

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA



A Project report submitted on

***A Study on the mechanical properties of Al6061
Silicon carbide composite material.***

DEPARTMENT OF MECHANICAL ENGINEERING

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APPROVALSHEET

This report entitled “A study on the mechanical properties on Al6061-SIC composite material” by Kapil Ahmed and Joy Das approved for the submission.

Examiner

Supervisor

Date -----

Place _____

DECLARATION

We declare that this written submission represents our idea in our own words and where other sides or words have been included, we have adequately cited a reference to the original sources. We declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea, data, fact, source in our submission. We understand that any violation of the above will be caused for disciplinary action by the institute and can also evoke panel action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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TITLE

A Study on the mechanical properties of Al6061 Silicon carbide composite material.

ABSTRACT

In this study, Silicon Carbide(SiC) hybrid composite was produced by stir casting method. In this project Al6061-SiC composite was prepared by adding 6 wt% of SiC into Al6061 melt. The morphology, distribution of reinforcement materials and elements present in the composites were analyzed. The mechanical properties, impact strength and hardness of hybrid composite were measured and compared with those of Al6061. Al6061-SiC hybrid composite is lighter than Al6061. Hardness of Al6061 is 79.88 and hardness of Al6061-SiC hybrid composite is 85.79. Therefore the hardness is increased by 7.39%. Impact strength of Al6061 is 115 joule and impact strength of Al6061-SiC hybrid composite is 131 juole. Therefore Impact strength is increased by 13.91%.

OBJECTIVE

To make a hybrid composite of Al6061 and silicon carbide which has a density lower than Al6061 and mechanical properties higher than Al6061 and study the mechanical properties of the composite.

INTRODUCTION

Generally, composites are macroscopic combination of two or more distinct materials, having a recognizable interface between them. Composite materials are used in the manufacture of automotive components such as automotive panels chassis etc. and aerospace components like wings, fuselages etc. Aluminium matrix composites (AMC's) are produced by liquid phase process, solid–liquid process, two-phase (solid–liquid) process, deposition techniques and in-situ process. Stir casting is a low cost liquid phase process that is widely employed to make composite materials. In order to reduce the density and weight of the aluminium matrix reinforced with SiC, addition of lower density materials is suggested recently.

LITERATURES

1. *Characterization of Coconut Shell Ash for Potential Utilization in Metal Matrix Composites for Automotive Applications:*

(Authors of the literature are P.B Madakson, D.S Yawas and A Apasi findings: 1.Grain fineness number of coconut shell ash is 75.08 2.Density of coconut shell ash is 2.05 g/cm³)

2. *Investigation on physical and mechanical properties of Al6061-Silicon Carbide (SiC)/Coconut shell ash (CSA) hybrid composites.*

(Authors : M. Sateesh and M. Pugazhvadivu , Findings: 1.The density of composite is higher than Al6061, Distribution of reinforcement particles are uniform in composite, The addition of 10% SiC increases the hardness by 37%(70 HV).2.The tensile strength increases by 18.26% for Al6061-SiC composite compared to that of Al6061 casted material. 3.The hard SiC and CSA particles restrict the dislocation and thus stop the crack propagation by deflecting the growth plane of the cracks.)

3. *Effect of Heat Treatment on Mechanical and Wear Characterization of Coconut Shell Ash and E-glass Fiber Reinforced Aluminum Hybrid Composites*

(Authors : J.W. Pinto, G. sujaykumar, Sushilendra R.M, Findings: 1.An improvement of 84.2VHN increase is noticed with addition of 4% CSA and 4% E-glass fibre reinforcement in matrix alloy composite. 2.Maximum tensile strength obtained was 83 MPa for 3% CSA + 3% E-glass fibre reinforced aluminum composites)

MATERIALS

1. In this project we used Al6061 as matrix material and silicon carbide as a reinforcement.
2. Both Al6061 and silicon carbide were collected from our laboratory.



Aluminium 6061

Preparation of the composite

- 1.** To prepare the composite we first melted Al6061 with a high temperature in a crucible.
- 2.** After it got completely melted we mixed silicon carbide into melted Al6061.
- 3.** Then we applied stir casting method to mix the silicon carbide completely into Al6061.
- 4.** After stir casting we took the crucible at that temperature for sometime so that silicon carbide can completely mix into Al6061.
- 5.** Then we took the melted composite and placed it in a rectangular box to get a sample.



Melted Al6061



Impact test

An impact test is used to observe the mechanics that a material exhibit when it experiences a shock loading that causes the specimen to immediately deform, fracture or rupture completely.

Specimen for IMPACT TEST

1. To do the impact test of the composite material first of all we have prepared a suitable sample for the metal impact test machine in our SOM lab.
2. To prepare the specimen we cut a suitable portion from the composite material by power saw and hack saw.



3. After cutting that particular part we made the part of 75mm in length and 10mm in width by surface finishing .
4. Then we have made a v shape notch at 28mm distance from one end of the specimen.

5. The angle of the notch was 45 degree.
6. The use of notch causes high localized stress concentration which artificially reduces ductility and makes specimen fail from that particular portion.



Specimen for impact test

TEST

The izod impact test entails striking a notched(v-shaped notched) impact specimen with a swinging weight attached to swinging pendulum. The specimen breaks at its notched cross section upon impact and the upward swing of the pendulum is used to determine the amount of energy absorbed in the process. Energy absorption is directly related to the brittleness of the material.

Result

Finally the result we have obtained from the izod test was 131 joule. That means the energy absorbed by the specimen due to the applied load by a moving pendulum is **131 joule**.



ROCKWELL HARDNESS TEST

Hardness is a characteristic of material not a fundamental physical property. It is defined as the resistance to indentation and it is determined by measuring the permanently depth of indentation.

SPECIMEN PREPARATION

1 .To make the specimen for rockwell hardness test first of all we cut a rectangular portion from the composite material and then by surface finishing and roughing we have made the surface very smooth son that the indenter can indent easily and no error occurs in the experiment.

2. we made another specimen for pure aluminium 6061 and by the same way we made smooth surface of the specimen.



Specimen of composite material



Specimen of Al6061

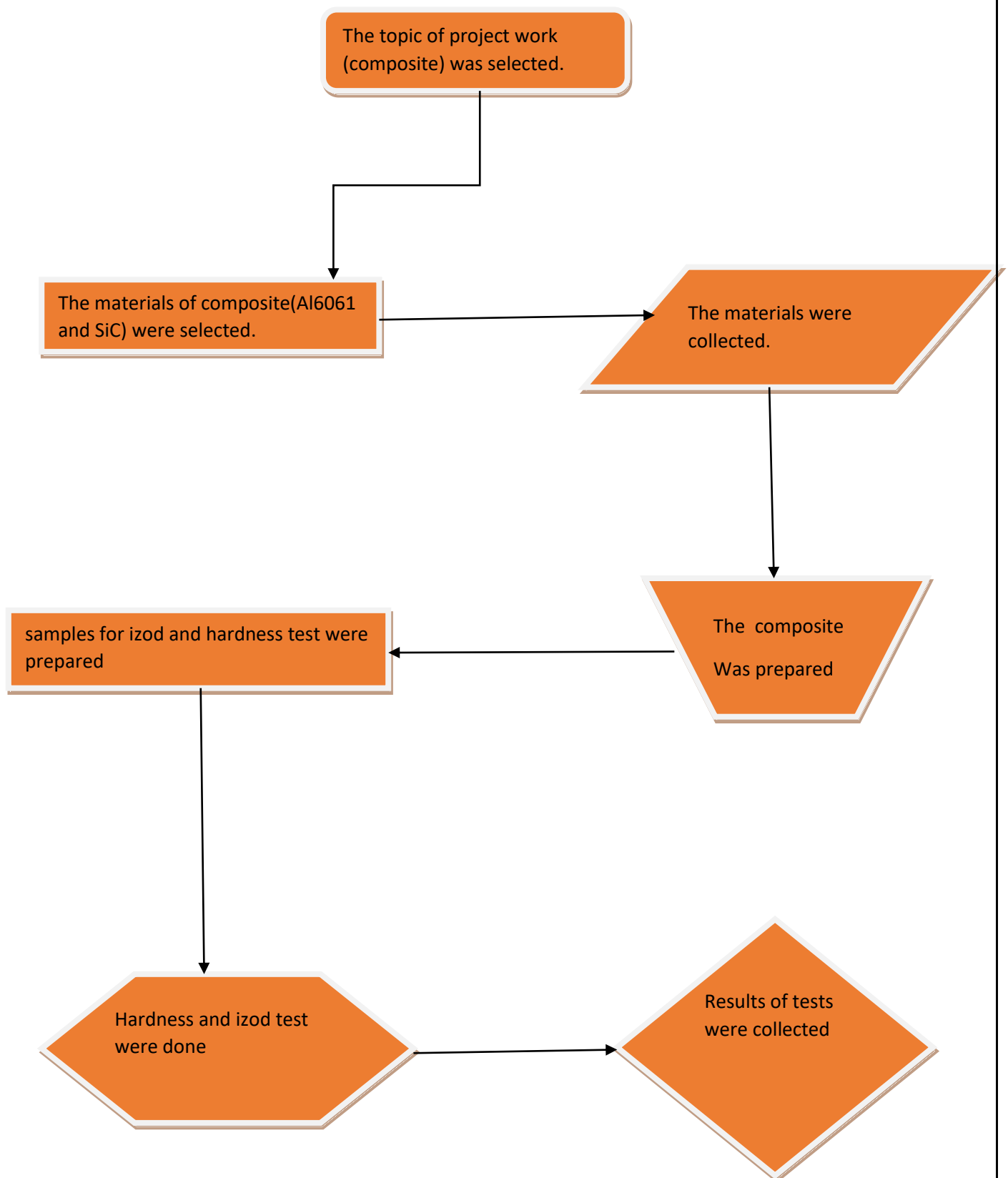
HARDNESS TEST AND RESULT

Rockwell test is generally easier to perform and more accurate than other type of testing methods. The rockwell hardness is used for all metals except in condition where the test metal structure or surface condition would introduce too much vibration.

The rockwell method measures the permanent depth of indentation produced by a force/load on an indenter. First a preliminary test force was applied to the specimen by a ball intender. After the preload an additional major load was applied. This major load was then released returning to the preliminary load. After holding the preliminary test load for a specific time the final depth of indentation was measured. The rockwell hardness value was derived from the distance between baseline and final depth. This distance is converted to hardness number.

The hardness number was 79.88 for pure aluminium and for the composite material it was 85.79. so we can say that the hardness of the composite material is increased.

WORKPLAN



Conclusion

Stir casting process was employed to fabricate Al6061- SiC hybrid composite. Then impact and hardness tests were done. After the test it was observed that both the hardness and the impact strength of the composite material were increased.

References

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