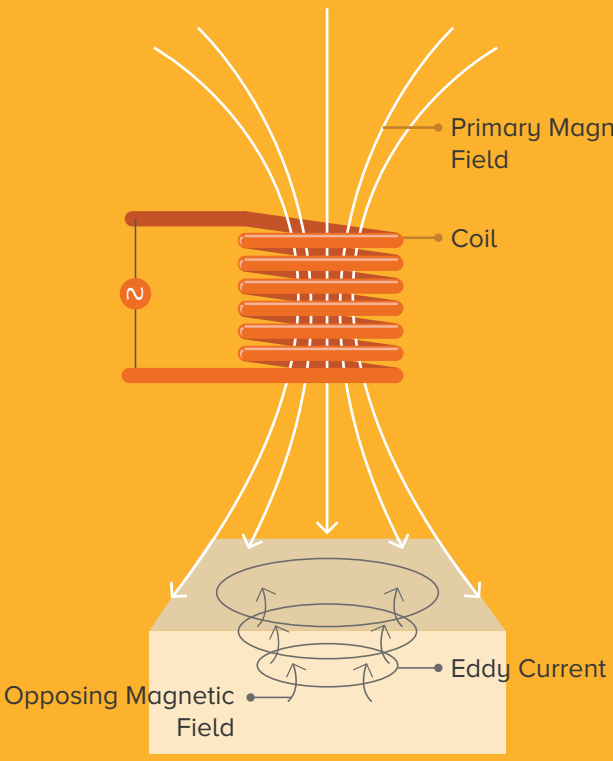
GEF - UNIDO - BEE PROJECT

on

"Promoting EE/RE in selected MSME Clusters in India"

INDUCTION FURNACE



Uses electric currents to melt metal.

Ideal for melting and alloying a wide variety of metals with minimum melt losses

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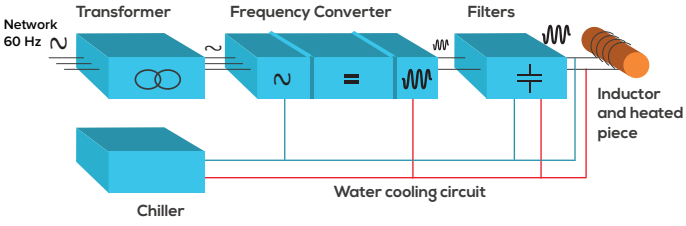
Induction Furnace

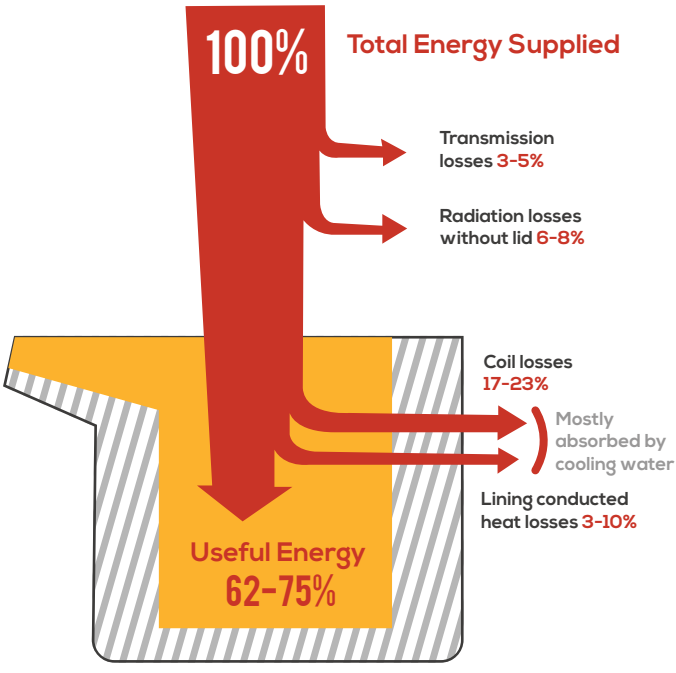


Principle of Induction furnace is Induction heating

Any electrically conductive material placed in a variable magnetic field is the site of induced electric currents, called eddy currents, which will eventually lead to joule heating

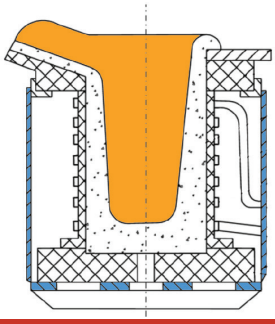
Electromagnetic Induction	Joule Effect

Sankey Diagram of Furnace losses



Types of Induction Furnace

1. Coreless induction furnace



Cover with cement and asbestos
Upper frame with firebricks
Crucible
Insulation cloth
Induction coil
Protection plate
Pedestal with firebricks
Aluminium frame

- Coil is the heart of coreless induction furnace
- To protect it from overheating, the coil is water-cooled,
- Granular refractory between the coil and a hollow internal

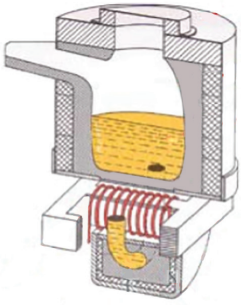
Advantages

- Furnace can be completely emptied to change an alloy mix
- Can be sized to meet melting needs

Dis-Advantages

- Refractory cracks can cause premature lining failure

2. Channel furnace



Insulated furnace cover
Refractory lining
Liquid metal
Laminated iron core
inductor case
Refractory lining
Inductor channel
Inductor coil

- Consists of refractory lined furnace body made of steel
- Several channel type inductors are at bottom flanged for heating the metal
- Hot metal in the channel circulates into the main body of the metal in the furnace and is replaced by colder metal Granular refractory between the coil and a hollow internal

Advantages

- Higher efficiency than coreless and natural gas furnace
- Extremely effective at mixing to have homogeneous temperature

Dis-Advantages

- Require small quantity of molten metal in the furnace for holding and needs continuous power during holding period

Why Induction Heating ?

Higher Yield

Clean Heating

Environmental Friendly

Cleaner Melting

Compact Installation

Natural Stirring

Faster Start-up

Controlled Features

Benefits of Induction Heating ?

Higher Yield

Absence of combustion sources reduces oxidation losses that can be significant in production economics

Faster Start-up

Full power from the power supply is available, instantaneously, thus reducing the time to reach working temperature

Flexibility

No molten metal is necessary to start medium frequency coreless induction melting equipment. This facilitates repeated cold starting and frequent alloy changes

Natural Stirring

Medium frequency units can give a strong stirring action resulting in a homogeneous melt

Cleaner Melting

No by-products of combustion means a cleaner melting environment and no associated products of combustion pollution control systems

Compact Installation

High melting rates can be obtained from small furnaces

Reduced Refractory

The compact size in relation to melting rate means induction furnaces require much less refractory than fuel-fired units

Better Working Environment

- Induction furnaces are much quieter than gas furnaces, arc furnaces, or cupolas
- No combustion gas is present and waste heat is minimized

Energy Conservation

Overall energy efficiency in induction melting ranges from 55 to 75 percent, and is significantly better than combustion processes

Energy Saving Tips..

Charge must be free from sand, dirt and oil/grease. Rusty scrap not only takes more time to melt but alsocontains less metal per charging. For every 1% slag formed at 1500 °C energy loss is 10 kWh per tonne

The maximum size of single piece of metal/scrap should not be more than **1/3** of diameter of furnace crucible. It avoids problem of bridging

Furnace should never be charged beyond the coil level, i.e. charging the furnace to its capacity.

A well-fitting furnace lid in the closed position will limit the furnace radiation heat loss to about 1% of the input power

Avoid unnecessary superheating of metal. Superheating by 50°C can increase furnace specific energy consumption by 25 kWh per tonne

Use of IGBT based -6 pulse or more Induction furnace

INDUCTION BILLET HEATER

INDUCTION HEATING

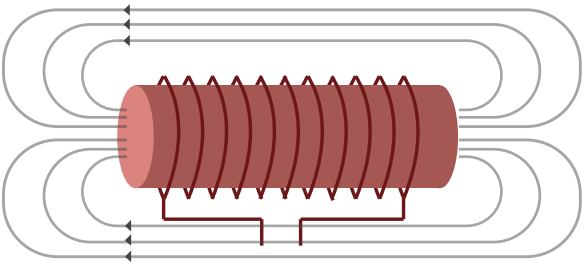


Diagram 1. Piece of metal being heated by magnetic field by an induction coil

When a conductor carries electric current, it is surrounded by magnetic field, produced by and in proportion to the intensity of the current.

Alternating current passing through a coil shaped conductor produces alternating magnetic field inside and around the coil.

When a piece of metal is placed within such alternating magnetic field, electric currents are induced in the metal. Since metal posses electrical resistance, heat is generated by the current induced in the metal, (see Diagram 1)

Heating different shaped work pieces is easily achieved by appropriate Induction coil design. Diagram 2 shows example.

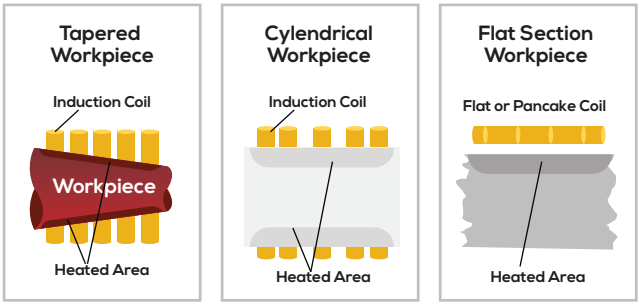
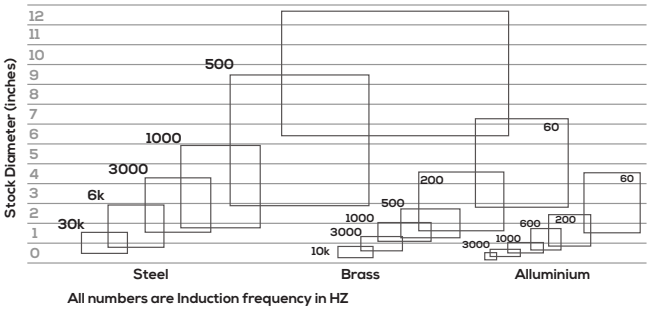


Diagram 2.

Induction Heating Frequency selection



All numbers are Induction frequency in HZ

Extrusion temperatures of common metals & alloys

Metals & Alloys	Temp. of extrusion, K	° C
Aluminum and alloys	673 – 773	400 – 500
Magnesium and alloys	573 – 673	300 – 400
Copper	1073 – 1153	800 – 880
Brasses	923 – 1123	650 – 850
Nickel brasses	1023 – 1173	750 – 900
Cupro nickel	1173 – 1273	900 – 1000
Nickel	1383 – 1433	1110 – 1160
Monel	1373 – 1403	1110 – 1130
Inconel	1443 – 1473	1170 – 1200
Steels	1323 – 1523	1050 – 1250

Induction Heater Block Diagram

Equipment Selection

In most cases, the choice of equipment for a particular application is a compromise both in the selection of the power source and material handling. This is most oftne due to the range of stock material that needs to be processes on a single induction heating system

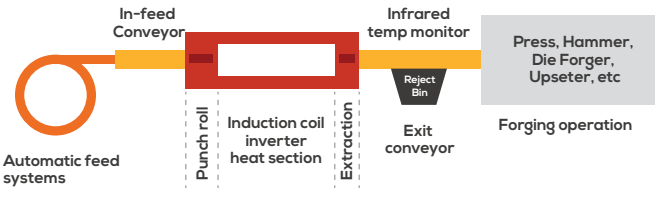


Fig. Typical induction System for forging

Tempreture Control

- Thermocouples positioned at depth of current penetration, and on billet end faces used in dynamic & static heating.
- Side entry thermocouples for taper/base profiles
- Multiple, Controlled zones optimise billet temperature

About Project

Promoting Energy Efficiency & Renewable Energy in Selected MSME Clusters in India

To develop and promote a market environment for introducing energy efficiency and enhanced use of renewable energy technologies in process applications in the selected energy-intensive MSME clusters under GEF UNIDO BEE project.
The main objective of the project is to increase the capacity building of suppliers of EE/RE product and service providers

Desclaimer

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