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THE EFFECT OF ADDITION OF MAGNESIUM ELEMENTS ON THE ALUMINUM VELG CASTING PROCESS METHOD OF CASTING MOLD PRESSING TO THE LEVEL OF VIOLENCE, STRENGTH OF IMPACT AND MICRO STRUCTURE

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KEYWORDS

Impact power, hardness level, micro structure, magnesium addition, alluminium alloy velg

ABSTRACT

The aims of this research are : (1) the effect of adding magnesium in alluminium alloy velg casting toward hardness, (2) the effect of adding magnesium in alluminium alloy velg casting toward the impact power, (3) the effect of adding magnesium in alluminium alloy velg casting toward micro structure. This research use experiment method with the descriptive data analysis. The result of this research shows that : (1) there are effects of hardness level from the variation of adding magnesium with the value of 2% has hardness value average as 74.04 HB, while 3% magnesium has value average as 81.47 HB, then 4% magnesium has value average as 95.87 HB. (2) there are effects of impact power from adding magnesium , with the value of 2% has average value of impact as 0.055 J/mm^2, 3% magnesium has average value of impact as 0.041 J/mm^2, and 4% magnesium has average value of impact as 0.026 J/mm^2. (3) there is an effect of adding magnesium toward matrix distribution of alluminium alloy velg.

INTRODUCTION

Aluminum is a lightweight metal that has good corrosion and heat conductivity capabilities. Aluminum also has a resilient nature so that it is widely used. This metal has the ability to cast but has poor mechanical properties (Raharjo, 2008: 28). Automotive components that are often produced from aluminum alloy products, one of which is alloy wheels. Along with the increasing need for these parts, the spur industry has made use of used aluminum alloy wheels / scrap to be re-melted (remelting) and reshaped into motorcycle wheels (Sunaryo et al, 2013: 2).

Cast aluminum alloy wheels can be produced by small and medium industries, but there are still obstacles because the product quality is still far compared to factory-made alloy wheels (Kuncahyo, 2010). Efforts to improve quality can be improved by adding other alloying elements. One element of alloy that is often used is magnesium. Mo¨ller, et al (2007) stated that Mg content can have a very significant influence on the natural behavior and artificial aging of aluminum alloys. Increased Mg content in aluminum alloys will result in an increase in the quality index.

Hardness is a reliable property in lieu of metal strength. According to Supardi, E. (1999: 41) violence is a resistance from material to a permanent change of form. Metal hardness test aims to determine the hardness of a metal being tested. Hardness testing is to calculate the durability of a material against scratches or penetration on the surface. According to Kamei et al (2014: 19) states that charpy impact testing or commonly known as Charpy V-Notch Testing is a testing method that is destructive to specimens where the value / strength is determined by the energy received by the specimen during the test. Charpy test samples were carried out using 3 degree V variations namely (30 °, 45 ° and 60 °) with angular depth of shape v is 2 mm will be hit with a pendulum at the tip of the V.

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Micro structure is a material structure in small order. The structure can be observed using several tools including light microscopy, metallographic miskroscopes, electron microscopes, field on microscopes, field emission microscopes and X-ray microscopes. The benefit of observing microstructure is to study the relationship between the properties of the material with the structure and defects in the material, and estimate the nature of the material if the relationship is known (Supardi, E: 1999). Based on the description above, it is necessary to improve the mechanical properties of aluminum wheels by adding the element of Mg to the aluminum alloy.

RESEARCH METHODS

This research is an experimental study conducted in a laboratory with conditions and equipment that are adjusted to the need to obtain data on the effect of adding magnesium to the results of casting aluminum alloy wheels for motorcycles.

The research method used is a pre-experimental design method in the form of a one-shot case study design. There are 2 types of samples in this study, namely samples for hardness testing and microstructure. Each sample used three specimens of aluminum casting results with the addition of magnesium (Mg) each of 2%, 3%, and 4%. First is the sample for photo testing of microstructure and hardness testing with dimensions of 20mm x 20mm x 20mm shown in Figure 1. Second is a sample for testing rod-shaped impact with dimensions of 10mm x 10mm x 55mm with V notch in the middle measuring 2mm shown in picture 2

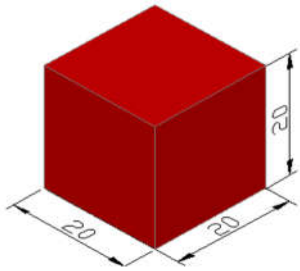

Figure 1. Specimen for Hardness Test and Micro Structure

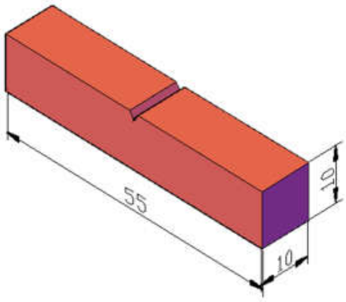

Figure 2. Shape and Size of Specimens for Impact Test

RESULTS AND DISCUSSION

Data on the results of hardness and impact strength testing are presented in the form of figures obtained from reading the test equipment. Micro structure specimens data were obtained from metallography using Metallurgical Microscope with Interved (Olympus PME), while hardness test values for each casting specimen were obtained from Brinnel hardness test, and impact test results for each casting specimen were obtained from impact charity test.

The results of the hardness tests carried out showed differences in the value of hardness in each test specimen with different levels of magnesium addition. Graphic images showing the difference in the value of hardness between variations in the addition of magnesium (Mg) of 2%, 3%, and 4% can be seen in Figure 3. below:

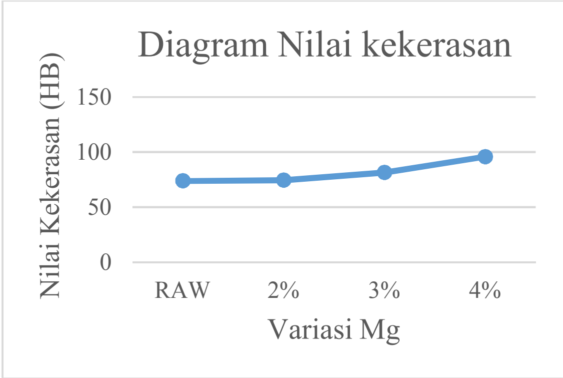

Figure 3. Effect of Mg Addition on Hardness Value

The graph above shows the hardness value of aluminum casting results with the addition of magnesium by 2%, 3%, and 4%. The addition of different elements of magnesium will affect the hardness of the specimen. The hardness test results on the addition of 2% magnesium (Mg) have an average hardness value of 74.07 HB, the results of the hardness testing on the addition of 3% magnesium (Mg) have an average hardness value of 81.47 HB, while on the addition of 4 Magnesium (Mg)% obtained an average value of 95.87 HB. This is in accordance with Surdia and Saito's statement in Suparjo (2011: 26) Al-Si alloys that require heat treatment plus Mg as well as Cu and Ni to provide violence. The added magnesium content will cause the process of hardening the aluminum alloy due to the deposition of the alloy when the metal starts to freeze thereby increasing the hardness value of the alloy (Suparjo. 2011: 27)

Comparison of the impact strength of each test specimen will be presented in the graph below :

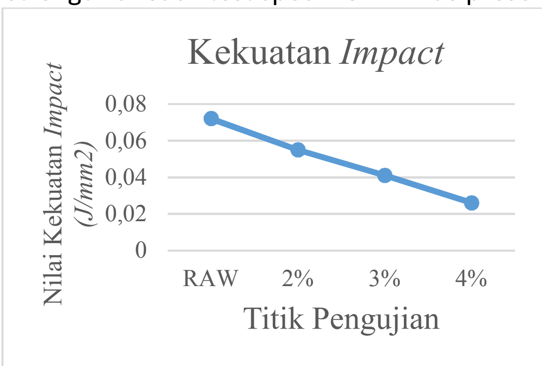

Figure 4. Effect of Mg Addition on Impact Strength

Figure 4 shows that the average value of the impact strength on variations of magnesium addition of 2%, is 0.055 J / mm2. The average value of the impact strength on variations of magnesium addition of 3% is 0.041 J / mm2. The average value of the impact strength on variations in the addition of 4% magnesium (Mg) is 0.026 J / mm2. From the above data it is concluded that the highest impact strength value is found in the variation of the addition of magnesium by 2% with a value of 0.055 J / mm2, followed by a variation of adding 3% magnesium by 0.041 J / mm2, while for the smallest impact strength value at 4% addition magnesium with a value of 0.026 J / mm2. This is because as more magnesium is added, it reduces the impact strength. Basically, magnesium itself has the property of improving the mechanical properties of aluminum alloys. Precipitated magnesium produces susceptibility to intergranular cracking and stress corrosion. The addition of magnesium significantly increases the strength of aluminum without reducing ductility. Good corrosion resistance and weldability (ASM International Handbook, vol. 2: 171). Magnesium will cause a decrease in impact strength because magnesium will combine with the element Si (silicon) in aluminum alloys, causing cracks in the aluminum alloy. So the impact power decreases with increasing magnitude of magnesium (according to Ye, H in Kurniawan, F. A. & Isranuri, I. 2016: 2).

This metallurgical test is carried out after conducting hardness testing and impact testing. This metallurgical testing requires a machining process first, this test is carried out to determine the spread of aluminum matrix in casting results that are not visible to the naked eye. Observation of the microstructure is used magnification of 200 times.

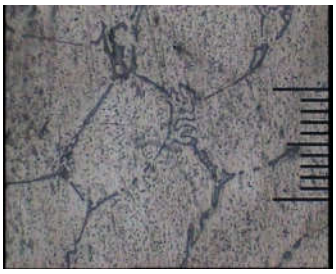

Figure 5. Photographs of microstructure with variations of the addition of 2% Mg at 200 times magnification

Figure 6. Photographs of microstructure with variations of the addition of 3% Mg at 200 times magnification

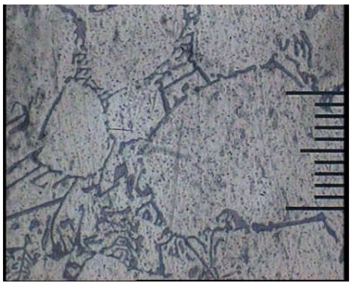

Figure 7. Photographs of microstructure with variations of 4% Mg addition at 200 times magnification

Figure 5. s.d. Figure 7 shows that the microstructure of each specimen is different with the addition of different magnesium. Figure 5. is the addition of the element 2% magnesium shows the spread of aluminum matrix is greater than the picture 6. with the addition of 3% magnesium and figure 7. with the addition of 4% magnesium. The microstructure at the addition of 3% has a denser distribution of aluminum matrix compared with the addition of 2% magnesium, while figure 7. has the most dense matrix distribution compared with the addition of magnesium by 2% and 3%. So the distribution of the aluminum matrix is the tightest at a percentage increase of 4% magnesium.

The addition of magnesium has an influence on the value of hardness and impact strength. Variation in the addition of magnesium with increasing levels will affect the hardness value of the aluminum alloy so that its hardness increases and the distribution of the aluminum matrix will also increase as magnesium is added to the aluminum alloy. The value of the impact strength will decrease with increasing magnesium added to the aluminum alloy. This means that the greater the variation of magnesium added to the aluminum alloy, the wider the aluminum matrix distribution will be, thus increasing the hardness of the alloy but the impact strength decreases.

CONCLUSION

Based on data analysis conclusions can be drawn as follows:

1. The addition of the element magnesium causes an increase in the value of hardness in aluminum alloy wheels. The addition of magnesium with a variation of 2% has an average value of hardness of 74.04 HB, the addition of 3% of magnesium has an average value of hardness of 81.47 HB while in the addition of magnesium variation of 4% has an average value of hardness of 95 , 87 HB.
2. Increasing the amount of magnesium increases the impact strength of the aluminum alloy wheels. The addition of magnesium at a variation of 2% has an average impact value of 0.055 J / mm2, at the addition of 3% magnesium has an average impact value of 0.041 J / mm2, and at a variation of magnesium addition of 4% has an average impact value of 0.026 J / mm2.
3. Increasing the amount of magnesium will indicate the denseness of the aluminum distribution matrix.

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