

# Preparation and Analysis of Mechanical Properties of SiC Reinforced Aluminum Metal matrix composite

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**Abstract** - In this study, the Mechanical properties of AMMC with base alloy Al6063 were analysed with varying wt % of SiC prepared by using Stir Casting Technique, and keeping other parameters constant such as Stirring speed, Preheating temperature, Cooling temperature etc. Various mechanical tests were performed and then they were analysed using topsis analysis to obtain most appropriate wt% of SiC with certain parameters.

**Key Word:** Stir Casting, AMMC, Alloy Al6063, Compressive Strength, Tensile Strength, Hardness, Topsis etc.

## 1. INTRODUCTION

Aluminum is most widely used metal due to its Nobel properties such as high conductivity and high strength to weight ratio. Large no. of aluminum alloys are available for application in various fields such as Automobile, aeronautics, construction etc. But changing scenario of demand and modern technology requires some Noble properties which can not be fulfilled by Conventional Material but these properties can be achieved using Metal Matrix Composite. Composites are Metal with some non reacting Impurities up to a certain percentage.

The Metal which is used to bind the introduced additives is known as Matrix Material, and additives are known as reinforcement material

Variety of Matrix metal are available such as Aluminum, Iron, copper etc. Wide range of reinforcement material is also available such as tungsten carbide, silicon carbide, graphite, Rice husk ash etc.

Here, it is very crucial to understand that Alloy are different from Composites.

## 2. LITERATURE REVIEW

No. of Journals and books has been referred for selection of appropriate Matrix material and Reinforcement material.

Based on this review certain key factors like fabrication method, matrix material, reinforcement material, Preheating temperature, Stirrer speed, stirring time etc are chosen appropriately.

From this review we found that Al6063 is aluminum alloy with some elements introduced in it, such as Silicon, copper, ferrus, chromium, zinc, manganese etc. Al 6063 is used particularly in

Architecture, Specifically in window frames, door frames, roofs and sign frames and other structures.

Research scholars used no. of reinforcement material to obtain enhanced mechanical properties, we selected here, SiC as reinforcement material due to its high hardness and toughness. SiC will help the composite to improve its tensile strength and hardness. though it may not help in obtaining high compressive strength.

## 3. EXPERIMENT

This section elaborates selection of material for composite i.e. alloy with different chemical composition in it, appropriate reinforcement material for AMMC.

The chemical composition of Al6063 is given in table 1.

**Table -1:** Composition of Al6063

Chemical Element	Present By Weight
Manganese(Mn)	0.10%
Iron(Fe)	0.35%
Magnesium(Mg)	0.60%
Silicon(Si)	0.40%
Zinc(Zn)	0.10%
Chromium	0.10%
Aluminum	Balance

### 3.1 Selection of Materials -

Based on literature review We selected Al6063 as matrix material due to its application in large no. of fields and SiC as Matrix Phase due to its mechanical properties such as hardness, toughness etc.

Composition of material also plays pivotal role in AMMC. Here we prepared samples with Composition weight

percentage 2%,4%,^% of SiC .The Composites were prepared Using Automatic Stir casting composite preparation technic.and during this experiment all parameters were kept constant except wt%.

**3.2 Synthesis of composite -**

synthesis of composite was done by stir casting process. The parameters which are important for this purpose are stirrer design and stirring speed and reinforced preheating temperature.

The synthesis of composite includes following steps

**3.2.1.Preparation of Matrix Alloy**

Matrix alloy was collected and cut in small pieces for primary melting using automatic hacksaw.then these were allowed to melt upto750°C for one hour.



**Fig -1:** Cutting of Al6063

**3.2.2. Preheating of reinforcement material**

Preaheating plays crucial role in preparation of composite.it helps to remove humidity,moisture and gases.It is also helpful in proper mixing of matrix material and matrix phase.

The reinforcing material was preheated upto 450C for 30 Minutes.This preheating prevents possibilities of cogulation.

**3.2.3 Stirrer Design**

Melt of Al6063 and preheated reinforcement are mixed in the furnace slowly, And stirrer is allowed to stir for proper distribution of reinforcement. Stirrer design is one of the significant parameters for the stir casting process.

It is necessarily required for whirlpool configuration for uniform dispersion of particles. There is different type of stirrer available at different angles and different speed. Here we have used stirrers with stirring speed 400 rpm and stirring angle 90°..

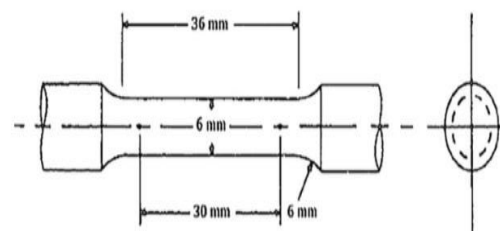
**3.2.4Casting**

The mixture was stirred for 5 min and then slowly poured in the cavity, then allowed to cool through natural convection up to room temperature. After achieving normal temperature work piece is obtained.

**3.3 Sample Testing –**

The samples were prepared using a lathe machine and grinding machine for Tensile, compressible and hardness testing. Here ASTM Standards are obtained for the Tensile test (ASTM B557M), Compressive test (ASTM E9) and Brinell hardness test.

**3.3.1 Tensile test -** For the purpose of tensile testing 3 samples were prepared from each composite sample and then there mean reading was taken for greater accuracy. So,total 9 samples were prepared and tested. Dimensions of the prepared samples were as shown in the figure



**Fig -2** ASTM B557 M Tensile test Specimen

**3.3.2. Compression test –**

For compression testing ASTM E9 standards were used.9 Samples were taken in the similar manner to that of tensile test. Dimensions of samples are Diameter 11 mm Length 25 mm L/D Ratio 2.0 shown in fig

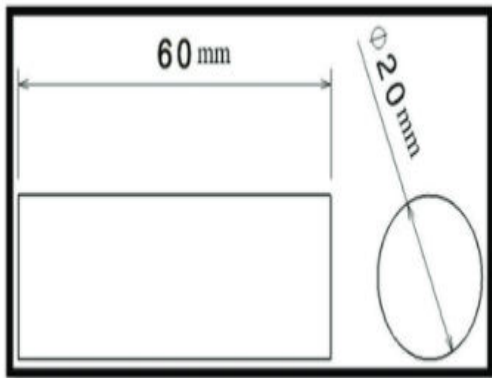


Fig -3ASTM E9 standard Dimensions for compression

**3.3.3 Brinell Hardness test** - We successfully performed Brinell hardness test for the prepared samples of dimension 15 mm x 10 mm. Finishing operation such as Grinding and Polishing were carried out preliminary with coarse filing and finishing using a motor-driven emery belt. We implicated gradual load of 125 kg on the test piece for a time span of 15 seconds and after performing the test the diameter of the impression measured.

**4. EXPERIMENTAL RESULT**

After successful preparation of composite following properties were measured

- Tensile strength
- Compressive strength
- Hardness (BHN)

The effect of various Compositions observed on mechanical properties of A6063 aluminium alloy castings has been discussed in this section

**4.1 Tensile Test Result**

We used ASTM standerds to obtain result

Obtained results are as shown in table.

**Table -2:**Tensile Test Result

Chemical composition of samples Casting	Ultimate Tensile Strength (MPa)
2% SIC+Al6063	228
4% SIC+Al6063	234

6% SIC+Al6063	254
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**4.2 Compressive Test Result**

Testing standards were used as prescribed by ASTM. Obtained results are as shown in table.

**Table -3:**Compression test result

Composition	Compressive Strength (N/mm <sup>2</sup> )
Al6063 + 2% SIC	196
Al6063 + 4% SIC	224
Al6063 + 6% SIC	258

**4.3 Hardness Test Result –**

Again ASTM standerds for hardness test were used to obtain Hardness results.

Obtained result is as following –

**Table -4:** Brinnell Hardness Test Result

Composition	B H N
Al6063 + 2% SIC	25.2
Al6063 + 4% SIC	29.8
Al6063 + 6% SIC	32.8

**5. CONCLUSION**

From this investigation we found that we can use SiC to obtain improvement in Mechanical properties such as Tensile

strength, Compressive strength, Hardness of Aluminium alloy 6063 in a fractional percentage by weight.

The conclusion of our research is that AL6063 can be substitute from low cost and high strength SiC reinforced AMMC for many industries and other small machine components.

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