INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

IJARIIT

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 3 - V7I3-1373)
Available online at: https://www.ijariit.com

Mechanical Characterization of Al 8011 Aluminium alloy reinforced with Silicon carbide and fly ash

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ABSTRACT

Aluminium metal matrix composites are gaining widespread acceptance for automobile, aerospace, agriculture farm machinery, defense sector and many other industrial applications because of their essential properties such as high strength, low density, good wear resistance, easy to production and adoptable to modification compared to any other metal. The present study deals with the addition of reinforcements such as, fly ash, silicon carbide to the Aluminium matrix in various proportions. Each reinforced material has an individual property which when added improves the properties of the base alloy. An effort has been made to review the different combinations of the composites and how they affect the properties of the different alloys of Aluminium. A comprehensive knowledge of the properties is provided in order to have an overall study of the composites and the best results can be employed for the further development of the Aluminium reinforced composed. The investigation shows that Al metal matrix composites can be replaced with other conventional metals for better performance and longer life.

Keywords— *Aluminium; Reinforcement; Stir Casting; Silicon Carbide; Fly Ash.*

1. INTRODUCTION

The use of composite materials has increased to a great extent in various areas of science and technology due to their unique characteristics and properties. Decreasing the weight of mechanical components such as internal combustion engines greatly increase the efficiency. Further the strength to weight ratio of the components is increased by using composite materials. Due to these reasons' composites are increasingly being considered for use in automotive and aerospace applications.

If at least two or more reinforcements are added to the metal matrix, these composites are called hybrid metal matrix composites. These hybrid composites are advanced materials which has the mechanical properties of both reinforcements and the matrix metal. Among the wide diversity of MMC's, the most popular types of MMC's are Aluminium alloys reinforced with ceramic particles. These low-cost composites provide higher strength, stiffness and fatigue resistance with a minimal increase in density over the base alloy. Aluminium Matrix Composites (AMCs) refer to the class of light weight highperformance Aluminium centric material systems. Of all the commercial Aluminium alloys, 8011 is quite popular choice as a matrix material to prepare metal matrix composites. Several researchers have carried out experimental investigation on the effect of heat treatment on Aluminium matrix composites reinforced with ceramic particles. But only a very limited works has been carried out on the effect of Aluminium composites reinforced with SiC and fly ash particles. Hence, in this proposed research work, it is planned to investigate the effect of the mechanical properties of Aluminium hybrid composites reinforced with SiC and fly ash particles.

2. LITERATURE REVIEW

Deepak Singla and S.R. Mediratta proposed a Toughness of the composites was determined by using Izod and Charpy tests. As we increase the amount of ash the toughness value gradually increases up to some level. Hardness and tensile strength of the composites also showed the same results as like of toughness.

F. Anand Raju and Dr. M. L. S. Deva Kumar proposed a tensile characteristic of the AMMC decrease with a lower rate but the weight ratio of the material decrease notably which is the excellentsign for the light weight material. The SEM images reveal that the distribution of the reinforcement flyash is uniform.

3. PROPOSED SYSTEM

Our Project Focuses Mainly on Decreasing the weight of mechanical components such as internal combustion engines greatly increase the efficiency. Further the strength to weight ratio of the components is increased by using composite materials. Due to these reasons' composites are increasingly being considered for use in automotive and aerospace applications.

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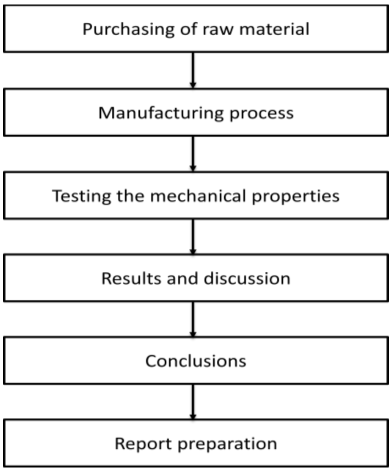
3.1 Process



3.2 Composition

SPECIMEN	COMPOSITION
1	(100% Al 8011 + 0% Silicon Carbide +0% Fly ash)
2	(97% Al 8011 + 2% Silicon Carbide + 1% Fly ash)
3	(97% Al 8011 + 1% Silicon Carbide + 2% Fly ash)

3.3 Process Carried

- Casting
- Machining
- Testing

3.3.1 Casting: The casting method used in this process is stir casting. The casting was done by adding Aluminium8011, Silicon Carbide and Fly ash.

Figure 1: Stir casting

3.3.2 Machining: Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. The various machining processes used are cutting and facing.

3.3.3 Metal Cutting: Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips. Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting.

3.3.4 Facing: Facing on the lathe uses a facing tool to cut a flat surface perpendicular to the work piece's rotational axis.A facing tool is mounted into a tool holder that rests on the carriage of the lathe. The tool will then feed perpendicularly across the part's rotational axis as it spins in the jaws of the chuck. A user will have the option to hand feed the machine while facing, or use the power feed option. For a smoother surface, usingthe power feed option is optimal due to a constant feed rate. Facing will take the work piece down to its finished length very accurately. Depending on how much material needs to be taken off, a machinist can choose to take roughing or finishing cuts.

4. METHODOLOGY

Initially Al8011 composites containing SiC and fly ash particles will be fabricated using the stir casting setup. The microstructure of the composite will be studied using scanning electron microscope (SEM). Then mechanical properties such as hardness, tensile strength and impact strength and also wear behavior of the developed composite will be studied. A mathematical model also will be developed to predict the wear rate of the composite. The direct and indirect effect of the wear parameters on the wear behavior of the composite will be studied. Finally based on the results obtained from various tests on composites a research project report will be prepared.

5. RESULT

5.1 Tensile Studies

Tensile properties indicate how the material will react to forces being applied in tension. A tensile test is afundamental mechanical test where a carefully prepared specimen is loaded in a very controlled manner while measuring the applied load and the elongation of the specimen over some distance. Tensile tests are used to determine the modulus of elasticity, elastic limit, elongation, proportional limit, reduction in area, tensile strength, yield point yield strength and other tensile properties. The main product of a tensile test isa load versus elongation curve which is then converted into a stress versus strain curve. Since both the engineering stress and the engineering strain are obtained by dividing the load and elongation by constant values (specimen geometry information), the load-elongation curve will have the same shape as the engineering stress-strain curve. The stress-strain curve relates the applied stress to the resulting strain and each material has its own unique stress-strain curve. A typical engineering stress-strain curve is shown below. If the true stress, based on the actual cross-sectional area of the specimen, is used, it is found that the stress-strain curve increases continuously up to fracture. The slope of the line in this region where stress is proportional to strain and is called the modulus of elasticity or Young's modulus. The modulus of elasticity (E) defines the properties of a material as it undergoes stress, deforms, and then returns to its original shape after the stress is removed.

5.2 Result of tensile studies

5.2.1 Tensile Specimen 1

Displacement in mm	Load in KN
0	0
0.69	0.56
0.69	0.56
1.72	0.87
1.72	0.87
2.41	1.07
2.41	1.07
3.45	1.24
3.45	1.24
4.49	1.31

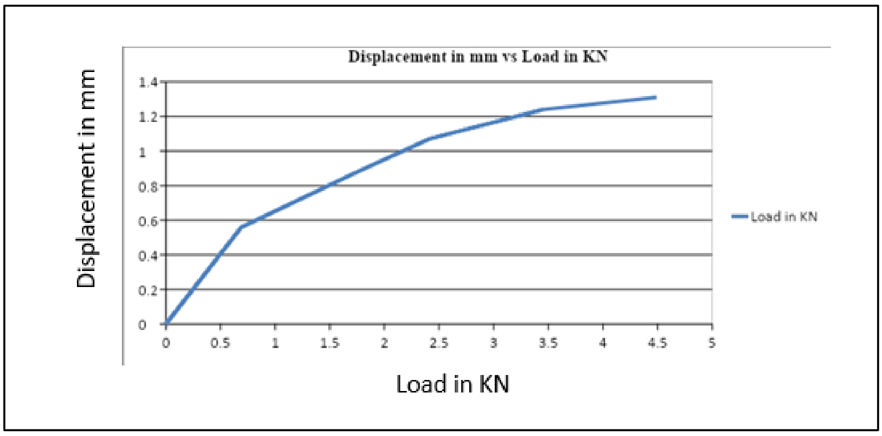


Figure 2: Tensile specimen 1 graph of displacement vs load [x-axis = 1 mm, y-axis = 0.2 KN]

Figure 3: Tensile specimen 1

5.2.2 Tensile Specimen 2

Displacement in mm	Load in KN
0	0
0	0.01
0	0.01
0	0.01
0	0.01
0.01	0.03
0.01	0.03
0.04	0.14
0.04	0.14
0.11	0.19
0.11	0.19
0.23	0.28
0.23	0.28
0.3	0.32
0.3	0.32
0.41	0.4
0.41	0.4
0.52	0.46
0.52	0.46
0.6	0.51
0.6	0.51
0.71	0.57
0.71	0.57
0.79	0.61
0.79	0.61

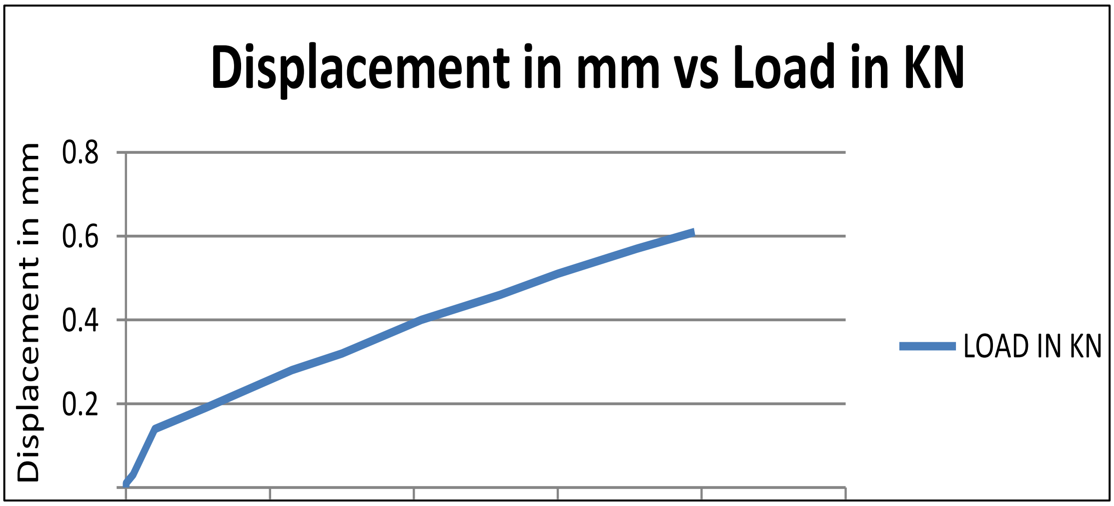


Figure 4: Tensile specimen 2 graph of displacement vs load [x-axis =0.1 mm, y-axis = 0.1 KN]

Figure 5: Tensile Specimen 2

5.2.3 Tensile Specimen-3

Displacement in mm	Load in KN
0	0
0	0.21
0	0.21
0.01	0.18
0.01	0.18
0.02	0.24
0.02	0.24
0.03	0.22
0.03	0.22
0.03	0.22
0.03	0.22
0.03	0.22
0.03	0.22
0.18	0.35
0.18	0.35
0.29	0.46
0.29	0.46
0.45	0.57
0.45	0.57
0.56	0.67
0.56	0.67
0.72	0.75
0.72	0.75
0.88	0.86
0.88	0.86
0.98	0.91
0.98	0.91
1.14	1.01

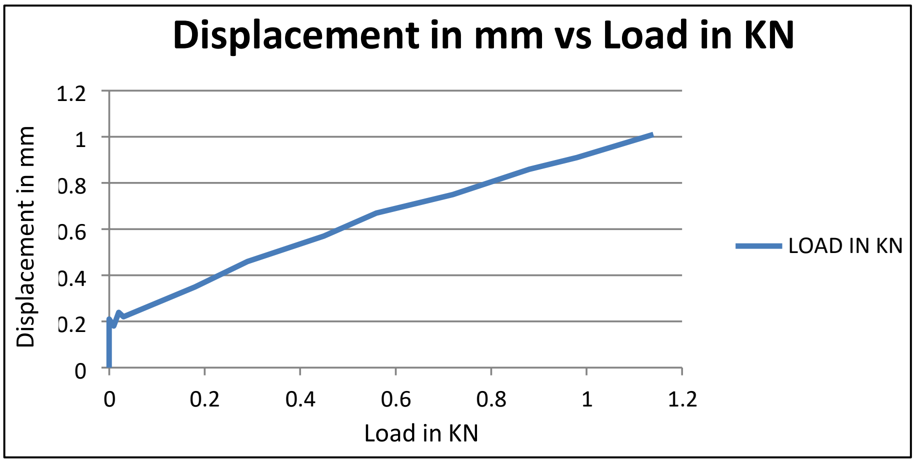


Figure 6: Tensile specimen 3 graph of displacement vs load [x-axis =0.2 mm, y-axis = 0.2 KN]

Figure 7: Tensile Specimen 3

6. CONCOLUSION

Aluminium 8011 / Silicone Carbide / Fly ash, with three various amounts of combination have been successfully fabricated by stir casting method. Aluminium is tested by tensile. The second compositionwas increased elongation is 22.22%. It observes the maximum load is 2.2 KN. Hence, the comparison of all tested results shows Al 8011 (97%) + SiC (2%) + Fly ash (1%) is best composition to give low weight, high strength, high hardness level.

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