Review of Recent Advancement In The Induction Furnaces Technology

Akhilesh Dhopre[1], Rohit Shah[2], Sunit Francis[3]
Guide-Dr.P.G.Mehar , Co- Guide-Er.K.D.Gadgil
Karmaveer Dadasaheb Kannamwar College of Engineering , Nagpur, Maharashtra, (India)

Abstract- *A furnace is an equipment where ferrous and non ferrous metal are melted, the melted metal has further use in foundry sector as well as for other application as well. An induction furnace is one of the type of furnace which utilizes the principle of Joules law, electromagnetic induction for melting the metal.*

There always has been a problem that we have to face because of the large setup of the induction furnace. This paper deals with the recent advancement in the induction furnace, and how the induction furnace advancement can be used locally in India for the domestic work.

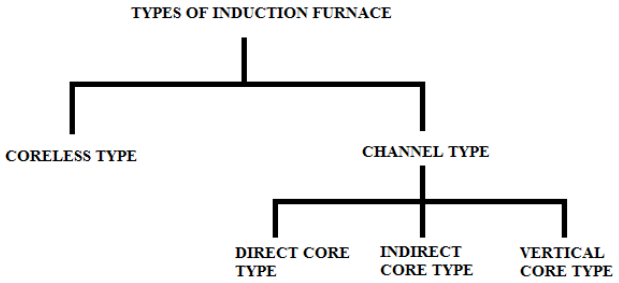
Keywords- Induction furnace ,coreless type , channel type , working principle , comparison and advantages

I. INTRODUCTION

The concept of electromagnetic induction was first proposed by Michael faraday in the year 1831, but DE Ferranti an European scientist who started conduction experiment on induction furnace in the year 1870.in the year 1890 the first induction furnace was patented for melting metals [1] In the present scenario where technology is changing day by day, new technique and methods are being used to save time and to make work efficient. Hence we should always look forward for advancement in the induction furnace[2]. The induction furnace is an equipment which utilizes the principle that a rate of production of heat by a constant direct current is directly proportional to the resistance of the circuit and to the square of the current which is the joules law .

The eddy current sets up electromotive forces which in turns produces stirring action for obtaining uniform quality[3]. As soon as the metal melts in the furnace due to the high frequency magnetic field the metal gets mix very efficiently. Induction furnace is a very clean, environmental friendly process. Unlike other furnace it does not require the use of non renewable resources like wood, coal, oil to generate heat for melting metal[4]. The energy is generated itself by induction furnace by passing electricity through copper coil.

II.TYPES OF INDUCTION FURNACE



There are basically two main type of induction furnace.

1. Coreless induction furnace
2. Channel type induction furnace

Coreless induction furnace

Coreless induction furnace is best utilized for metal having higher melting point. The coreless induction furnace is a refractory lined vessel coil wound around the refractory crucible. The furnace is capable of melting the most difficult metal such as cast iron and stainless steel .This type of furnace is simple in design it consist of a cylindrical crucible made up of graphite, ceramic, iron core material. Metal to be melted is loaded inside the crucible.

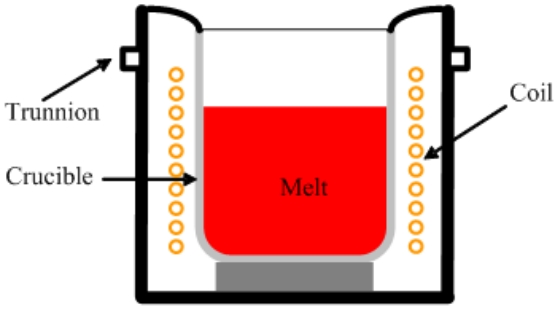


Fig – Coreless induction furnace

The copper coil is used to wound around the crucible. The primary coil is connected to high frequency A.C supply. The flux produce by primary winding produces eddy current

in the charge and heats it up to the melting point. Normally the furnace operates at a frequency of 50Hz to 1500Hz , the furnace operating at 250 to 1000Hz are the most popular.

Channel type induction furnace

Another type of induction furnace is channel type furnace. The channel type metal furnace is best suited for metal having low melting point or holding and superheating unit for higher melting point alloy, it can be either vertical or drum-type. The only difference between the two is the placement of induction coil and the location of the metal to be melted.

Channel induction furnace incorporate a steel shell which is lined with some refractory material and this is where the metal to be melted is loaded into the furnace the steel shell is attached to the heating unit with the help of channel. The induction unit comprises of an iron core which is surrounded by primary coil.

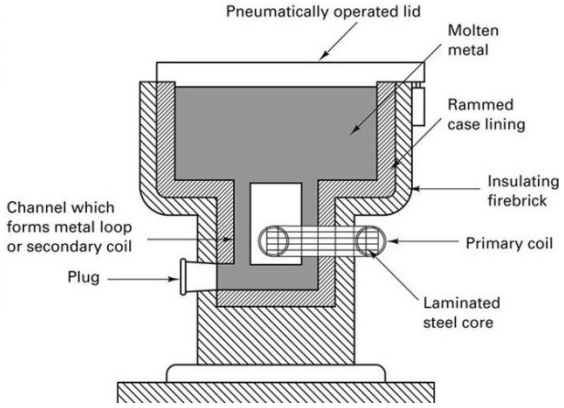


Fig. Channel type induction furnace

III. SAFETY MEASURE

1. Do not use attempt to use the equipment for any other purpose other than its intended purpose.
2. A furnace containing molten metal must never be left un-attended, molten metal temperature should be regularly checked.
3. Wear proper protection gear when operating temperature is very high.
4. All the material to be melted must be loaded dry.
5. Never clean water line with compressed air, as it will spread water in system and make it to overheat.
6. Molten metal when poured out into pit, must not have any moisture or oil particles it may cause explosion.
7. Water leakage may enter the refractory lining this may cause explosion.

IV. PRINCIPLE OF INDUCTION FURNACE

Induction furnace follows the two principle as follows.

1. Electromagnetic induction.
2. Joules law.

Electromagnetic induction

Any conductive material placed in variable magnetic field produces eddy current which lead to joule heating.

$\varepsilon=\Delta\Phi/\Delta t$
ε = magnitude of induced voltage (EMF)
$\Delta\Phi$ = change in
Δt = magnetic flux

Joule law

Joule heating also called as resistive heating is the process passage of electric current through conductor produces heat.

Mathematically,
$Q \alpha I^2R$
Q = heat generated.
I = current induced in coil.
R = resistance.

V. COMPARISON BETWEEN CORELESS AND CHANNEL TYPE INDUCTION FURNACE

Parameter	Coreless induction	Channel type induction
cleaning cycle	3 day required with around 52 cleaning cycle	No cleaning cycle required
Efficiency	Less	High
Cost	Less	Very high
Availability	High	Medium
Metal to be melted	Ferrous and non ferrous having high melting point	Mainly

VI. ADVANTAGES

1. Natural stirring action resulting in homogenous melt.
2. Melting is cleaner which does not effect the environment.
3. Installation of furnace is compact.
4. Better working environment.
5. Energy efficiengy is around 55 to75 percent.
6. Full heating capacity is obtain at a faster rate.
7. High production rate as times required to melt is less.

VII. FUTURE SCOPE

The furnace can be used in foundry industry at lower as well as for high production. It results in high productivity, higher quality and causes less pollution. With fewer modification induction furnace can also be powered by using solar energy. Which will lead in new approach in Indian foundry industry.

VIII. CONCLUSION

Through this paper, we have got a brief review about the induction furnace, its different types, modification. Safety measures required for proper functioning.

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