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Role of amount of council and diameter of copper on metal smelting temperature

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ABSTRACT

This paper discusses the role of the number of turns and the diameter of copper wire on metal melting temperature. The aim is to determine the effect of the number of turns and wire diameter on the temperature produced in the metal smelter. The method used by testing using the number of turns referred to is 20 turns, 25 turns, 30 turns, and a wire diameter of 1 mm, 1.5 mm and 2 mm. The results of the average value of the number of turns that vary, where the number of turns (30) has the highest average temperature value of 681.11 ° C, while the number of turns (25) produces the lowest average temperature of 648.22 ° C, the number of turns (20) the average temperature value is 651.11 ° C. and the larger the coil wire diameter is used, the higher the temperature produced. At 2mm, the coil wire diameter has the highest average temperature value of 691.11 ° C, while the coil wire diameter of 1.5mm has the highest average temperature value of 691.11 ° C. The average temperature value is 667.22 ° C, then the coil wire diameter of 1 mm has the lowest average value of 622.11 ° C.

Key words: Windings, wire diameter, temperature, metal smelting

1. INTRODUCTION

Metal casting is a process that involves melting metal, making moulds, casting, dismantling and cleaning castings. In melting metal a wide variety of induction kitchens can be used for cast steel. The performance of the induction kitchen is greatly influenced by the magnitude of the inductive value to produce an electromagnetic field. The magnitude of the electromagnetic field will absorb reactive power which will reduce the power factor [1]. The furnace used requires a temperature with a melting point of 660 ° C, but the material from aluminium ore is not available in abundance, so the need for aluminium is mostly obtained from remelting aluminium scrap. It smelt some scrap aluminium in a furnace heated by the burning of fossil fuels, natural gas, oil, or perhaps coal. However, the use of fossil fuels as an energy source for the liquefaction process has several drawbacks. Besides its lower efficiency, combustion produces residual smoke particles that contaminate liquid aluminium[2], [3].

Temperature is the heat of an object. Temperature affects all mechanical properties of the material and static or average stress also causes slow changes in the material [4]. High temperatures will make the material experience a shift or dislocation and will reduce its resistance, the higher the temperature of a material, the less resistance it will be so that the material will reach its fatigue point, which is where the condition of the material can no longer work [5] .

The inductor is a conductor wire formed into a coil; the coil helps create a strong magnetic field in the coil. The inductor is one of the basic electronic components used in circuits whose current and voltage variations because of the inductor's ability to process alternating current. The copper coil remains protected from the melting process by cooling the coil. The induction furnace is a simple system consisting of a coil that is wound around a crucible or refractory container containing the material to be melted and connected to an alternating system [6]. Copper wire is inexpensive and easy to get material. The availability of enough copper wire encourages researchers to examine the response characteristics of copper wire to very low-temperature changes. This wire is formed into a coil of copper wire which is called a coil to increase the resistance value of the copper wire [7].

2. THEORY

2.1 Induction furnace

A furnace is a device used to melt metal in the casting process or to heat materials in a heat-treatment process. Because the exhaust gas from the fuel is in direct contact with the raw material [5].

The induction furnace has a very low magnetic field and also the temperature regulation of an induction furnace for aluminium metal is also difficult, so it uses an electric resistance mechanism system for liquefaction. In order not to give too high an electric load, it made a furnace with a small capacity of 2 kg. This research is not only to reduce some weaknesses of the existing stoves but also to show maximum performance [8].

Although electric furnaces are more efficient, in electric furnaces it is more difficult to determine the melting capacity than with reverberatory furnaces on a large scale. Electric furnaces are more efficient than using gas or oil-fired furnaces, especially in their smaller size [9].

An induction furnace is a furnace that uses electrical energy as a source of heat energy, alternating current (alternating current) passing through the copper coil will produce a magnetic field in the filler metal (charging material). This magnetic field will also mix the liquid metal because of the magnetic force between the coil and the liquid metal which will cause a stirring effect (stirring effect) to homogenize the composition of the liquid metal [10].

The furnace used requires a temperature with a melting point of 660 ° C, but the material from aluminium ore is not available in abundance, so the need for aluminium is mostly obtained from remelting aluminium scrap. It smelt some scrap aluminium in a furnace heated by burning fossil fuels - natural gas, oil, or perhaps coal. However, the use of fossil fuels as an energy source for the liquefaction process has several drawbacks. Besides its lower efficiency, combustion produces residual smoke particles that contaminate liquid aluminium [11].

2.2 Inductor Coil

The inductor coil is a component consisting of an arrangement of wire windings that form a coil. An inductor can cause a magnetic field when energized by an electric current. The magnetic field generated can store energy in a relatively short time. The copper coil surrounds the refractory layer that surrounds the entire length of the furnace interior. A strong electric current through the coil will generate a magnetic field that penetrates the refractory material and melts the material in the crucible inside. The copper coil remains protected from the melting process by cooling the coil. The induction furnace is a simple system consisting of a coil that is wound around a crucible or refractory container containing the material to be melted and connected to an alternating system [12]. Copper wire is inexpensive and easy to obtain material. The availability of enough copper wire encourages researchers to examine the response characteristics of copper wire to very low-temperature changes. It forms this wire into a coil of copper wire which is called a coil to increase the resistance value of the copper wire [13].

As an excellent conductor of heat from Copper (Electrical and Thermal Conductor) Copper and ranks second after Silver, but for this Copper is required to have a purity of up to 99.9%. One of the good properties of copper is its resistance to atmospheric corrosion and even other types of corrosion. Copper is easily formed and joined through soldering, brazing and welding. It has good heat transfer properties, the melting point of 1100 °C can be rolled into thin plates, is easy to cut, can be filed, and can be bent.

3. MATERIALS AND METHODS

This type of research is an experiment on the effect of the number of turns in an electric metal smelter on the temperature produced in the metal smelting process. The use of the number of turns in question is 20 turns, 25 turns, 30 turns, with the number of turns it is expected to know the difference in temperature produced in the electric metal smelter.

The induction device works on the principle of a transformer with the primary coil being supplied with AC from the power source and the secondary coil. The secondary coil that is placed in the magnet field of the primary coil will produce an induced current. Unlike the transformer, the secondary coil is replaced by the raw material for smelting and is designed in such a way that the induced current turns into heat that can melt it. Under the working frequency used, the induction furnace is categorized as a mesh frequency induction furnace (50 Hz - 60 Hz) with a melting capacity of above 1 ton/hour and an induction furnace of the medium frequency (150 Hz - 10000 Hz) for furnaces with low melting capacity. It changes the mesh frequency in the medium frequency induction furnace first by using a thyristor to a higher frequency before it applies the primary coil. Heating is only done in the liquid channel. The hot liquid material will move upwards, while the cold liquid material will move down to fill the channel. Thus the liquid in the furnace will circulate. The induction device can be seen in Figure 1.

Figure 1 Induction Apparatus

4. RESULTS AND DISCUSSION

From the research results, it is obtained the relationship between the diameter of the wire and the resulting heating temperature.

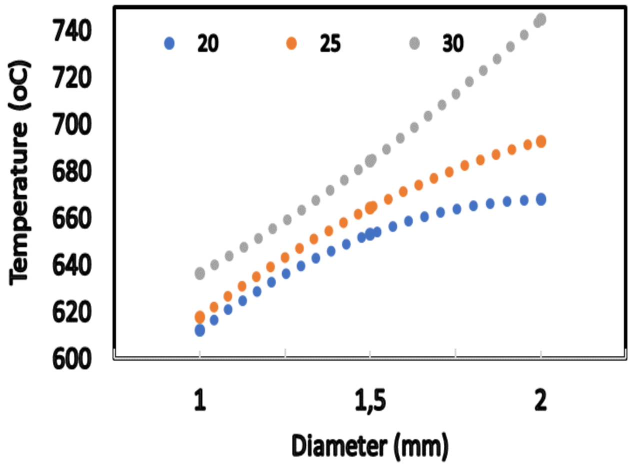

Figure 2. Relationship between wire diameter and heating temperature.

Figure 2. shows the diameter of the winding wire of 1mm, the lowest temperature is 610 ° C at the number of turns of 20 and the highest temperature is 632 ° C, which is obtained at the number of turns of 25, the resulting temperature does not reach the desired temperature, namely 660.02 ° C because the induction field does not. Can spread evenly and quickly so it may take a while to reach the desired temperature.

At 1.5 mm winding wire diameter, the lowest temperature is 645 ° C at the number of turns 20, the highest temperature is 680 ° C is obtained at the number of turns 30. At 2 mm coil diameter, the lowest temperature is 660 ° C at the number of turns 25 and the highest temperature is at 725 ° C with several turns of 30. The larger the diameter of the winding wire used, the higher the resulting temperature. At 2 mm diameter, a coiled wire has average values, the highest temperature is 691.11 ° C, while the coil wire diameter of 1.5mm has an average temperature value of 667.22 ° C, then the 1mm diameter coil wire has an average value. -The lowest average is 622.11 ° C.

5. CONCLUSION

From the results of the discussion, the following conclusions can be drawn:

1) The results of the average value of the number of turns that vary, where the number of turns (30) has the highest average temperature value of 681.11 ° C, while the number of turns (25) produces the lowest average temperature of 648.22 ° C, the number of turns (20) the average temperature value is 651.11 ° C.

2) In the variable coil wire diameter, it shows that the larger the coil wire diameter is used, the higher the temperature produced. At 2mm, the coil wire diameter has the highest average temperature value of 691.11 ° C, while the coil wire diameter of 1.5mm has the highest average temperature value of 691.11 ° C. The average temperature value is 667.22 ° C, then the coil wire diameter of 1 mm has the lowest average value of 622.11 ° C.

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