Design of Aluminium Melting Furnace Using Coconut Shell Charcoal on Laboratory Scale as Learning Medium

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Abstract. The laboratory is a means to conduct student practicum. Manufacuring Engineering Laboratory at the Industrial Engineering Department of the University of the Pacific is still lacking in equipment, this is a problem in the lecture and research process in the laboratory. The aim of this research is to design a laboratory scale aluminum melting furnace to support the smooth learning process and research in the laboratory. The melting furnace is designed to melt aluminum using coconut shell charcoal. The combustion process is carried out using shell charcoal and air from the blower. The design results show that the making and assembly of the melting furnace are made according to the design, the combustion chamber is made of refractory cement and is equipped with an air circulation system produced from the Blower. The coconut shell charcoal fuel needed to melt ½ kg of used aluminum is as much as 2 kg in phase I testing and 1 kg for phase II testing. The melting temperature in the first phase of testing was 729 ˚C with a melting time of 55 minutes, while in the phase II test the melting temperature was 690 ˚C and the melting time was 48 minutes.

1. Introduction

Aluminum is a metal that is often used in daily life and in various industries. Aluminum has good mechanical properties and corrosion resistance. Metal Casting is a process of making objects by means of a solid metal which is heated until it melts and then the metal liquid is poured into the mold cavity. To conduct the casting process, a melting furnace is needed to melt the metal. Melting furnace is a device used to melt and melt metal or material in the casting process or to heat a material in the heat treatment process [1] Coconut shell actually has a prospect as fuel because the heating value is quite high at 20890 kJ / kg [2]. The melting furnace is made in the form of a square with the inside of a cylindrical furnace and a cylindrical cup and the results of the analysis note that the amount of heat used to melt 5 kg of aluminum required heat of 3,030,600 J. The solid fuel furnace used to melt aluminum with a melting rate of 2.6 kg aluminum scrap per hour and a fuel consumption rate of 3.25 kg of fuel per hour [3]. The aim of this research is to design a aluminum melting furnace using coconut shell charcoal on a laboratory scale as a learning medium at the University of Pacific Manufacturing Labolaturium.

2. Research methods

2.1. Research Tools and Materials

The tools used in this study are blowers, digital thermocouples, electric welding machines, hand grinders, hand drills, cutting machines. The materials used are refractory cement, iron plates, angle iron 5 x 5 x 2 cm, crucibles, 2-inch steel pipes and coconut shell charcoal.

2.2. Design Method

The furnace is made according to the design results. Furnace with dimensions of 60 cm long, 60 cm wide and 60 cm high. The inside of the furnace is made of refractory cement and perforated like an inverted cone shape with diameters of 40 cm and 30 cm respectively. The melting furnace cover is designed with a length of 60 cm, width 60 cm, and height 10 cm. the part of the furnace cover is made of iron, iron and the walls are coated with iron plates. While the inside of the cover is made of refractory cement so that no heat is wasted out.

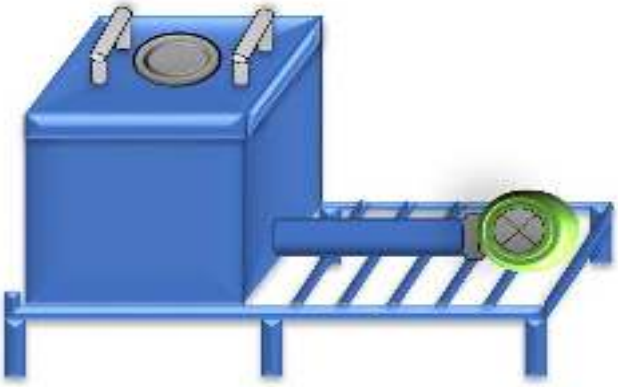

Figure 1. Isometry of the smelting furnace.

2.3. Smelting Furnace Testing

The melting furnace test results of the design were carried out twice by using aluminum used soft drink cans as material to be melted and coconut shell charcoal as fuel. The steps of the test are as follows. First the fuel in the form of coconut shell charcoal is weighed and put into the furnace. then the crucibles are inserted into the furnace and the remaining fuel is put back into the sidelines of the crucibles until the furnace combustion chamber is filled.

The next process is burning coconut shell charcoal with the help of kerosene to facilitate the initial combustion process. The blower is turned on to help the combustion process in the furnace. Used aluminum soft drink cans are loaded into a smelter that has previously been weighed. Measuring the temperature of the aluminum inside the crucibles is carried out using a digital thermocouple. After aluminum melts and reaches a temperature above its melting point, then molten metal is poured into the space provided.

3. Results And Discussion

The results of aluminum melting furnace with coconut shell charcoal can be seen in the picture below.

Figure 2. Furnace design results

The results of the manufacture and assembly of the smelting furnace are made according to the design, the combustion chamber is made of refractory cement and is equipped with an air circulation system produced from the Blower. The inside of the furnace cover is made of refractory cement, so there is no loss of heat from the melting chamber. The furnace cover is equipped with 2 handles so that it is easy to lift or move.

Smelting Furnace Testing can be seen in Figure 3. Phase I and II tests were carried out with the amount of coconut shell charcoal supplied for the smelting process was 3 kg and the amount of used aluminum cans was 1 kg.

Figure 3. Testing the furnace of the design

The results of the testing phase I and II in an aluminum melting furnace is known that the melting furnace designed able to smelt aluminum soft drink cans with total material (aluminum) that melted as much as 1 kg. The first phase of testing the amount of coconut shell charcoal used as much as 2 kg to melt aluminum as much as ½ kg, with a melting temperature of 729 ˚C and a melting time of 55 minutes. In the second test phase the remaining fuel used is 1 kg and is capable of melting as much as ½ kg aluminum with a melting temperature reached 690 ˚C and a melting time of 48 minutes.

In the second phase of testing, the fuel needed to melt aluminum is less, that is 1 kg. This is because there is still residual fuel from test I, while the melting time is also reduced by 48 minutes. Due to high temperatures in the combustion chamber which resulted in the aluminum material in testing II is easy to melt.

4. Conclusions

From the results of the design and testing of aluminum smelting furnaces using coconut shell charcoal that has been done, it can be concluded that manufacture and assembly of melting furnaces are made according to their design, the combustion chamber is made of refractory cement and is equipped with an air circulation system produced from a Blower. The inside of the stove cover is made of refractory cement and is equipped with 2 handles so that it is easy to lift or move.

The coconut shell charcoal fuel needed to melt ½ kg of used aluminum is as much as 2 kg in stage I testing and 1 kg for phase II testing. The melting temperature in the first phase of testing was 729 ˚C with a melting time of 55 minutes, while in the phase II test the melting temperature was 690 ˚C and the melting time was 48 minutes.

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