ISSN XXXX XXXX © 2017 IJESC

IJESC

Research Article Volume 7 Issue No.6

Analysis of Mechanical Properties of Aluminum Matrix Material Reinforced by Silicon Carbide

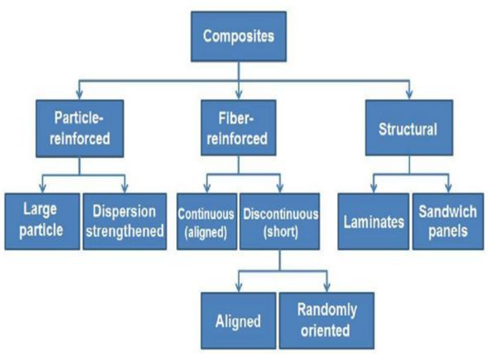
K Sudhindra Srinivas[1], S Mohammed Asif[2], B Sai Hari Prasad[3], N Pavn Kumar M.Tech [4]
B.Tech[1, 2, 3], Assistant Professor[4]
Department of Mechanical Engineering
SVIT, India

Abstract:
This work deals with producing aluminum based Metal Matrix Composite and then observing its microstructure and mechanical properties such as tensile strength, impact strength and Hardness of produced test specimen. In the present observation a modest attempt has been made to develop aluminum based MMCs with reinforcing material as SiC, with an objective to develop a conventional low cast method of producing MMCs and to obtain homogeneous dispersion of reinforced material. To achieve those properties the stir casting technique has been adopted. Aluminum and SiC, Fly Ash has been chosen as matrix and reinforcing material respectively. Experiment has been conducted by varying weight fraction of SiC (2%, 4%, &6%) and fly ash (5g,10g,15g) respectively. The result shown that the increase in addition of SiC at different weight fractions increases the Tensile Strength, Impact Strength, Hardness of the specimen

INTRODUCTION

1.1 Introduction about Composite Material:

A Composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, the new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials. More recently, researchers have also begun to actively include sensing, actuation, computation and communication into composites, which are known as Robotic Materials.



General Classification of Composite Materials

Composite materials are generally used for buildings, bridges, and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bath tubs, storage tanks, imitation granite and cultured marble sinks and countertops. The most advanced examples perform routinely on spacecraft and aircraft in demanding environments.

1.2. Significance of Composite Material:

Fiber-reinforced composite materials have gained popularity (despite their generally high cost) in high-performance products that need to be lightweight, yet strong enough to take harsh loading conditions such as aerospace components (tails, wings, fuselages, propellers), boat and scull hulls, bicycle frames and racing car bodies. Other uses include fishing rods, storage tanks, swimming pool panels, and baseball bats.

The new Boeing 787 structure including the wings and fuselage is composed largely of composites. Composite materials are also becoming more common in the realm of orthopedic surgery. And it is the most common hockey stick material.

Carbon composite is a key material in today's launch vehicles and heat shields for the re-entry phase of spacecraft. It is widely used in solar panel substrates, antenna reflectors and yokes of spacecraft.

It is also used in payload adapters, inter-stage structures and heat shields of launch vehicles. Furthermore, disk brake systems of airplanes and racing cars are using carbon material, and the composite material with carbon fibers and silicon carbide matrix has been introduced in luxury vehicles and sports cars.

Pipes and fittings for various purposes like transportation of potable water, fire-fighting, irrigation, seawater, desalinated water, chemical and industrial waste, and sewage are now manufactured in glass reinforced plastics.

1.3. Types of Composite Materials:

Typical engineered composite materials include:

- Mortars, concrete.
- Reinforced plastics.
- Metal composites.
- Ceramic composites.

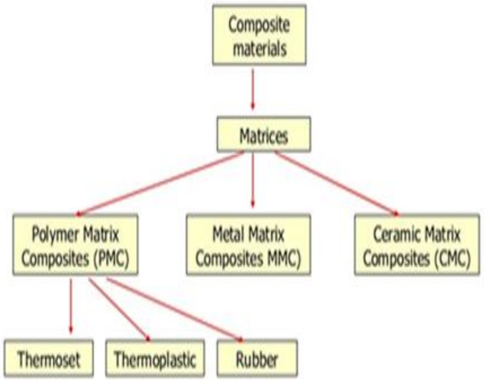


Fig.1.2 Classification Based on Matrices

1.3.1. Mortar:

Mortar is a workable paste used to bind building blocks such as stones, bricks, and concrete masonry units together, fill and seal the irregular gaps between them, and sometimes add decorative colors or patterns in masonry walls. In its broadest sense mortar includes pitch, asphalt, and soft mud or clay, such as used between mud bricks. Mortar comes from Latin moratorium meaning crushed.

1.3.2. Concrete:

Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements, such as cement fondue. However, asphalt concrete, which is frequently used for road surfaces, is also a type of concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer.

1.3.3. Reinforced Plastics:

Reinforced plastics are also known as polymer-matrix composite (PMC) and fiber reinforced plastics (FRP), consist of fibers (the discontinuous or dispersed, phase) in a polymer matrix (the composition phase). These fibers are strong and stiff and they have high specific strength (strength-to-weight ratio) and specific stiffness (stiffness-to-weight ratio).

1.3.4. Metal Matrix Composite:

Metal matrix composite is composite material with at least two constituent parts, one being a metal necessarily; the other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. An MMC is complementary to cermets.

1.3.5. Ceramic Matrix Composites:

Ceramic matrix composites are a sub group of composite materials as well as a subgroup of technical ceramics. They consist of ceramic fibers embedded in a ceramic matrix, thus forming a ceramic fiber reinforced ceramic material. The matrix and fibers can consist of any ceramic material, whereby carbon and carbon fibers can also be considered a ceramic material.

1.4. Metal Matrix Composites:

Metal matrix composite is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. An MMC is complementary to a cermets.

MMCs are made by dispersing a reinforcing material into a metal matrix. The reinforcement surface can be coated to prevent a chemical reaction with the matrix. For example, carbon fibers are commonly used in aluminum matrix to synthesize composites showing low density and high strength.

However, carbon reacts with aluminum to generate a brittle and water-soluble compound Al_4C_3 on the surface of the fiber. To prevent this reaction, the carbon fibers are coated with nickel or titanium boride.

The matrix is the monolithic material into which the reinforcement is embedded, and is completely continuous. This means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together. In structural applications, the matrix is usually a lighter metal such as aluminum, magnesium, or titanium, and provides a compliant support for the reinforcement. In high-temperature applications, cobalt and cobalt–nickel alloy matrices are common.

Fig.1.3 Composite Materials

The reinforcement material is embedded into a matrix. The reinforcement does not always serve a purely structural task (reinforcing the compound), but is also used to change physical properties such as wear resistance, friction coefficient, or thermal conductivity. The reinforcement can be either continuous, or discontinuous. Discontinuous MMCs can be isotropic, and can be worked with standard metalworking techniques, such as extrusion, forging, or rolling. In addition, they may be machined using conventional techniques, but commonly would need the use of polycrystalline diamond tooling (PCD).

1.5. Matrices:

1.5.1. Organic:

Polymers are common matrices (especially used for fiber reinforced plastics). Road surfaces are often made from asphalt concrete which uses bitumen as a matrix. Mud (wattle and daub) has seen extensive use. Polyester resin tends to have yellowish tint, and is suitable for most backyard projects. Its weaknesses are that it is UV sensitive and can tend to degrade over time, and thus generally is also coated to help preserve it. It is often used in the making of surfboards and for marine applications. Its hardener is peroxide, often MEKP (methyl ethyl ketene peroxide).

Epoxy resin is almost totally transparent when cured. In the aerospace industry, epoxy is used as a structural matrix material or as structural glue.

Shape memory polymer (SMP) resins have varying visual characteristics depending on their formulation. These resins may be epoxy-based, which can be used for auto body and outdoor equipment repairs cyan ate-ester-based, which are used in space applications and acrylate-based, which can be used in very cold temperature applications, such as for sensors that indicate whether perishable goods have warmed above a certain maximum temperature.

These resins are unique in that their shape can be repeatedly changed by heating above their glass transition temperature. When heated, they become flexible and elastic, allowing for easy configuration. Once they are cooled, they will maintain their new shape. The resins will return to their original shapes when they are reheated above their Tg The advantage of shape memory polymer resins is that they can be shaped and reshaped repeatedly without losing their material properties. These resins can be used in fabricating shape memory composites.

Traditional materials such as glues, muds have traditionally been used as matrices for papier-mâché and adobe.

1.5.2. Inorganic:

Cement (concrete), metals, ceramics, and sometimes glasses are employed. Unusual matrices such as ice are sometime proposed as in pykecrete.

1.6. Reinforcements:

1.6.1. Fiber:

Reinforcement usually adds rigidity and greatly impedes crack propagation. Thin fibers can have very high strength, and provided they are mechanically well attached to the matrix they can greatly improve the composite's overall properties.

Common fibers used for reinforcement include glass fibers, carbon fibers, cellulose (wood/paper fiber and straw) and high strength polymers for example aramid. Silicon carbide fibers are used for some high temperature applications.

1.6.2. Other Reinforcement:

Concrete uses aggregate, and reinforced concrete additionally uses steel bars (rebar) to tension the concrete. Steel mesh or wires are also used in some glass and plastic products.

1.6.3. Cores:

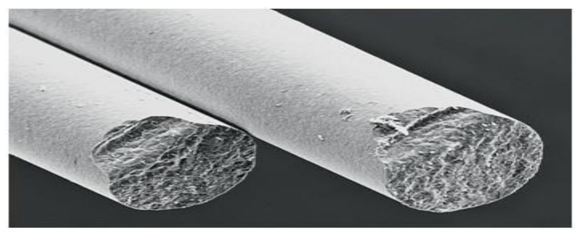
Many composite layup designs also include a co-curing or post-curing of the various other media, such as honeycomb or foam. This is commonly called a sandwich structure. This is a more common layup for the manufacture of redoes, doors, cowlings, or non-structural parts.

Reinforcing Materials

1.7 Aluminum Matrix Material:

The automotive industry recognizes that weight reduction and improved engine efficiency will make the greatest contribution to improved fuel economy with current Power trains.

This is evidenced by the increased use of aluminum alloys in engine and chassis components. Aluminum and magnesium castings in this sector have grown in leaps and bounds over the past five years to help engineers design and manufacture more fuel efficient cars.



The low density and high specific mechanical properties of aluminum metal matrix composites (MMC) make these alloys one of the most interesting material alternatives for the manufacture of lightweight parts for many types of vehicles. With wear resistance and strength equal to cast iron, 67% lower density and three times the thermal conductivity, aluminum MMC alloys are ideal materials for the manufacture of lightweight automotive and other commercial parts.

MMC’s desirable properties result from the presence of small, high strength ceramic particles, whiskers or fibers uniformly distributed throughout the aluminum alloy matrix. Aluminum MMC castings are economically competitive with iron and steel castings in many cases. However, the presence of these wear resistant particles significantly reduces the machinability of the alloys, making machining costs higher due mainly to increased tool wear. As a result, the application of cast MMCs to components requiring a large amount of secondary machining has been somewhat stifled.

Most components do not require the high performance capability of aluminum MMCs throughout their entirety. An un-reinforced cast alloy may accommodate the stresses in these areas. Reinforcement of only the high stress regions of a component is referred to as selective reinforcement. This approach to component design and manufacture optimizes the material for the application, reduces the cost of the cast MMC part and lowers machining costs.

CHAPTER - III
MATERIAL PREPARATION & METHOD OF EXPERIMENTS

This chapter contains the details about materials and the experimental procedure that were considered for the fabrication of composite and the test procedure followed for testing the characterization of composites, respectively. The raw materials used for fabrication are

- Aluminium Matrix Material
- Silicon Carbide (SiC)
- Fly Ash

3.1 Materials:

Aluminum is cut into pieces of cross section about 50mm * 600 mm. Thepure Aluminum is taken as matrix material is distributed by Metal House India Ltd. Commonly Aluminum have good mechanical properties. Again the aluminum material is cut into different cross sections which will gives the total weight of 600grams the aluminum material is cut by electrical Hacksaw by using water as lubricant.

Silicon Carbide (>300micrometer) of suitable grit size is weighed to different percentages commonly 2%, 4%, 6% of the weight of matrix material that is aluminum. The fly ash is used as filler material whose presages is not differed. The silicon carbide is supplied by Akshar Chemicals Pvt. Ltd, Calcutta.

The weights are measured by electronic weighing machine which is used in laboratories to weigh chemicals. The different compositions of reinforcement materials are collected according to their weight percentages taken as 2% of sample 1 (i.e., 12gm), 4% of sample 2 (i.e., 24gm), 6% of sample 3 (i.e., 36gm) to prepare the composite material.

The particulars of different weighs of compositions of reinforcement materials are tabled below:

Table 3.1 Composition of Materials:

Pure Aluminum	Silicon Carbide	Fly Ash (gm)
600	2%	5
600	4%	10
600	6%	15

Table 3.2 Combination of Materials:

Material Combination	Silicon Carbide	Filler Percentage
A1	12%	5%
A2	24%	10%
A3	36%	15%

As per the Table 3.1 Composition of Materials, three Composites are fabricated with different compositions are shown in the Table3.2by using the stir casting technique. The different compositions of reinforcement materials are collected according to their weight percentages taken as 2% of sample 1 (i.e., 12gm), 4% of sample 2 (i.e., 24gm), 6% of sample 3 (i.e., 36gm) to prepare the composite material.

The filler materials are added to the material of quantity of 5gm, 10gm, and 15gm with respect to the reinforcement material.

3.2. Preparation of Composite Material:
3.2.1. Casting:

Casting is a manufacturing process in which a liquid material is usually poured into a mould, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mould to complete the process.

A mould is formed in to the geometric shape of a desired part. Molten metal is then poured in to the mould. The mould holds this material in shape as it solidifies. A metal casing is created. Although this seems rather simple the manufacturing process of metal casing is both a science and an art.

The following steps involve the procedure of casting manufacturing process to prepare the mould:

- Prepare the sand and mould.
- Place a pattern in sand to create a mould.
- Incorporate the pattern and sand in a gating system.
- Remove the pattern.
- Preparation of furnace.
- Prepare molten metal.
- Stirring Process
- Pouring the metal.
- Allow the metal to cool.
- Break away the sand and remove the casting.

Fig 3.1 Preparation of Sand

Sand Casting the most widely used casting process utilizes expendable sand molds to form complex metal parts that can be made of nearly any alloy. Because the sand must be destroyed in order to remove the part called the casting. Sand casting typically has low production rate. The sand casting process involves the use of a furnace, metal, pattern, and sand mold.

In addition to the sand, a suitable bonding agent (usually clay) is mixed or occurs with the sand. The mixture is moistened, typically with water, but sometimes with other substances, to develop the strength and plasticity of the clay and to make the aggregate suitable for molding. The sand is typically contained in a system of frames or mold boxes known as a flask.

Fig 3.2 Making Mould

From the design, provided by an engineer or designer, a skilled pattern maker builds a pattern of the object to be produced, using wood, metal, or a plastic such as expanded polystyrene. The sand is well rammed along the pattern not to form air spaces.

Fig 3.3 Preparation of Gating System

The metal to be cast will contract during solidification, and this may be non-uniform due to uneven cooling. Therefore, the pattern must be slightly larger than the finished product, a difference known as contraction allowance. Pattern-makers are able to produce suitable patterns used according to the percentage of extra length needed.

Fig. 3.4 Incorporate the Pattern and Sand in a Gating System

A foundry is a factory that produces metal castings. Metals are cast in to shapes by melting them into a liquid, pouring the metal in a mold, and removing the mold material or casting after the metal has solidified as it cools. The most common metals processed are aluminum and cast iron.

In metal working, casting involves pouring liquid metal in to a mould, which contains a hollow cavity of the desire shape, and then allowing it to cool and solidify. The solidified part is also known as casting, which is ejected or broken out of the mould to complete the process.

Fig 3.7 Manual Stirring

In metal working, casting involves pouring liquid metal into a mold, which contains a hollow cavity of the desired shape, and then allowing it to cool and solidify. Furnaces are refractory-lined vessels that contain the material to be melted and provide the energy to melt it. Modern furnace types include Electric Arc Furnaces (EAF), induction furnaces, cupolas, rever berator, and crucible furnaces.

Fig 3.8 Pouring Molten Metal into Mould

Fig 3.9 Allowing Metal to Cool Down

Fig 3.10 Breaking the Mould

The poured molten metal is allowed to solidify this process is called solidification. The solidification can take few hours to solidify the molten metal. Once the solidification is completed the material casted is removed by breaking the mould.

3.3 Characterization of Mechanical Properties of Specimens:

After fabrication, the characterization mechanical properties of each specimen subjected to the following mechanical tests as per the workshop equipments are listed in the below tabular column as follows:

Table 3.3.1 Shows Type of Test and Machine Setup:

Sl.No	Test	Machine Setup
1	Tensile Test	Universal Testing Machine
2	Three Point Flexural Test	Universal Testing Machine
3	Impact test	Izod Impact Machine
4	Hardness Test	Brinell's hardness Machine
5	Study of Microstructure	Metallurgical Microscope

3.3.1. Tensile Test:

The Tensile test is performed on specimens Universal Testing Machine. In each case three samples of different compositions are taken and their values are recorded.

Specifications of the Test Specimen**:** Dimensions of Tensile Test Specimen.

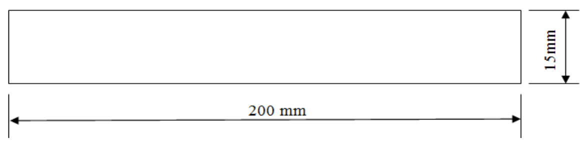


Fig 3.11 Specifications of Tensile Test Specimen

The tensile properties of the samples of sizes of length of the specimen is 200mm long, and minimum diameter of the specimen 15 mm as shown in Fig 3.11 were considered for conducting the tensile test on sample specimen. The tensile test determines the overall strength of the given object. In a tensile test, the object fitted between two grippers at either end then slowly pulled apart until it breaks.

The tensile strength is determined as,

The elongation measurement is used to calculate Engineering strain.

$$\in = \frac{L - L_0}{L_0}$$

Where,
L_O is the change in gauge length.
L is the final length.
The force measurement is used to calculate the Engineering Stress, $\sigma = \frac{F}{A}$
Where,
F is the tensile force, and A is the nominal cross-section of the specimen.

3.3.2. Flexural Test:

Flexural test were performed using 3-point bending method according to workshop procedure. In each case three samples of different composition are taken and average values are recorded.

The three point bending flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress-strain response of the material. The main advantage of a three-point flexural test is the ease of the specimen preparation and testing.

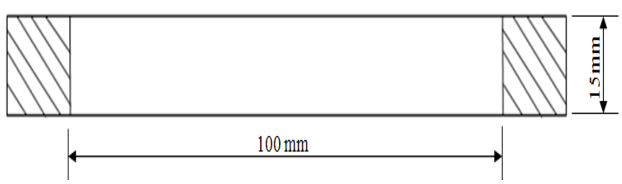


Fig 3.12 Dimensions of Flexural Test Specimen

The Formula used to determine the flexural strength of the test specimen is given by,

$$\text{Flexural Stress} = f = \frac{PL}{\Pi r^3}$$

Where,
L = Span (or) Length of the sample (mm)
P = Maximum Load (N)
r= Radius of Specimen (mm)

3.3.3. Impact Test:

The purpose of impact testing is to measure an object's ability to resist high – rate loading. It is usually thought of in terms of two objects striking each other at high relative speeds. A part (or) material ability to resist impact often is one of the determining factors in the service life of the part. The ability to quantify this property is a great advantage in product liability and safety.

Impact tests were performed to understand the toughness of material. During the test, specimens were subjected to a large amount of force for a very short interval of time. For any material, the higher amount of impact strength indicates that it can absorb a large amount of energy before failure.

As the impact energy increases the toughness of material increases and its plasticity will be also large. The specimen was clamped into the tester and the pendulum was released from a height to strike the specimen. The corresponding values of impact energy of different specimens were getting directly from the dial indicator. The size of the specimen for the impact test was 55 x 15 mm^2.

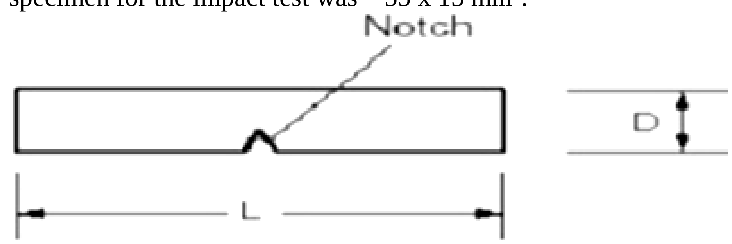


Fig 3.13 Dimensions of Impact Test Specimen

The formula used to determine the impact strength of the test specimen is given by, $U = \frac{\sigma^2}{2E} * V$
Where, U = Impact Energy in Joules
E = Young's Modulus, V = Volume of the Specimen, σ = Impact Strength

3.3.4. Hardness Test:

The Rockwell method measures the permanent depth of indentation produced by a force/load on an indenter. First, a preliminary test force (commonly referred to as preload or minor load) is applied to a sample using a diamond indenter. This load represents the zero or reference position that breaks through the surface to reduce the effects of surface finish. After the preload, an additional load, call the major load, is applied to reach the total required test load. This force is held for a predetermined amount of time (dwell time) to allow for elastic recovery. This major load is then released and the final position is measured against the position derived from the preload, the indentation depth variance between the preload value and major load value. This distance is converted to a hardness number.

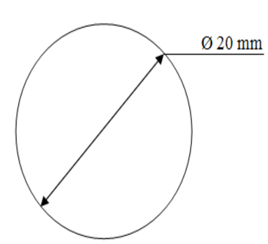


Fig 3.14 Dimensions of Specimen for Hardness Test

The formula used to determine the hardness number of the test specimen is given by, Brinell's Hardness Number = $\frac{\Pi D}{2} \times \left[D - \sqrt{D^2 - d^2}\right]$

Where,D = Diameter of Indent.
d = Diameter of Impression.
Rockwell hardness number is given by,

Rockwell Hardness Number $= 59 \times \frac{\left[1-\frac{H}{160}\right]^2}{d}$

Where,H = Hardness Number,
D = Diameter of Impression.

3.3.5. Study of Micro Structure:

Metallographic study is the study of metals by optical and electron microscopes. Structures which are coarse enough to be discernible by the naked eye or under low magnifications are termed macrostructures. Useful information can often be gained by examination with the naked eye of the surface of metal objects or polished and etched sections.

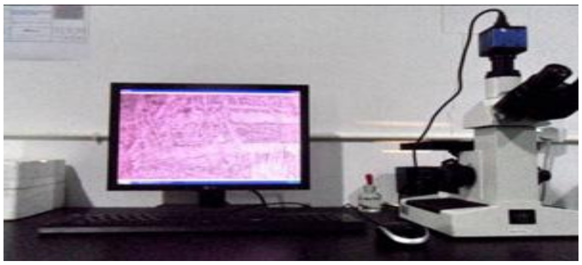
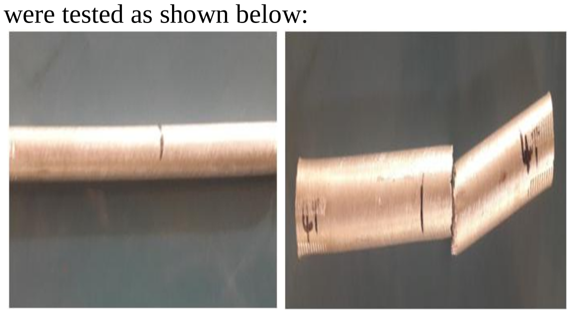


Fig 3.15 Microstructure Study

3.4. Experiments and Calculations:

3.4.1. Tensile Test:

For each test three different composition specimens were tested as shown below:



Specimen before and afterTensile Test

3.4.1.1. Experimental Design and Results:

Table 3.4.1 Evaluation of Tensile Strength

Sl. No	Type of Component	Tensile Load (N)	Deformation (mm)	Tensile Strength (N/mm^2)
1	2% SiC	16500	25.1	93
2	4% SiC	20200	20.2	114
3	6% SiC	14000	13.1	79

3.4.1.2. Sample Calculations:

Tensile Strength= $\frac{F}{A}$

Tensile Load= 20200

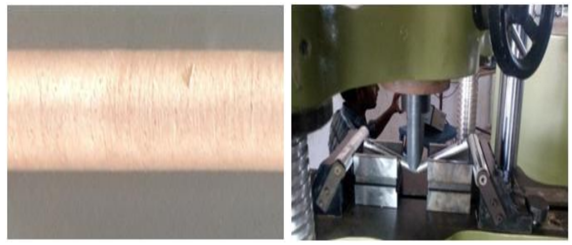
Cross-Sectional Area= $\frac{\pi \text{ x } 15^2}{4}$

Tensile Strength= $\frac{20200}{176}$

Tensile Strength= 114.308673 N/mm^2

3.4.2. Flexural Test:

For each test 3 different composition specimens were tested as shown below:



Specimen before and after Flexural Test

Fig 3.20 Setup of Specimen for Flexural Test

Specimen after Flexural Test

3.4.2.1. Experimental Design and Results:

Table 3.4.2Evaluation of Flexural Strength:

Sl. No	Type of Component	Flexural Load [P] (Newtons)	Length of the Beam (mm)	Radius of Bar (mm)	Flexural Strength (MPa)
1	2%SiC	4390	100	7.5	331.24
2	4%SiC	6800	100	7.5	513.08
3	6%SiC	9200	100	7.5	694.17

3.4.2.2. Sample Calculations:

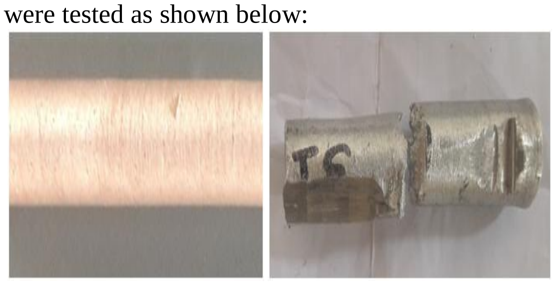
Flexural strength = $\frac{F\,(L)}{(\pi * R^3)}$

Flexural Load on the Specimen = 9200N
Length of the Specimen = 100mm
Minimum radius of the specimen = 15mm

Flexural strength =$\frac{9200*100}{3.1415*7.5*7.5*7.5}$ = 694.17N/mm^2

3.4.3. Impact Test:

For each combination 3 different composition specimens were tested as shown below:



Specimen before Impact Test **Specimen after Impact Test**

3.4.3.1. Experimental Design and Results:
Table 3.4.3 Values of Impact Strength:

Sl. No	Type of Component	Impact Energy	Impact Strength (N-mm)
1	2%SiC	228	5.9
2	4%SiC	248	7.6
3	6%SiC	292	8.52

3.4.3.2. Sample Calculations:
Impact Strength for the given test specimen is given by, $U = \frac{\sigma^2}{2E} * V$
Where,
Impact Energy = 248 J
Young's Modulus (E) $= \frac{\sigma}{\epsilon} = \frac{114}{0.101}$
$= 1128.71 N/mm^2$
Volume of the specimen = 176.7145*55
V = 9719.29 mm^3
Impact strength is given by,
$U = \sqrt{\frac{2*248*1128.71}{9719.30}}$, $U = 7.60\ N/mm^2$

3.4.4. Hardness Test:
For each test 3 different composition specimens were tested as shown below:

Specimen before Hardness Test **Specimen after Hardness Test**

3.4.4.1. Experimental Design and Results:
Table 3.4.4 Values of Hardness Test:

sSl. No	Type of Component	Load	Diameter of Indent (mm)	Diameter of IMP (mm)	BHN
1	2%SiC	150	1.587	1.15	121.96
2	4%SiC	150	1.587	0.8	278.06
3	6%SiC	150	1.587	0.75	319.37

3.4.4.2. Sample Calculations:
Brinell hardness number is given by,

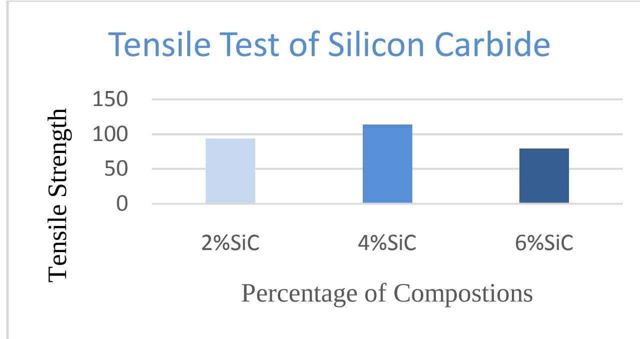
$$B.H.N = \frac{\Pi D}{2} \times \left[D - \sqrt{D^2 - d^2}\right]$$

Where,
Diameter of steel ball indent =1.587mm
Diameter of impression = 0.75mm
Brinell hardness number is given by,

$$B.H.N = \frac{\Pi D}{2} \times \left[D - \sqrt{D^2 - d^2}\right] \quad B.H.N = \frac{\Pi * 1.587}{2} \times \left[1.587 - \sqrt{(1.587)^2 - (0.75)^2}\right]$$

B.H.N = 319.37

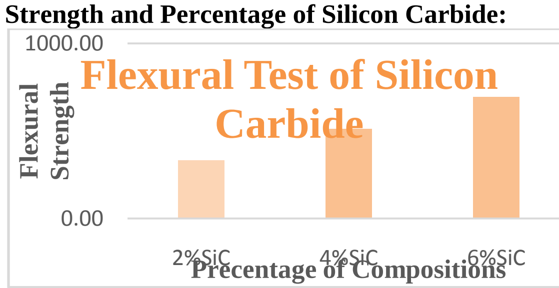
RESULTS AND DISCUSSIONS
4.1. Results of Tensile Test:
Graph 4.1 Graphical Representation between Tensile Strength and Percentage of Silicon Carbide:



From the graph it can be observed that the tensile strength of the composites are increased to an extent and then decreased. It can be observed that the increase in the filler content contributes in increasing the tensile strength of the composite up to the 10gm of mixture adding to the base matrix.

Also from the graph it is also observed that the Tensile strength of the Aluminium composites at 4% is higher than that of the composites of 2% SiC. But the Percentage of tensile strength decreases as the percentage of silicon carbide (6%) and fly ash (15gm) increases. However, declining of tensile strength was observed for sample 3 composite due to agglomeration and casting defect.

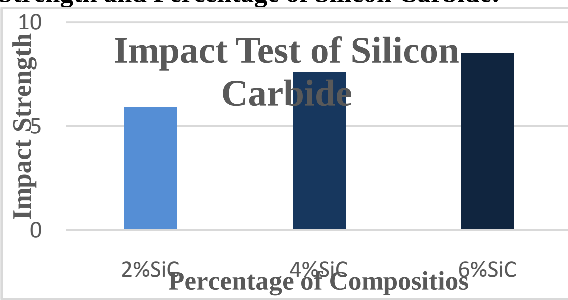
4.2. Results of Flexural Test:
Graph 4.2 Graphical Representation between Flexural Strength and Percentage of Silicon Carbide:



Flexural test is carried out at room temperature using universal testing machine. In this study it can be noted that the addition of SiC and Fly Ash particles improved the flexural strength of the composites. It is apparent that an increase in the volume fraction of Fly Ash particle results in an increase in the flexural strength. Graph 4.2 shows the effect of the weight fraction on the flexural strength. The flexural strength of Sample 1 is 331.24 N/mm^2 and this value increases to a maximum of 694.17 N/mm^2 for Sample 3 which is about 30% improvement on that of Sample 1.

4.3. Results of Impact Test:

Graph 4.3 Graphical Representation between Impact Strength and Percentage of Silicon Carbide:

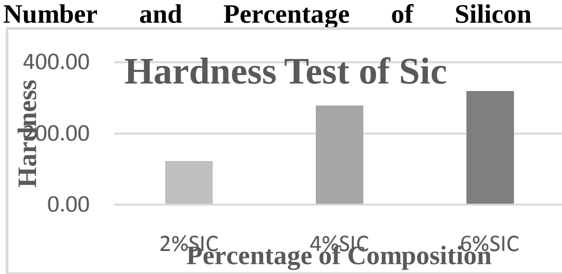


The Izod impact test, also known as the Izod v-notch test, is a standardized high strain- rate test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's toughness.

From the graph4.3 it is observed that the amount of absorption of energy increases as the percentage of reinforcement material and filler increases continuously. The sample 1 has energy of 5.90N/mm^2 whereas the sample 3 has energy of 8.52N/mm^2 it shows that there is 30% of increase in Toughness.

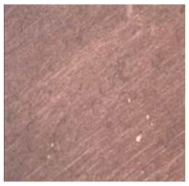
4.4.Results of Hardness Test:

Graph 4.4 Graphical Representation between Hardness Number and Percentage of Silicon Carbide:

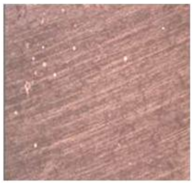


Graph 4.4 shows, the hardness behavior of composites. It can be observed that hardness shows increasing trend with increasing percentage of SiC particulates. This hardness increase was observed from 121 BHN for sample 1 to 319 BHN at 6 wt% SiC reinforced composite (A3) at room condition. This could be due to the presence of SiC particulates which are hard in nature.

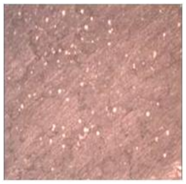
4.5. Results of Microstructure:



Micro Structure of 2%SiC



Micro Structure of 4%SiC



Micro Structure of 6%SiC

Microscopy of different composites materials such as Al+2wt%SiC, Al+4wt% SiC, Al+6% are shown. One of the most important considerations in the fabrication of metal matrix composites (MMCs) materials is the uniform dispersion or distribution of the reinforcement particles.

In Fig. 5.4.1, 5.4.2, and 5.4.3, the reinforcing particles of SiC are clearly visible as white specks. In Fig.5.4, uniform distribution of SiC particles is achieved. Some minor clustering and segregation of particles is seen in Fig. 5.4.3. Non uniform distribution of the particles can be a result of poor stirring of the particles into the metal matrix during the fabrication process. Segregation of particles may also occur during the solidification of the composite.

CONCLUSION

The results are obtained by testing the various specimens are listed below and are follows:

- Stir casting method can be successfully used to manufacture metal matrix composite with desired properties.
- Reinforcing Aluminium and its alloys with Silicon Carbide particles has shown an appreciable increase in its mechanical properties.
- The Tensile Strength of the aluminium matrix material increased by adding reinforced material silicon carbide up to the extent of 4% and there by decreased by 6%.
- The flexural strength (bending strength) of aluminium composite material increased by increasing the percentage of reinforcement material (i.e., Silicon Carbide).
- The Impact Strength of aluminium composite material increased by increasing the percentage of reinforcement material (i.e., Silicon Carbide).
- It was observed that the hardness of aluminium matrix composites material increased by increasing the percentage of reinforcement material (i.e., Silicon Carbide).
- Micro Structure studies revealed that the homogenous structure was obtained when the aluminium matrix material is reinforced by Silicon Carbide using fly ash as Nano Filler.

REFERENCES

1. International Conference on Materials Processing and Characterization (ICMPC 2014) on A Review on Mechanical and Tribological Behaviours of Stir Cast Aluminium Matrix Composites proposed by Himanshu Kalaa, K.K.S Merb, Sandeep Kumar.

2. International Journal of Advanced Science and Technology on Tribological properties of Aluminum Metal Matrix Composites (AA7075 Reinforced with Titanium Carbide (TiC) Particles) proposed by M. M. M. Sarcar V. Ramakoteswara Rao and N. Ramanaiah.

3. International Journal on Effect of Particulate ReinforcedAluminum Metal Matrix Composite proposed by Saravanan.C, Subramanian.K, Ananda K.V, and Sankara N. R.

4. International Journal onFabrication of ceramic preforms basedon Al2O3 CL 2500 powderproposed by L.A. Dobrzanski, M. Kremzer, A. Nagel, B. Huchler.

5. International Journal onProduction of MA956 Alloy Reinforced Aluminum MatrixComposites by Mechanical Alloying proposed by Luiz Antonio Carlos Moutinho Gomesa, Dilermando Nagle Travessaa, Jose Luis Gonzalez-Carrascob.c, Marcela Lieblichb, Katia Regina Cardosoa.

6. International Journal onManufacturing of aluminum matrix composite materials reinforcedby Al2O3 particles proposed by A. Włodarczyk-Fligier, L.A. Dobrzański, M. Kremzer, M. Adamiak.

7. International Journal of Engineering Research and General Science Volume 2, Issue 6, October-November, 2014 on Aluminium Alloy Metal Matrix Composite proposed by Vengatesh.D , Chandramohan.

8. International Journal of Automotive and Mechanical Engineering (IJAME) on Analysis of a Metal Matrix Composites AutomotiveComponent proposed by N. Fatchurrohman, S. Sulaiman, S.M. Sapuan, M.K.A. Ariffin and B.T.H.T. Baharuddin.

9. International Journal of Mechanical and Materials Engineering 2014 on Properties of ceramic-reinforced aluminiummatrix composites proposed by Dipti Kanta Das, Purna Chandra Mishra, Saranjit Singh and Ratish Kumar Thakur.

10. Journal of Minerals & Materials Characterization & Engineering, Vol. 9, No.1, pp.43-55, 2010 on Studies on Al6061-SiC and Al7075-Al2O3 Metal Matrix Composites proposed by G. B. Veeresh Kumar, C. S. P. Rao, N. Selvaraj, M. S. Bhagyashekar.

11. Journal of Materials Science - January 1998 on Reinforcement coatings and interfaces inaluminium metal matrix composites proposed by T. P. D. Rajan, R. M. Pillai, and B. C. Pai.

12. International Journal of Chemical, Molecular, Nuclear, Materials and Metallurgical Engineering Vol:6, No:8, 2012 on Physio-mechanical Properties of Aluminium Metal

13. Matrix Composites Reinforced with Al2O3 and SiC proposed by D. Sujan, Z. Oo, M. E. Rahman, M. A. Maleque, C. K. Tan

14. International Journal on The influence of reinforcement shape on wear behaviour of aluminium matrix composite materials proposed by L.A. Dobrzański, M. Kremzer, M. Adamiak.

15. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2ndEdition, 2004.

16. Strength of Materials by R.K. Bansal, Laxmi Publishers, 5th Edition, 2012.

17. Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishers.

18. Strength of Materials by R.K. Rajput, S.Chand& Company, 5th Edition, 2012.

19. Introduction to Physical Metallurgy, Sidney H. Avner, US, 2nd Edition, 2007 Tata McGraw-Hill, Noida, 1985.

20. Essential of Materials Science and Engineering, Donald R.Askeland, USA, 3rd Edition, Cengage Publisher, 2013.

21. Manufacturing Technology, Vol I P.N. Rao, Tata Mc Graw Hill, 4th Edition, 2013.

22. Manufacturing Technology, Kalpakjain, Pearson education, 4th Edition, 2002.