ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.4

Mechanical Characterization of Aluminium Hybrid Metal Matrix Composite

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Abstract:
Silicon Carbide-Graphite and AL6061 alloy composite was cast using stir casting method having a base material of Aluminum (6061), 7% of SiC and 3% Gr; as well as 3% of SiC and 7% Gr by weight. Silicon Carbide and graphite were used as reinforcements. The cast material was machined as per ASTM standards (B557). The machined material was then tested to determine its mechanical characteristics; the tests carried out were tensile test, shear test, impact testing as well as finding out the materials hardness as well as its microstructure. It was concluded that the cast composite material outperformed the alloy of Aluminum.

Keywords: Stir casting, Al6061, SiC, Graphite, Reinforcement, Hardness, Tensile strength, Compression strength, Aluminium hybrid metal matrix composite.

I. INTRODUCTION

Composite materials have replaced the customary materials in light weight and high quality applications. The reasons why composite are chosen for such applications arebecause of their superior mechanical characteristics. Composite material is a material composed of two or more physically distinct phases, the properties of a composite as a whole are enhanced as compared with the properties of its components.

The technological and commercial interest in composite materials develop from the fact that their properties not just different than their components but they are superior. Composite material consists of two phases, primary phase and secondary phase.

Matrix forms the primary phase within which secondary phase is imbedded. The imbedded is also known as reinforcing agent it improves the overall mechanical properties of the matrix. The reinforcing phase usually in the form of fibers, particles/particulates, flakes and fillers.

II. MATERIALS

Aluminium 6061

The aluminium Al6061 grade was utilized as the matrix material. Aluminium is the third richest component after oxygen and silicon. It is extricable in character, reveals reasonable excellence and surpassingly corrosion resistance. They have been contemplated broadly in view of their mechanical significance and due to precipitation hardening it as got their excellent increment in quality.

Silicon Carbide

Silicon carbide (SiC) can be utilized as reinforcement in the form of particulates, whiskers or fibers to enhance the properties of the composite. SiC certainly improves the overall strength of the composite along with corrosion and wear resistance.

Graphite

Graphite is a crystalline form of carbon having a layered structure with basal parts planes or sheets of close packed carbon atoms. Consequently, graphite is a week when sheared along the layers. This characteristic, in turn gives graphite its low frictional properties as a solid lubricant. However, its frictional properties are low only in an environment of air or moisture, in vacuum graphite is abrasive and a poor lubricant.

III. METHODOLOGY

Step1: Casting

In the present work Hybrid aluminium composites are created via stir casting, with varying percentage weight of reinforcement. The required amount of weighed aluminium ingots are melted in a crucible and weighed reinforcement added to the molten metal and vortex is created in the molten metal by the help of the stirrer rotating at the constant speed, then the molten metal is allowed to fill the mould and the solidification takes at room temperature, then cast is taken out from the mould. The tensile, hardness, shear and impact test properties of the cast specimen are evaluated by conducting the experiment. Instrument used for this was a resistance arc furnace.

Step2: Tensile, Hardness, Shear and Impact evaluation

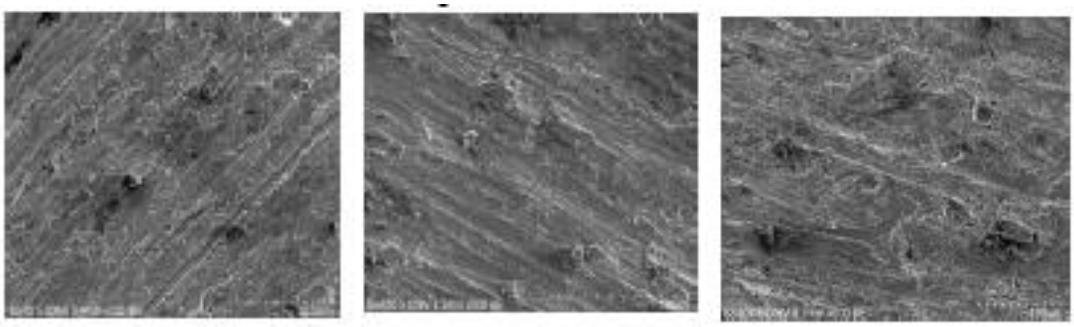
The specimens are subjected to tensile, hardness and shear test to assess the wear rate, hardness, and shear strength of the specimens. Instrument used for these were the Universal Testing Machine, thee charpy and izod impact testing machine as well as a rockwell hardness testing machine,

Step3: Micro Structural Analysis

The specimens and the fractured surfaces are analyzed using scanning electron microscope to study the microstructure and distribution of reinforcements.

IV. RESULTS AND DISCUSSIONS

Microstructure Analysis Scanning under Electron Microscope



Al6061 **Al6061+Si3%+Gr7%** **Al6061+Si7%+Gr3%**

Hardness Test

Hardness measurement is made by using Rockwell hardness tester machine. The surface being tested generally requires a metallographic finish and it was done by using 600 and 100 grit size emery paper. Load used on Rockwell's hardness tester was 15 kg at dwell time of 10seconds for each sample. The result of Rockwell hardness test for the specimen HAMMCs and base metal are given below

Sample no.	Sample Name	Hardness Value
1.	Al6061	62
2.	Al6061+SiC(3%)+Gr(7%)	74
3.	Al6061+SiC(7%)+Gr(3%)	81

Shear Test

Shear test has been carried out using universal testing machine (UTM) with the specimen of dimension 85mm length and 10mm diameter.

Serial No.	Specimen	C/s area in mm2	Ultimate shear load in KN	Ultimate Shear strength in N/mm2
1	Al6061	78.53	18.9	240.67
2	SiC(3%)-Gr(3%)	78.53	20.7	263.59
3	SiC(7%)-Gr(7%)	78.53	22.6	287.78

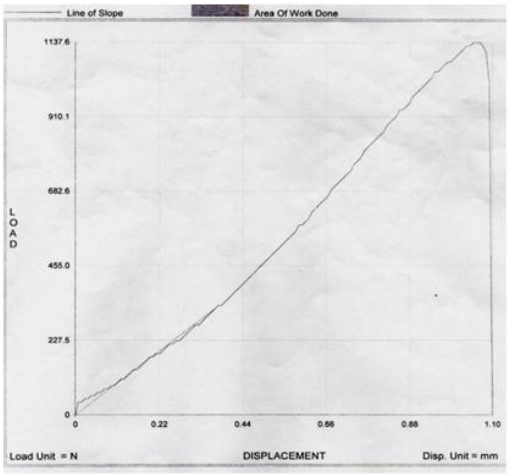
Impact Strength

Charpy impact test has been carried out using impact testing machine(ITM) with the specimen of dimension 55 mm length with a square cross-section of 10mm x10mm

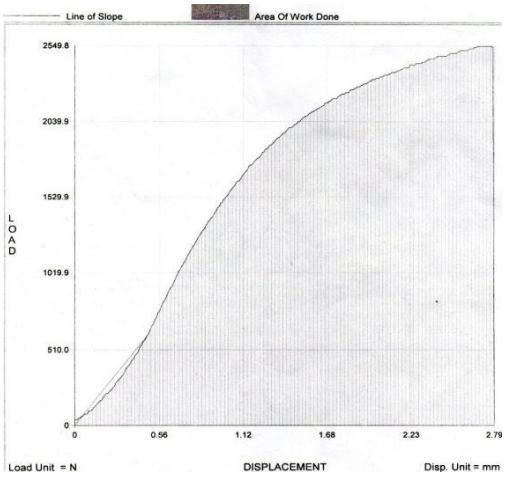
Sample No.	Sample Name	Impact Strength
1	Al6061	44
2	Al6061+Sic3%+Gr7%	49
3	A:6061+Sic7%+Gr3%	53

Tensile Strength

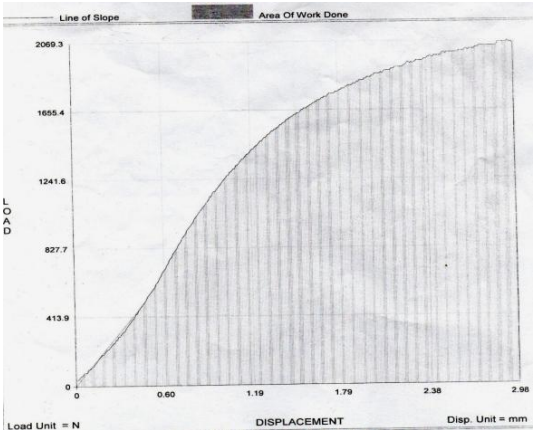
The cast hybrid composite are subjected to tensile test as per ASTM B557 standard**.** The load-displacement curves and the stress-strain diagram of as cast specimens with 0%, 3% & 7% SiC& 0%, 3%& 7%of Gr as shown below. From the load-displacement curves and stress-strain diagram Tensile strength and strain to failure of the cast composites have been calculated.



Load vs Displacement (Elongation) for 0%Sic and 0%Gr

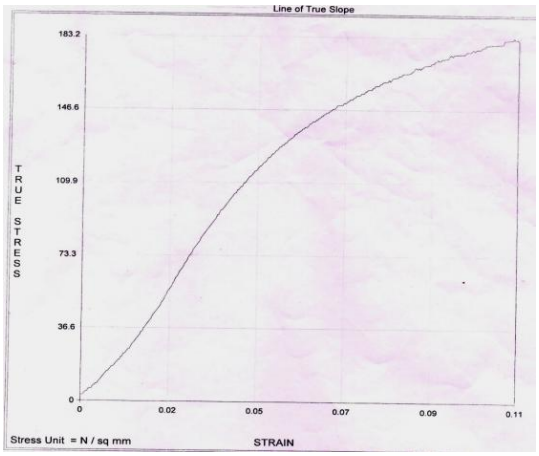


Load v/s Displacement (elongation) for 3%SiC and 7%Gr

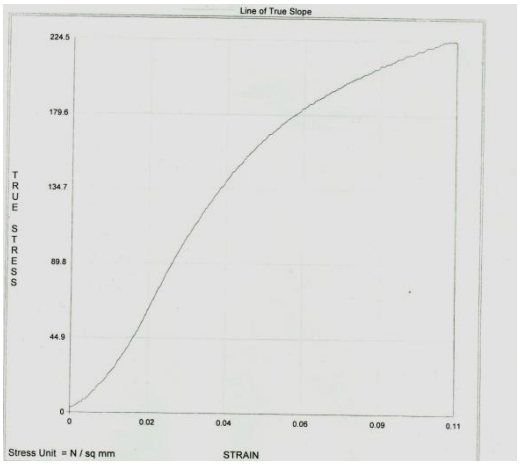


Load v/s Displacement (elongation) for 7%SiC and 3%Gr

Stress – Strain Diagram of 0%Sic and 0%Gr



Stress- Strain diagram for 3%Sic and 7%Gr



Stress-Strain diagram for 7%Sic and 3%Gr

V. CONCLUSIONS

From the experimental investigation, the following conclusions were drawn to study the influence of percentage composition of SiC and graphite particulates in Al6061 Aluminium matrix and from the microstructure and mechanical characteristics of hybrid aluminium composite.

1.Al6061 hybrid composites have been successfully fabricated by stir casting method with uniform dispersion of SiC and Gr particles.

2. The hardness of hybrid composites increased up to 10 to 15% with addition of SiC and Gr.

3. The addition of weight percentage of SiC and Gr to Al6061 leads to increase in tensile strength about 30-50%.

4. The shear strength of the hybrid composite increased about 10 to 20 %.

VI. REFERENCES

[1]. G.B. Veeresh Kumar, C.S.P. Rao,N. Selvaraj, "Studies on mechanical and dry sliding wear of Al6061–SiCcomposites, "Elsevier. Composites: Part B 43, pp.1185–1191, August 2011.

[2]. El-Sabbagh, M. Soliman, M. Taha, H. Palkowski, "Hot rolling behaviour of stir-cast Al 6061 and Al 6082 alloys -SiC fine particulates reinforced composites," Elsevier. Materials Processing Technology 212, pp.497–508, October 2011.

[3]. Ahmed M. El-Sabbagh, Mohamed Soliman, Mohamed A. Taha, HeinzPalkowski, "Effect of rolling and heat treatment on tensile behavior of wrought Al-SiCp composites prepared by stir-casting," Elsevier. Materials Processing Technology 212, pp.1669–1681, May 2013.

[4]. S. Gopalakrishnan and N. Murugan, "Production and wear characterization of AA 6061 matrix titanium carbide particulate reinforced composite by enhanced stir casting method," Composites: Part B 43, pp. 302–308, September 2011.

[5].J.JebeenMoses, I.Dinaharan,S. JosephSekhar, characterizati on of silicon carbide particulate reinforced AA 6061 aluminium alloy composites produced via stir casting," Procedia Materials Science 5,pp. 106–112, July 2014.

[6]. Pradeep Sharma, GulshanChauhan, Neeraj Sharma, "Production of AMC by stir casting," Contemporary Practices. Vol. 2, issue 1, pp.23–46, May 2008.

[7]. Manoj Singla, D. Deepak Dwivedi, Lakhvir Singh, Vikas Chawla, "Development of Aluminium Based Silicon Carbide Particulate Metal Matrix Composite," JMMCE. Vol. 8, No.6, pp. 455–467, March 2009.

[8]. David Raja Selvam. J, Robinson Smart. D.S. Dinaharan. I, "Synthesis and characterization of Al6061-Fly Ashp SiCp," Elsevier. Energy Procedia 34, 637 – 646, 2013.