IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 18, Issue 3 Ser. II (May – June 2021), PP 20-23
www.iosrjournals.org

The Effect of Adding Wood Charcoal Powder and Coconut Shell Charcoal on Recycle Aluminum Alloy 6061 on Hardness

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Abstract:
Background*: The purpose of this study was to analyze the hardness of the castings made of Aluminum Alloy (AA) 6061 mixed with wood charcoal powder and coconut shell charcoal powder. AA 6061 is an aluminum alloy with elements of Magnesium and Silicon that is widely used in automotive and construction equipment, this aluminum alloy has beneficial properties such as corrosion resistance, light weight and malleability.*
Materials and Methods*: Wood charcoal powder is wood charcoal that is crushed into a fine powder. Wood charcoal is obtained from the carbonization process of wood by burning with limited oxygen. Meanwhile, coconut shell charcoal powder is charcoal powder made from burned coconut shells and also undergoes a carbonization process. Smelting is done with the material in the form of pieces of AA6061 which is melted in a crucible until it melts, where the melting temperature is an average of 700^{o}C. The aluminum melt is poured into a cylindrical tube in which wood charcoal powder has been added and in another pouring process, coconut shell charcoal powder is added. The hardness test sample was obtained from the casting which was cut with a thickness of 1 cm and a diameter of 5 cm. Samples were prepared for hardness test by the Brinell method.*
Results*: The addition of 12.5 grams of charcoal powder increased the hardness value from 48.18 BHN to 49.12 BHN. On the other hand, with the addition of 25 grams of coconut shell charcoal, the hardness value decreased by 49.12 BHN. By adding 37.5 grams of charcoal powder has a reduced hardness value of 52.50 BHN. The addition of 12.5, 25, and 37.5 grams of charcoal powder affected the Brinell hardness.*
Conclusion: *The more coconut shell charcoal powder and wood charcoal added, the more the Brinell hardness value was not too significant.*
Key Word*: AA6061, Wood Charcoal, Coconut Shell Charcoal, Hardness.*

Date of Submission: 29-05-2021 Date of Acceptance: 12-06-2021

I. Introduction

Aluminum is the most dominant commercial metal used in construction, machinery, households, and aircraft. The use of aluminum in large quantities in everyday life produces a large amount of metal waste. Aluminum from various activities produces waste, including recyclable materials such as beverage cans, cooking utensils, scrap, cable waste and almost all countries in the world recycle this material. Aluminum traded contains economic value, aluminum can be classified according to the type of load, type of treatment, and the result of its manufacture. AA6061 is the most economical and attractive alloy, and has properties including good appearance for various applications, light weight and corrosion resistance. Its outstanding physical property is that the strength-to-weight ratio of aluminum is higher than that of iron or steel.

In addition, aluminum alloys have a built-in corrosion resistance when aluminum castings are cooled. In aluminum metal, a thin layer of oxide is found that adheres strongly to the surface, namely on the outside of the aluminum alloy, the inside is protected by stable coating properties. The material used for this research is Aluminum 6061 alloy which is included in the category of aluminum that can be heated and forged. Mechanical treatment of the material will affect the level of hardness of the material [1]. Materials that have excellent fatigue properties, corrosion resistance can be used in heavy duty, namely the type of aluminum that contains the dominant elements of magnesium and silicon called Aluminum Alloy. Aluminum Alloy 6061 is melted and then added new elements obtained from the combustion.

II. Material And Methods

The material that will be used in this research is aluminum which is commercial aluminum alloy 6061, aluminum alloy 6061 which is the most widely used of this type. The aluminum cylinder rod is cut to size and it is a simulation of recycling machined 6061 aluminum alloy chip. Coconut Shell Charcoal is taken from PT MUTIARA AGUNG in Kramat Jati, East Jakarta. when shell charcoal is heated and burned can be observed through proximate analysis. the percentage value of water content, volatile matter, and ash is a proximate analysis, so that the total difference is 100%, namely the fixed carbon content [1]. Coconut Shell Charcoal and

Wood Charcoal At high temperatures are burned to leave ashes. The amount of coconut shell charcoal and powdered wood charcoal added to the cylinder tube mold was 12.5, 25, and 37.5 grams. In comparison, the smelted aluminum is also poured without wood charcoal powder and coconut shell charcoal

The smelting is carried out with the material in the form of pieces of aluminum that are put into a crucible until it melts, the aluminum feeder is aluminum, before entering the material so that it can be melted the initial melting temperature is measured by the Hand-Held Infra-Red Thermometer with a minimum temperature range of 700oC, in order to obtain an even melt, it is necessary to withstand temperature between 5 to 15 minutes before entering the mold. A tube mold measuring 5 cm long and 30 cm high is prepared, held with long tongs, in which the tube is preheated on a crucible. This high-temperature aluminum pouring into the tube mold produces a high enough flame indicating the presence of charcoal burning in the tube. This combustion provides continued heating of the aluminum material in the tube and if any impurities appear, it is immediately removed. However, it is also estimated that not all of the coconut shell charcoal powder and wood charcoal powder are burned, which are trapped in the castings. So it is estimated that there are 2 (two) components of coconut shell charcoal powder and wood charcoal powder remaining due to this heating, namely unburned charcoal powder and ash.

The test sample was obtained from the molding of a mixture of charcoal and aluminum alloy 6061. For hardness testing, the sample was made in the form of a circle with a diameter of 5 cm and a thickness of 1 cm. In the Brinell hardness test, a steel indenter ball with a diameter of 5 mm which is given a load of 500 kgf is pressed against the surface of the sample so that it forms a hollow. The relationship between the magnitude of the load, the diameter of the indenter steel ball, and the diameter of the base on the surface of the sample being tested is the basis for calculating the Brinell hardness value.

III. Result and Discussion

Hardness is defined as the resistance of a material to plastic deformation which is usually carried out by means of penetration so as to produce marks or indentations on the surface of the object being tested. Material hardness testing using the Brinell method is one of the most widely used hardness testing methods. From the research process, a number of samples have been obtained for hardness testing. Samples were codified as WOC (without wood charcoal and coconut shell charcoal), which used wood charcoal (cc) (12.5 grams), (25 grams), and (37.5 grams) and those using coconut shell charcoal (scc). namely (12.5 grams), (25 grams), and (37.5 grams).

Table no 1 : Hardness/Brinell results.

	Sample	BHN
E	woc	58.58976
F	cc12.5	48.18758
G	cc25	49.12303
H	cc37.5	52.50435
I	scc12.5	50.49701
J	scc25	53.57065
K	scc37.5	49.12302

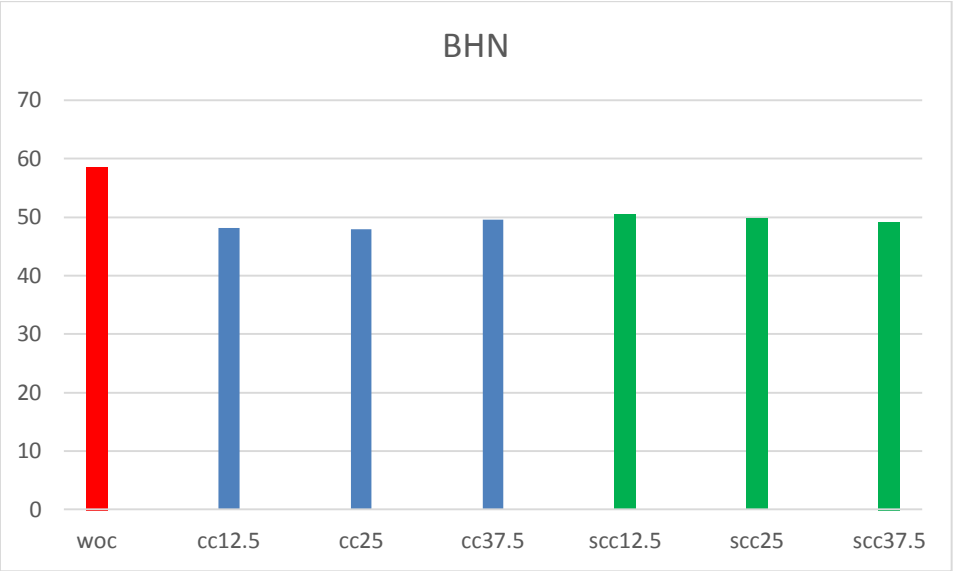
Description :

woc = without charcoal
cc = charcoal
csc = shell charcoal

E = 0 gram, wco

Charcoal:
F = 12.5 gram
G = 25 gram
H = 37.5 gram

Shell Charcoal
I = 12.5 gram
J = 25 gram
K = 37.5 gram



Gambar 1: Brinell Hardness

From Figure 1, the results of casting AA 6061 without the addition of wood charcoal (WOC) show a material hardness value of 58,58976. The addition of wood charcoal (cc) affects the value of castings. It can be seen from Figure 1, that with the addition of 12.5 grams of wood charcoal, the hardness value decreased to 48,18758 (sample F). With the addition of 25 grams of wood charcoal (sample G), it was seen that the hardness value of the material increased significantly compared to sample F which increased to 49.12303 For sample H, where 37.5 grams of wood charcoal was added (sample H). , the increase in hardness value is quite large, namely 52,50435 compared to sample G.

The addition of coconut shell charcoal (scc) affects the hardness value of the castings. From Figure 1, it can be seen that with the addition of 12.5 grams of coconut shell charcoal, the hardness value increased to 50.49701 (sample I). With the addition of 25 grams of coconut shell charcoal (sample J), it is seen that the hardness value increased significantly compared to sample J which increased to 53,57065. For the sample that added 37.5 grams of coconut shell charcoal (sample K), the decrease in hardness was 49.12303 compared to sample J. The decrease was due to the presence of other elements apart from the main material, thereby reducing the hardness value of the aluminum material. Other elements added to the main material have also changed the value of hardness and other mechanical properties. [1][2][3][4][5]. The addition of fly ash also results in the combustion of coal in the manufacture of composite materials which has an impact on the value of the mechanical properties of the material [6][7].

IV. Conclusion

From this discussion, it can be concluded that research by adding coconut shell charcoal and wood charcoal into a cylindrical tube has an effect on the hardness of cast aluminum material. The addition of 12.5 gr, 25 gr, and 37.5 gr of wood charcoal powder to the foundry of Aluminum Alloy 6061 did not significantly increase the hardness and the addition of coconut shell charcoal powder was 12.5 gr, 25 gr, and 37.5 gr in the foundry. Aluminum. Alloy 6061 for hardness is not too significant decrease.

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