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Effect of copper and Magnesium on Hardness of LM6 Aluminium Alloy

S.Balamurugan , C.Anantharaj ,V.K. Arul Arasan , A.Boopathi , A.Gowrisankar

Abstract— Aluminium alloys with a wide range of properties are used in engineering applications. Aluminium alloys are used extensivelyin aircraft due to its high weight to strength ratio. As the pure aluminium is soft, the various alloying elements are added with aluminium to enhance its mechanical properties. In this work, lm6 aluminium alloy is selected because of its higher fluidity property. The selected alloying elements are copper and magnesium. Copper is used to strengthen the aluminium alloy and on the other hand magnesium is used to increase the hardness of the aluminium castings. The work pieces are casted with different composition of copper (4%, 6%, 8%) and fixed composition of magnesium (1%). After completion of casting, the cast parts are examined for various mechanical properties.

Keywords: Aluminium alloys, mechanical properties, hardness.

I. INTRODUCTION

Aluminium is doped with copper, magnesium, silicon and zinc in various proportions to form aluminium alloys. It is classified into casting alloys and wrought alloys which is further subdivided into heat treatable and non-heat treatable. These are widely used in engineering structure where light weight corrosion resistance is required.

LM6 is an alloy which is usedin Propellers in marinebodies, actuators, strainers in valves, Impellers, manifolds in pumps. LM6 has a high resistance to corrosion. It is equally adaptable for both sand and permanent mould casting and for die castings.The LM6 alloy is chosen for those application because of its high hardness. This work planned to make anew alloy with LM6 as base metal and alloying elements are Cu and Mg at different proportions (4%, 6%, 8%) of copper and fixed composition of magnesium (1%).

II. CHEMICAL COMPOSITION OF LM6

Copper	0.1 max
Magnesium	0.10 max
Silicon	10.0-13.0
Iron	0.6 max
Manganese	0.5 max
Nickel	0.1 max
Zinc	0.1 max.
Lead	0.1 max.
Tin	0.05 max
Titanium	0.2 max
Aluminium	Remaining

S.Balamurugan , Assistant Professor , Department of Mechanical Engineering, KSR Institute for Engineering and Technology, Namakkal, Tamilnadu,

C.Anantharaj, V.K. Arul arasan, A.Boopathi, A.Gowrisankar, UG Scholars , Department of Mechanical Engineering, KSR Institute For Engineering and Technology,Namakkal,Tamilnadu.

III. EXPERIMENTAL PROCEDURE

Manufacture of a machine part by heating a alloy above its melting point and pouring the liquid alloy in a cavity approximately of same shape and size as the machine part is called casting process. After the liquid metal cools and solidifies it acquires the shape and size of the cavity and resembles the finished product required. The department of the workshop, where castings are made is called foundry.

The manufacture of a casting requires:

- Preparation of a pattern,
- Preparation of a mould with the help of the pattern,
- Melting of alloy in a furnace,
- Pouring of molten metal into mould cavity,
- Breaking the mould to retrieve the casting,
- Cleaning the casting,
- Inspection of casting.

Castings are made in a large number of metals and alloys, both ferrous and non- ferrous. Aluminium and aluminium – magnesium castings are used in automobile. Casting is an economical way of producing components of required shape either in small lots or in larger lots. However casting offer the possibility of having slightly improved properties in certain part of the casting by techniques such as use of chill etc. In casting process, very little metal is wasted.

Brinell test should be performed on smooth, flat specimens from which dirt and scale have been cleaned.The test should not be made on specimens so thin that impression shows through the metal, nor should impressions too close to the edge of the specimen.Brinellhardness test were performed on the polished sample of the aluminium alloy. The dimension of specimen for hardness test is20 mm x 10 mm. Hardness test were conducted on test specimen in three different places. 500kgf load is applied for a given time period and indenter diameter is 10 mm. The test result were shown in the table.

$$BHN=\frac{2P}{\Pi D(D-(\sqrt{D^2-d^2}))}.$$

Where

D = Diameter of indenter in mm

d = Diameter of indentation in mm

P = load in kgf

S. No.	Sample description	Dia. of impression in (mm)	BHN	Mean (BHN)
S1	LM6-Cu 4%	3.1	63.69	61.88
		3.2	60.08	
S2	LM6-Cu 6%	3.05	66.34	65.01
		3.12	63.69	
S3	LM6-Cu 8%	2.98	69.99	66.84
		3.1	63.69	
S4	LM6-Cu 4%Mg1%	3.06	66.34	61.21
		3.32	56.08	
S5	LM6-Cu 6%Mg1%	3.13	62.46	65.12
		3.02	67.79	
S6	LM6-Cu 6%Mg1%	3.12	63.69	67.23

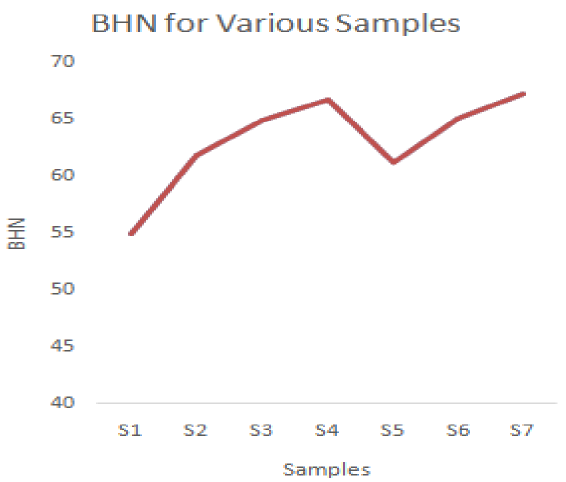

Fig 1. Effect of copper and magnesium content of Al-Cu-Mg Alloy

From the fig 1. it is evident that the addition of copper with LM6 aluminium alloy increase the hardness. The BHN for LM6 is 55. The Addition of 8% Cu increases the hardness from 55 to 66.84. The hardness increases upto 12% with the Addition of Cu. The further addition of 1% of magnesium with LM6-Cu alloy makes the castings more harden and the Hardness increases upto 13% from 55 to 67.23.

IV. Conclusion

With the addition copper hardness continuous to increase. Also, the higher the copper content the greater the hardness. Addition of copper and magnesium with LM6 aluminium alloy results an increase in hardness.

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