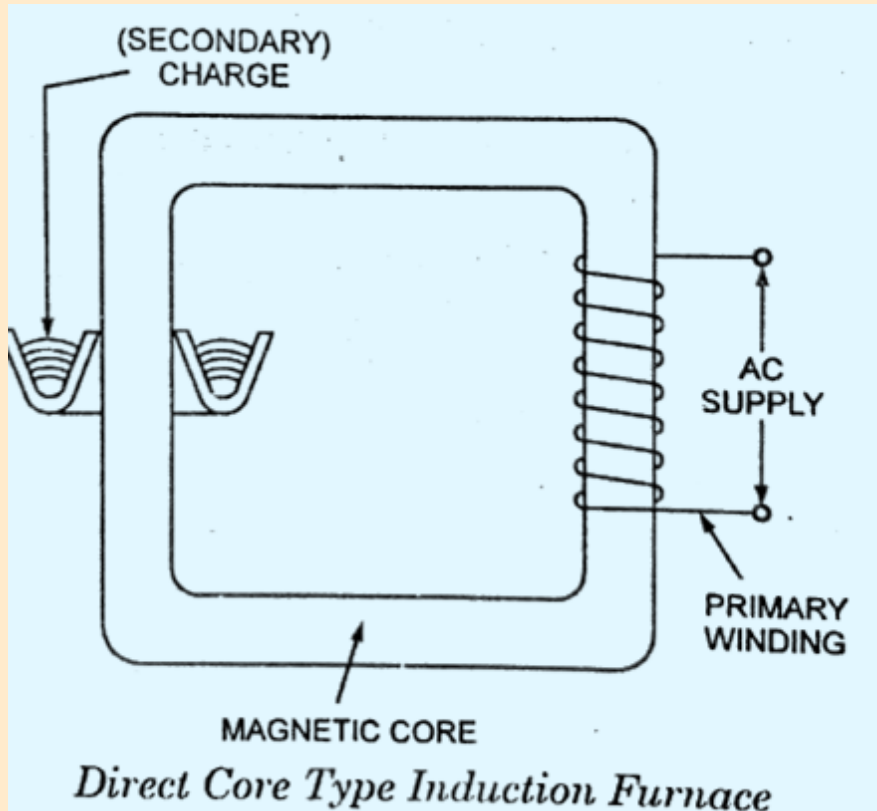
Resistance Heating



Indirect Resistance Heating

- Current is passed through heating element.
- Heating chamber is required
- Heat transferred by convection

Induction Heating



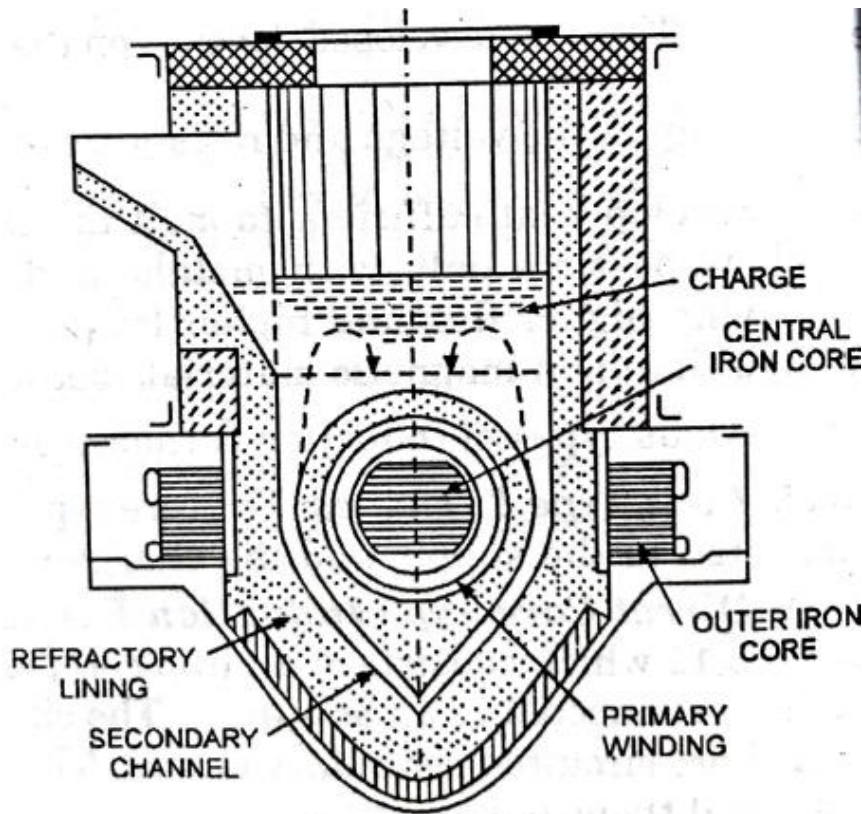
Direct Core type Induction Furnace

- Iron core, crucible (Insulating material) and primary winding
- Charge is kept in the crucible

Induction Heating

Vertical Core type Induction Furnace

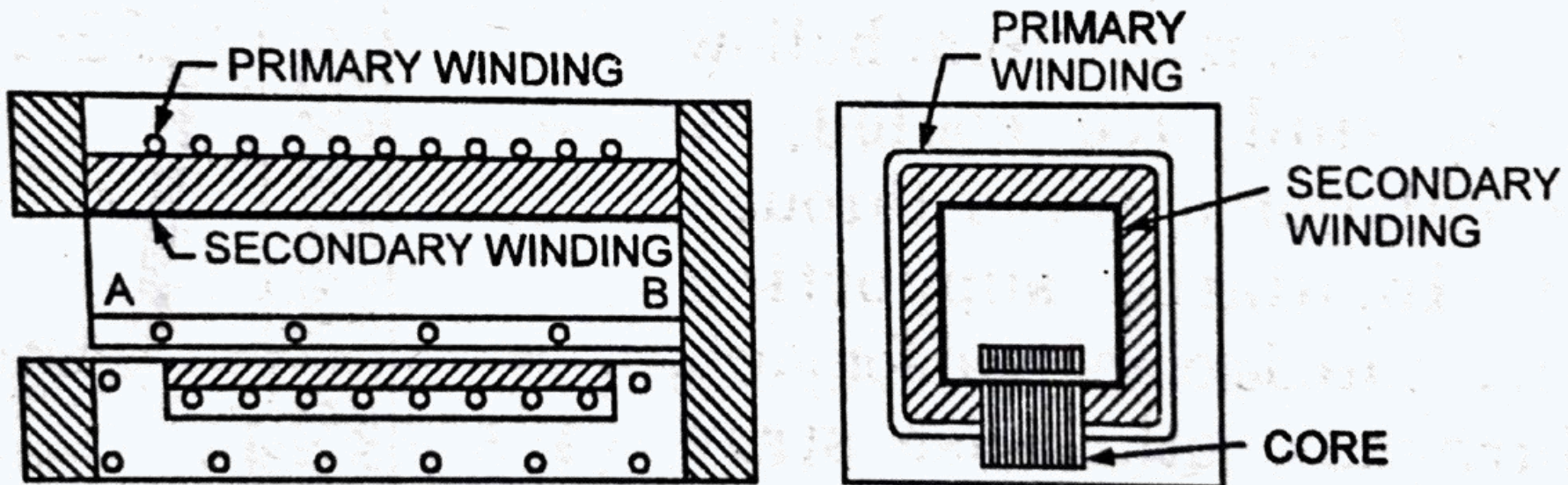
- Convection currents keep the circulation of molten metals round the V portion.



Ajax Wyatt Vertical Core Furnace

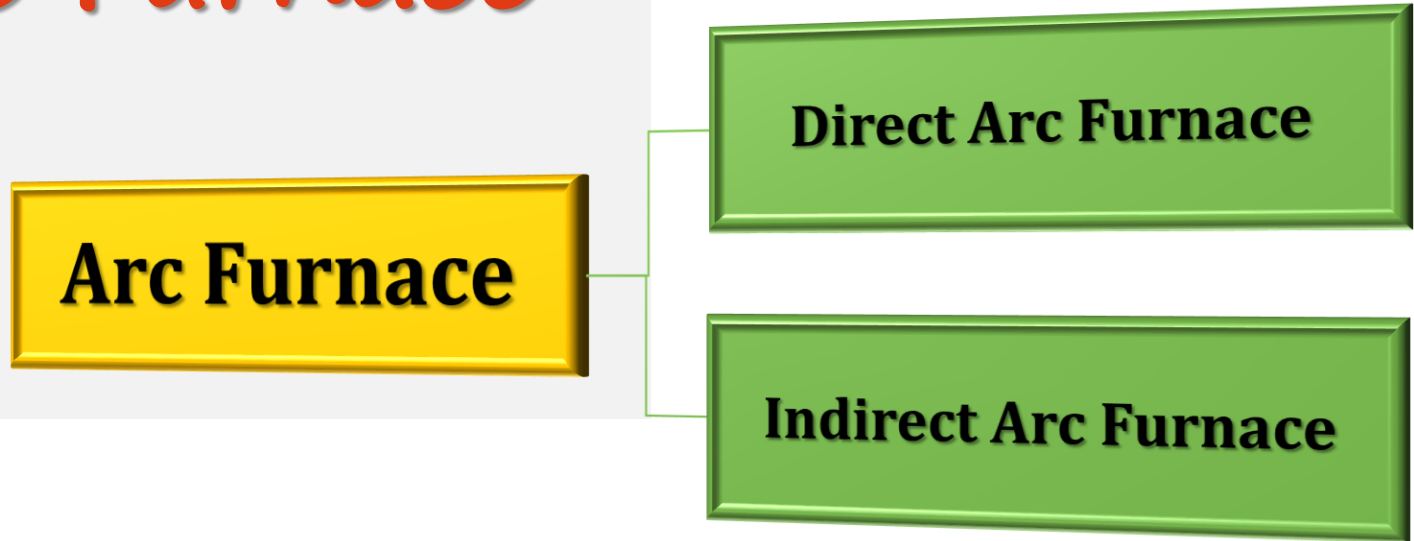
Induction Heating

- + Indirect Core type Induction Furnace
- + Heat transfer by Radiation



Indirect Core Type Induction Furnace

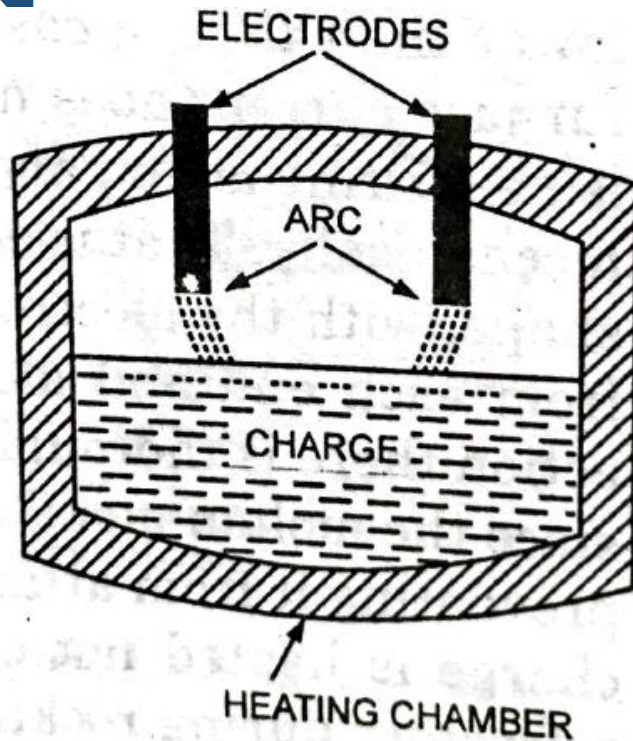
Arc Furnace



When a high voltage is applied across an airgap it gets ionized under the influence of electrostatic forces and becomes conducting medium.

Arc Furnace

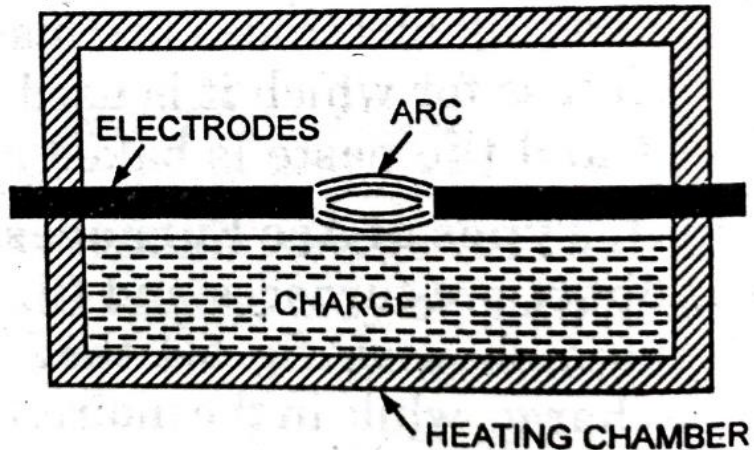
+ Direct Furnace



- Arc is produced between electrode and charge
- Advantages
 - Better temperature control
 - Heat is produced by two actions, Arc & I^2R
 - Cheaper process
 - Automatic stirring due to electromagnetic forces

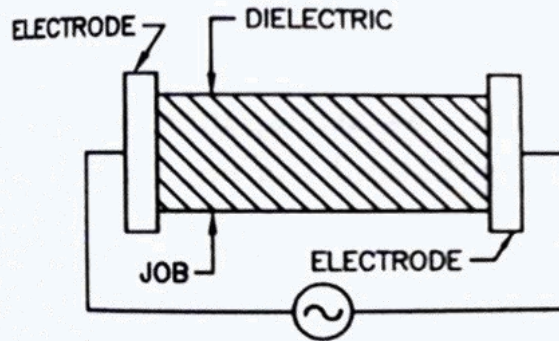
Arc Furnace

+ Indirect Furnace

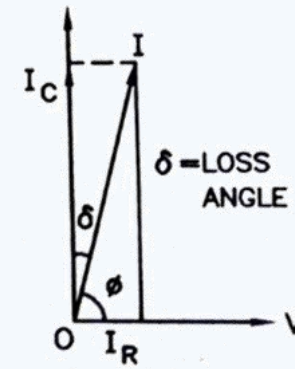
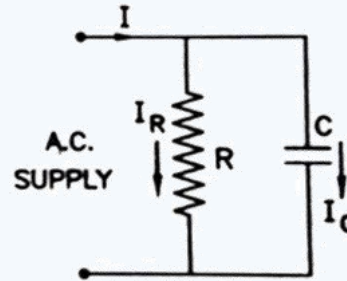


- Arc is produced between electrodes
- Advantages
 - Flexibility
 - High melting speed
 - Sound casting
 - Low metal losses
 - Economical

Dielectric Heating



HIGH FREQUENCY SUPPLY



- Two conducting plates are separated by an insulating material with high frequency supply.
- Application
 - Plastic industry
 - Wood industry
 - Food processing
 - Foundry
 - Medical
 - Textile
 - Electronic sewing
 - Rubber
 - Drying

Thank You



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