

EFFECT OF PREHEATING ON THE HARDNESS of Al₂₅Mg₂Si-2Cu-4Mn ALLOY

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ABSTRACT

In this paper the investigation is done on the hardness of Al₂₅Mg₂Si-2Cu-4Mn alloy. The preheated sample and as cast sample are tested on Brinell's hardness testing machine with load of 500kg and readings were recorded and studied and the result reveal that the preheated material has highest hardness number than that of as cast specimen.

Keywords- *preheated material, as cast specimen, Brinell's hardness testing machine.*

1. INTRODUCTION

Hardness is normally defined as the resistance to permanent indentation. Hardness test is carried to study the resistance to plastic deformation of the metal layer near surface of specimen. Special steel ball is used as tip for indentation, when indentation is done initially there is resistance to elastic deformation and next plastic deformation takes place in small amount. As deeper the indentation occurs, there will be large plastic deformation.

Heat treatment can be defined as, it is the procedure or the combination of procedures which involves heating plus cooling of the metal in the solid condition to obtain the desirable condition such as relieved stresses and also desirable properties are obtained such as improved ductility, better machinability, homogeneous structure etc. heat-treatment can also be defined as the method used to alter the physical and also sometimes chemical properties of a material. It can be applied for the special purpose of altering the properties intentionally only to processes where the heating and cooling are done.

Aluminium castings have played a vital role in the growth of the aluminium industry since its inception in the late 19th century. The first commercial aluminium products were castings, such as utensils and decorative parts, which exploited the novelty and utility of the new metal. The wide popularity of Al alloys in the automobile industry stems from their high strength to weight ratio, excellent casting characteristics, and good mechanical properties including wear resistance, low Co-efficient of thermal expansion, high thermal conductivity and high corrosion resistance.

2. EXPERIMENTAL DETAILS

An Al25Mg2Si-2Cu-4Mn alloy is the new composition prepared by the different weight percentages and produced by melting process and samples were prepared, and those samples are studied by conducting the hardness test. In this work, the hardness is compared between as cast and heat treated Al-25Mg2Si-2Cu4Mn alloy. The samples as cast Al-25Mg2Si-2Cu-4Mn alloy ingots are subjected to heat treatment. Initially the preheating process is carried out by soaking the as cast ingots in muffle furnace at 420°c for 25minutes and rapid quenching in ice cold water is done.

The apparatus needed for this test are as follows:

- As cast specimen and heat treated specimen
- Brinell's hardness testing machine
- Microscopic micrometer



Fig 1: Brinell's hardness testing machine

Two specimens of certain height, diameter and thickness are selected for this test and among these two samples one is as cast and another is heat treated. The certain load (F) and diameter (D) should be selected by observing the chart which contains the expected hardness of material. Next by placing the specimen on the anvil and raising it by means of hand wheel to certain height so that the surface of specimen should just touch the steel ball. Now the load is applied with the hand lever for prescribed time. Release the load and remove the specimen from the anvil. Now the specimens are kept under micrometer microscope, as shown in figure 2, below and diameter d, impression left by ball is measured.



Fig 2: Micrometer microscope with both the specimens

3. RESULTS AND DISCUSSION

The readings are recorded and calculated by using below formulas.

$$\text{BHN} = \frac{2F}{\pi D(D - \sqrt{D^2 - d^2})} = \frac{F}{\pi dt}$$

Where,

- F=Load in kgf
- D= dia of ball in mm
- d= dia of indentation in mm and
- t= deapth of indentation in mm

The values of D and F should be fixed because it is found that the brinell's number varies with the ball diameter and load applied

Tabular column:

Table 1: Tabular column of Brinell's hardness test

Sl No.	Material	Indenter	Steel ball dia(D) in mm	Total load (kg)	Indentation dia (d) in mm	BHN
1.	As cast Al-25Mg2si-2Cu4Mn alloy	Steel ball hardened	10mm	500kg	1. 2.6mm 2. 2.6mm Avg = 2.6mm	92.555 =93
2.	Heat treated Al-25Mg2Si-2Cu4Mn alloy	Steel ball hardened	10mm	500kg	1. 2 mm 2. 2.3mm Avg = 2.15mm	136.111 =136

In the below graph, it is showed that the value of hardness of as cast is less than the heat treated material.

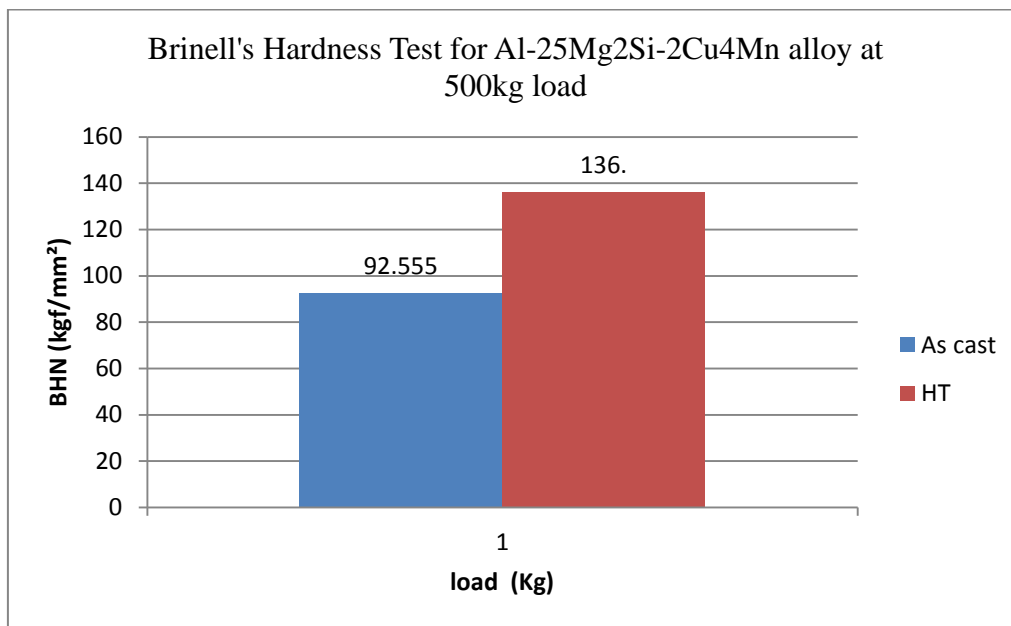


Fig 3: BHN graph

4. CONCLUSION

The hardness of Al₂₅Mg₂Si-2Cu-4Mn alloy was investigated on both as cast and heat treated condition. The highest hardness was obtained in the heat treated sample cooled in ice cold water.

ACKNOWLEDGMENTS

The authors express their thanks to Dr. V. P. Huggi, Principal of B.L.D.E.A's V.P.Dr.PG.H.College of Engg. & Tech Vijayapur, Prof.S.B.Koulagi, Head of Department, Department of Mechanical Engineering and to Prof. P. B. Kowalli, Associate Professor, Department of Mechanical Engineering, B.L.D.E.A's V.P.Dr.PG.H.college of Engg. & Tech Vijayapur., for their support and encouragement during the research studies.

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