

# Study of Hardness of Al-Sic Composites using stir casting Method .

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## ABSTRACT

In this study, Aluminum metal matrix composites containing several weight percentages of reinforcement particles were prepared using stir casting method .The study presents the results of experimental investigation on mechanical behavior of aluminum matrix reinforced with Silicon carbide particle .The effect of reinforced ratio of 20, 25 and 30 weight percentage of silicon carbide particles on mechanical behavior was examined. The result of weight proportion of carbide on hardness of composites was investigated by exploitation Brinell hardness check. It was observed that the distribution of silicon carbide particles was uniform. The hardness of the composites decreased with increasing reinforcement element addition in it.

**Keywords:-** Hardness, Stir casting , Aluminium, Silicon Carbide, Al-Sic Composites, Brinell Hardness.

## INTRODUCTION:

Silicon carbide particle strengthened Al matrix composites are developed over past few decades, due to their wonderful properties like light-weight, high modulus and wear resistance. Thus the silicon carbide particle reinforced aluminum matrix composites are expected to have many applications in aerospace, aircraft, automobile and electronic industries. The main steps in stir casting process are preparing of desired mould, pouring of metal, solidification. The experiments were performed on different composition of silicon carbide in the composite.

Casting is a manufacturing process by which a liquid material is usually poured into the mould, which contains a hollow cavity of the desired shape and then allowed to solidify. The solidified part is known as casting which is ejected or broken out of the mould to complete the process. Casting is most frequently used for creating advanced shapes that might be economical than other processes.

Stir Casting could be a liquid state technique of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibres) is mixed with a molten matrix metal by means of mechanical stirring.

Stir Casting is the simplest and also the most price effective technique of liquid state fabrication.

### Liquid- state processing by stir casting

Perhaps the most obvious method to distribute ceramic reinforcing particles into a metal matrix is to stir them into the molten matrix metal and solidify the mixture. This can be done rapidly and in large quantities causing conventional metallurgical processing equipment. Successful stir casting requires high turbulence in the molten metal to ensure good wetting between the particulate reinforcement and the liquid matrix melt. This can be achieved by melting the matrix metal or in our case we melt aluminium in a crucible, stirring vigorously to form a vortex at the surface of the melt and introducing the ceramic particles at the side of the vortex.

Stirring is maintained for few minutes before the slurry is cast. Stir casting is the simplest and least costly method to produce MMC.

In this study we produced the specimen with the method i-e stir casting and study the mechanical behavior of the specimen. We put our maximum effort to show that which method give better results

In Past Manoj Singla, D. Deepak Dwivedi, Lakhvir Singh, Vikas Chawla observed that by varying weight fraction of SiC (5%, 10%, 15%,) Hardness and impact strength were recorded and tabulated. Hardness take a look at has been conducted on every specimen employing a load of 250 N and a steel ball of diameter five metric linear unit as indenter.

Diameter of impression made by indenter has been predicted by Brinell microscope. The Corresponding values of hardness (BHN) were calculated from the quality formula. The results show the increasing trend of hardness and impact strength with increase in weight percentage of SiC up to 15% weight fraction. Beyond this weight fraction the hardness trend started decreasing as set on particles move with one another resulting in agglomeration of particles and consequently sinking down. Eventually the density of set on particles within the soften started decreasing thereby lowering the hardness. The best value of hardness and toughness comes out to be of sample containing 15% SiC i.e. 45.5 BHN (Hardness) and 36N-m (Impact Strength). The resultant samples were then examined for their hardness in terms of normalized displacement at varying loads .

G. B. Veeresh Kumar ,C. S. P. Rao ,N. Selvaraj concluded that the density of the composites increases with the incorporation of the hard ceramic reinforcement into the matrix material. In view of the higher than conclusions on density, experiments were conducted on the Al6061-SiC and Al7075-Al<sub>2</sub>O<sub>3</sub> to determine the density by weight to volume ratio and by rule of mixture. The experimental and theoretical densities of the composites were found to be in line with one another. There is a rise within the density of the composites compared to the bottom matrix.

<sup>3</sup>/<sub>4</sub> The hardness of the composites was reviewed and on conclusion, it is discovered that as the reinforcement contents increased in the matrix material, the hardness of the composites also increased. Further, the tests conducted to see an equivalent indicated the (Vickers and Brinell's hardness) inflated hardness with inflated reinforcement contents when put next with the bottom matrix. The mechanical properties were reviewed with relation to strength.

In this study, three specimen of the composite is produced with different weight percentage of SiC which are 20%, 25% & 30% to investigate the effect on mechanical behavior on the composites. From the specimens that have been produced by the Stir casting method, then they will be analyzed on microstructure and the hardness using the standardized testing method.

### OBJECTIVE

1. To develop the Al metal matrix with silicon carbide at different percentage.
2. Develop the pieces with Stir Casting method.
3. Hardness test of the specimen

### METHODOLOGY

It is decided that three pieces with different weight percentage of Sic will be produced. The percentage of Sic will be 20% ,25% and 30%.

### CALCULATION

#### IN CASTING

As we know that

Density of aluminium  $\rho = 2.7 \text{ gm/cc}$  i-e 2700 kg/m

As we require minimum length 13 inch

As 1 inch = 25.4 mm

So 13 inch= 330.2 mm

We require diameter = 1 inch= 25.4 mm

As volume=  $\pi/4 d^2l$

i-e  $1.6723 \times 10 \text{ m}$

As mass= volume\* density=  $2700 \times 1.6723 \times 10$

= 0.4515 kg or 451.5 gm

So from the calculations we came to know that we require each piece from casting which weighs 451.5 gm approx. But it is noted from the literature survey and with the consultation of the workshop heads that losses will also be encountered in both the processes. Losses are more in casting method as compared to powder metallurgy. It is noted that losses in casting is around 50 % that's why in casting the weight of aluminium is taken as double as it comes from calculations.

So we require each piece which weighs around 900 gm. The different composition of the composites is shown in table 1

| Composition | Weight of Al | Weight of Sic | Total weight |
|-------------|--------------|---------------|--------------|
| Al+20% Sic  | 720 gm       | 180 gm        | 900 gm       |
| Al+25% Sic  | 675 gm       | 225 gm        | 900 gm       |
| Al+30% Sic  | 630 gm       | 270 gm        | 900 gm       |

It is decided that the dimension of the specimen should be enough so that no difficulty will be encountered in the testing of the specimen on various machines. So diameter of 25.4 mm will be taken and length varies as according to the test.

## EXPERIMENTAL PROCEDURE

### MATERIAL USED

- AL A1 GRADE
- SILICON CARBIDE

### APPARATUS USED

- Furnace
- Safety devices
- Dies
- Moulding devices
- Electronic weight machine

## PROCEDURE FOR CASTING PROCESS

### Step: 1

Preparation of the molding sand.



Fig-1

### Step: 2

Making of the mould cavity



Fig-2

### Step: 3

Charge preparation by the stir casting process

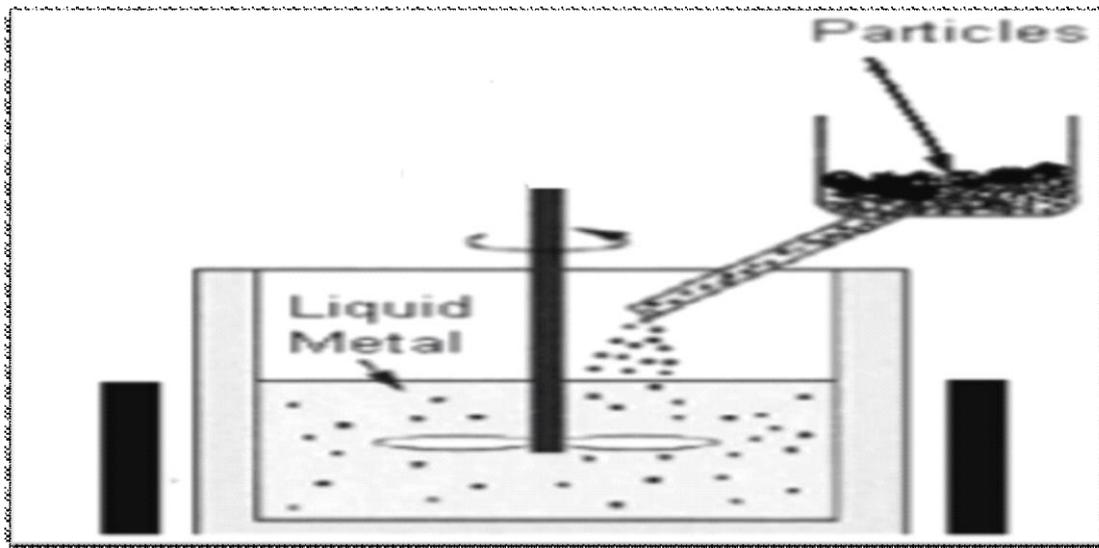


Fig-3

**Step:4**

Melt the metal in the furnace



Fig-4

**Step: 5**

Pouring the melt metal ( Al & SiC) in the mould cavity



Fig-5

**Step: 6**

Final rod of composite material



Fig-6

## RESULTS & DISCUSSION

Rod of composite material is obtained using Stir Casting as shown in fig 6. Wastage in Stir Casting method is Approx (50%), tabulated in table 2.

### OBSERVATION TABLE

| Sr no. | Al grade | Al wt. (gm) | % wt. SiC (gm) | Total Weight (gm) | Specimen Wt. (gm) | Slag and Wastage (gm) |
|--------|----------|-------------|----------------|-------------------|-------------------|-----------------------|
| 1.     | A1       | 720         | 180            | 900               | 450               | 450                   |
| 2.     | A1       | 675         | 225            | 900               | 450               | 450                   |
| 3.     | A1       | 630         | 270            | 900               | 450               | 450                   |

Table No-2

It is observed from the hardness test that when concentration of the SiC is increases the hardness of Al-SiC specimens is decreases as tabulated in table 3.

| MATERIAL | 20% SiC | 25% SiC | 30% SiC |
|----------|---------|---------|---------|
| A1       | 52      | 48      | 48      |

Table-3

### CONCLUSION

Stir Casting method is carried out to obtain a rod of composite material (Al-SiC). It is observed in past by various authors that hardness is increased with increase in percentage of SiC up to 20%. And it is observed from this study that hardness decreases with increase in percentage of SiC from 20% to 30%.

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