Effect of Variation of Silicon and Copper Contents in Aluminium-Silicon-Copper Alloy

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Abstract— In recent years aluminium alloys are widely used in automotive industries. This is particularly due to the real need to weight saving for more reduction of fuel consumption. The typical alloying elements are copper, magnesium, manganese, silicon, and zinc. Surfaces of aluminium alloys have a brilliant luster in dry environment due to the formation of a shielding layer of aluminium oxide. Due to such reasons, these alloys were subject of several scientific studies in the past few years [1].This project is aimed at studying the effect of varying the composition of Copper on the mechanical properties like Tensile Strength, Hardness and Corrosion Resistance in an Aluminium-Silicon-Copper alloy. Sand casting technique being the simplest one was used for the purpose of the project and testing was done on the samples for determining the resultant mechanical properties.

Key words: Al-Si-Cu Alloys, Casting, Tensile Strength, Hardness, Corrosion Resistance, Microstructure

I. INTRODUCTION

Aluminium alloys are used in advanced applications because of their combination of high strength, low density, durability, machinability, availability and relatively lower cost as compared to other competing materials.

However, the properties of commercial aluminum alloys depend on the amount of elements like magnesium, copper, silicon, zinc and other alloying elements present in them.

A variation in the composition of these elements has a significant impact on the mechanical properties of the resultant alloy. The properties are also influenced by the manufacturing techniques and heat treatment procedures employed.

In this project, an effort is made to study the effect of variation of composition of Copper in an Aluminium-Silicon-Copper alloy.

The specimens were prepared using Sand Casting for different variation of copper in the Al-Si-Cu alloy in order to study the effect of copper on the mechanical properties like hardness and tensile strength of the resultant alloy having about 5% Silicon by weight. Also, with this project we are trying to observe the Corrosion Resistant properties of the Al-Si-Cu alloy with the study of the microstructure of the alloy and its chemical compositions.

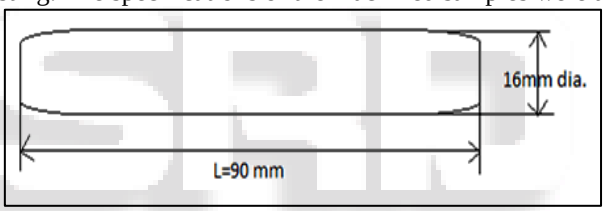
II. EXPERIMENTAL METHODOLOGY

Commercially available Aluminum, Silicon and Copper were taken for the present study. Alloy having 5% Silicon by weight was prepared and composition of Copper by weight was varied.

Cylindrical specimens were cast using sand mould for different compositions of alloying elements.

Chemical compositions of the resultant alloys were studied using Arc Met 930 Spectrometer. Tensile testing was done using Universal Testing machine.

Hardness testing was done using Brinell hardness testing Machine and Profile Projector. Corrosion resistance test was done using Corrosion resistance testing specimens. Microstructure test was done using specified Microscopes. The aluminium rods obtained from casting were machined on a lathe machine so as to prepare the samples for tensile testing. The specifications of the machined samples were as:



III. RESULTS & DISCUSSION

A. Weight % of different element present in the Al-si-cu specimens:-

ELEMENT	Sample - 1	Sample - 2	Sample - 3
Silicon(si)	5 %	10 %	15 %
Copper(cu)	5 %	10 %	15 %
Aluminium(Al) (6061)	90 %	80 %	70 %

B. Compression test of specimen on compression testing machine:-

Sample No.	Diameter of specimen(mm)	Length of specimen(mm)	L/d ratio	C/S area of the specimen(mm2)	Load at failure(KN)	Compressive strength(N/mm2)
1.	16	90	5.625	201.06	63.5	0.87
2.	16	90	5.625	201.06	63.82	0.93
3.	16	90	5.625	201.06	64.01	1.1

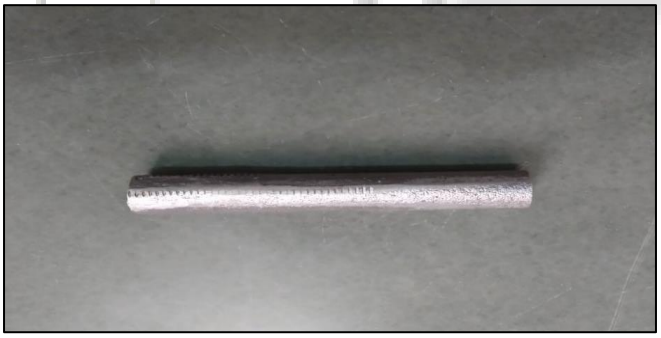
C. Compression Testing Machine with Specimen:-

This is the compression testing machine by using this machine we can perform the compression test on the different sample of alloys.

We obtain the different value of compression strength which is given in the above table.

And specimen figure before and after the compression test are as below:-

D. Specimen before the Compression Process:-



This is the sample of compression test before the compression testing process it would be look like a straight bar but after performing the compression test on this bar it would looks like the figure given below:-

E. Specimen after the Compression Process:-

This is the sample of compression test after performing the compression testing process it would be look like a bend bar and we obtained the compression strength of the different samples.

IV. CONCLUSION

The conclusions drawn from the current
Investigations are as under:-

1) The prepared Aluminium-Silicon-Copper alloy will have homogeneous distribution of silicon but heterogeneous distribution of copper content throughout the casting.
2) The amount of primary copper increases with the increase in copper amount in the casting.
3) Ultimate Tensile Strength increases with the increase of weight percentage of copper.
4) Hardness increases with the increase of weight percentage of copper.
5) When some amount of silicon is added to the alloy, the corrosion resistant property gets enhanced.
6) With an increase in silicon content, there was a slight decrease in hardness.
7) Mechanical properties of Aluminium alloys depend not only on the content of alloying elements, but also on their relative chemistries with each other.
8) The Future scope and enhancement drawn from the current investigations are as under:
9) Pure aluminium is soft and brittle, but can be strengthened by alloying with small amounts of copper, silicon, zinc, or magnesium.
10) The hardness of alloy is increase with increasing the copper contents.
11) Magnesium also has a positive impact on the tensile strength of the alloy.
12) The tensile strength of the resultant alloys increased with the addition of Zinc.
13) By adding magnesium in al-si-cu alloy the damping can be improved. However, a number of other elements are also added in small quantities for enhanced properties.

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