International Engineering Research Journal Page No 1720-1723

"Evaluation of Mechanical properties of Aluminium composite (Si & Gr)material"

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Abstract—**Metal matrix composites find their uses in so many fields of day today's applications. So they are becoming alternatives for metals, because of their easy construction and by these composites, any complicated shapes can be easily manufactured. And these composites have good mechanical and tribological properties like increased tensile strength, higher corrosion resistance and light weight. Because of these characteristics it's widely used in transportation, aviation and automobile sectors. In the present work we used AL 6061 and prepare by stir casting. Required specimens are prepared according to ASTM standard dimensions for tensile, hardness and wear tests. And by conducting these tests it's observed that the tensile strength, hardness are increased and wear rate and ductility are decreased.**

***Index Terms*— Al 6061 stir casting, composite material, hardness, tensile, wear test.**

I. INTRODUCTION

Composite materials assume a vital part in the field of aerospace and ahead of time assembling because of uncommon requests from innovation because of quickly upgrading exercises in air ships, aviation, and vehicles commercial ventures furthermore in the field of transportation, automobile and construction. The property of these materials having low specific gravity that makes their properties especially better in quality and modulus than numerous customary designing materials, for example, metals. As an aftereffect of concentrated studies into the basic way of materials and better comprehension of their auxiliary property relationship, it has ended up conceivable to grow new composite materials with enhanced physical and mechanical properties. .

These new materials incorporate superior composites, for example, reinforced composites. Constant headways have prompted the utilization of composite materials in more enhanced applications.

The composite materials, however, generally possess combination of properties such as stiffness, strength, weight, high temperature performance, corrosion resistance, hardness and conductivity which are not possible with the individual components. Composite materials are not homogeneous. Their properties are dependent on many factors, the most important of which are the type of fiber, quantity of fiber (as volume fraction) and the configuration of the reinforcement. They are generally completely elastic up to failure and exhibit neither a yield point nor a region of plasticity.

If all the fibers are aligned in one direction then the composite relatively stiff and strong in that direction, but in the transverse direction it has low modulus and low strength. When a unidirectional composite is tested at a small angle from the fiber axis, there is a considerable reduction in strength. A similar but less significant effect occurs with the tensile modulus.

II. PREPARATION OF COMPOSITE MATERIAL

The composite is prepared by Die- Casting using the following procedure

- A certain amount(weight) of Aluminium alloy 6061 is taken in the crucible and is
- kept in the electric furnace for melting.
- Close the furnace perfectly and cover it by ceramic wool for insulation
- Finger mould die having 5 fingers is used to get the casting.
- Finger mould die is coated with chalk powder.
- After coating die is kept in heat treatment furnace for preheating, for one hour up to a temperature of 3000C.
- Then the slurry is mixed thoroughly using a mechanical stirrer.
- The speed of the stirrer ranges from 200rpm to 300rpm.
-

Material	Aluminium	Silicon	Graphite
%of material in composite	89	7	4

- si, gr is added with certain amount with respect to aluminium amount.

- The temperature in the furnace (containing aluminium) is checked by using a dip
- Type thermocouple and is indicated as it reaches 700C.
- Pre-heated die is taken out from the furnace for pouring.
- The slurry is then poured into the mould slowly at a uniform rate under room temperature conditions. Thus the

- molten slurry is allowed to solidify at room temperature. The solidified cast is finally obtained.

Apparatus Used

1.Electric Resistance Furnace

Heat input: 3.5 kW
Total capacity: 3kg
Voltage: 240volts
Temperature varies from: 0-12000 C
Insulating material: Glass Wool

2. Stirring Unit

Stirrer material: Mild steel
Speed of the stirrer: 200-300 rpm

3. Casting Die

Material: EN-8 material
Dimensions: 250*250mm

Figure 1: Electric resistance casting furnace

Figure 2: Casting die

Figure 3: casting element

III. EXPERIMENTAL WORK

1. Tensile Test :

This is performed to evaluate some of the mechanical properties such as ultimate tensile strength, elongation, yield stress etc.

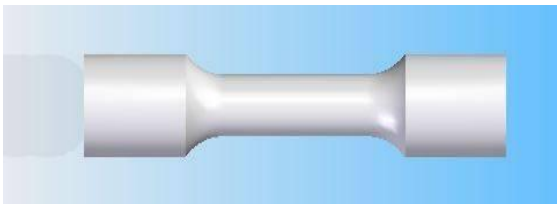


Figure 4: tensile specimen Sample preparation

Test procedure:

Specimens are placed in the grips of a Universal Test Machine at a specified grip separation and pulled until failure. For ASTM EN 95A the test speed can be determined by the material specification or time to failure (1 to 10 minutes). A typical test speed for standard test specimens is 10 mm/min and the gauge length is 62.5mm. An extensometer or strain gauge is used to determine elongation and tensile modulus. Test results such as load and displacement were automatically logged into a raw data file via a data acquisition system. The data collection will be stopped when total failure occurs. From this data, young's modulus value has been calculated and load-displacement curves were produced.

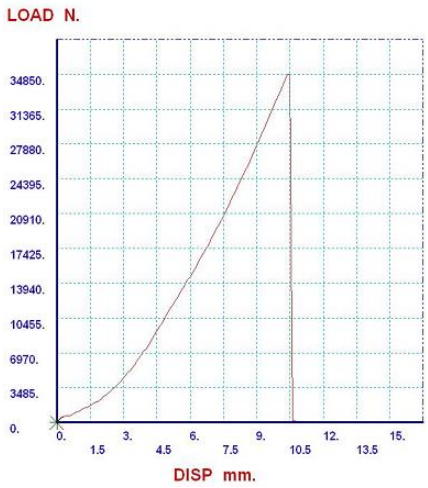


Figure 5: Load Vs. Displacement diagram from tensile test

The breaking load for carbon fiber is 34850 N. The tensile strength of Carbon/Epoxy can be calculated from the breaking load and the cross-sectional area is 557.580 MPa.

2. Hardness Test :

The cast composite is prepared to 15mm dia in lathe with the process of turning.
The turned sample is chopped into small piece of 10mm in thickness and few in
number.The smooth surface is prepared at both the ends..

Figure 6: Rockwell Hardness Tester

The fixing of sample is to be chosed so as to give a reliable indication of the properties of the material. The type of indenter, size of the indenter are chosed depending on the type of material has to be tested. The sample is fixed on anvil in that manner that the load is orthogonal to the surface of the sample.The anvil is raised by means of the elevating screw.Now, raise the anvil, the pointer comes to the red dot on the dial. Apply the major load wait for about 30 seconds duration, to ensure the complete application of the load on the specimen through indenter. Remove the load after 30 seconds. Note down the reading on the dial.

3. Wear Test

This is done to evaluate the wear rate and hence determine the wear strength of the specimen.
Disc Diameter = 180mm
Load range = 0 to 8Kg
RPM = 1000

Figure 6: Wear test machine

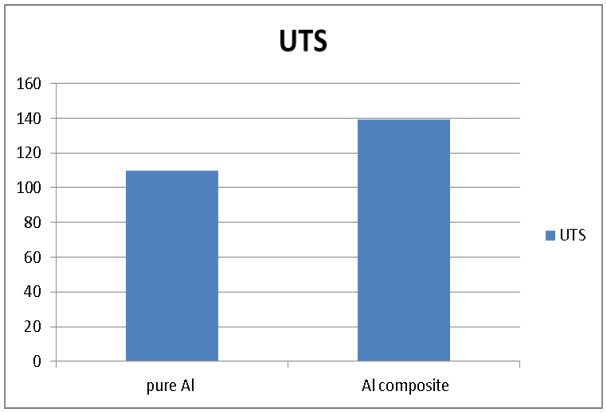
In this test samples are prepared in this manner:
First material is turned for a dia of 8millimeter by turning operation. The sample's end faces are finely finished.
The sample is then cut to 30mm long including tolerance for fine finishing of the ends.After surface smooth finishing the length must be 30mm.Out of the two ends one is made fine by the emery sheets.First cleaning of the rotation disc is done to avoid the presence of any external dust and particle. The electricity supply is checked and loads are nullified if there. Observe the device setup and its interaction with the computer for display of the output.The set device is started without any loads for calibration.

The initial weight of the wear sample is noted using digital scales. The chuck key is used to fix the sample in the chuck. The radius of the track is noted, which is the distance between center of the disc and the touching point of the specimen to that disc. The track dia is 140mm here.

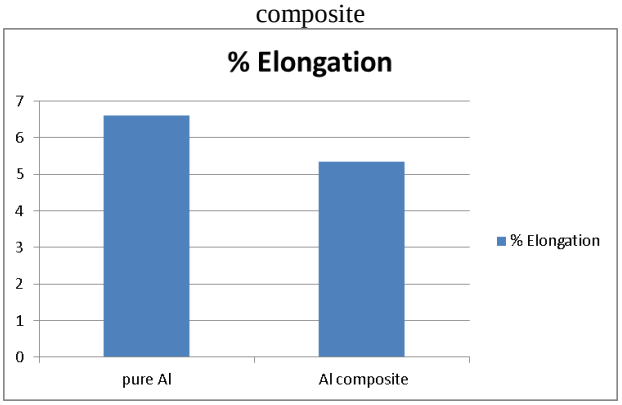
Set the speed, time and the load. This test is operated at 136rpm, 1kg load and varying time of 8.33,16.66,25,33.33 minutes. Start the electric motor after bringing the specimen to touch the disc. The time is set first for the predecided time, such that after reaching this time the electric motor stops automatically. Using the digital balance, final weight of the sample is noted. Changing only time and keeping load,speed to a fixed value conduct the experiment.

IV. Result and Discussion

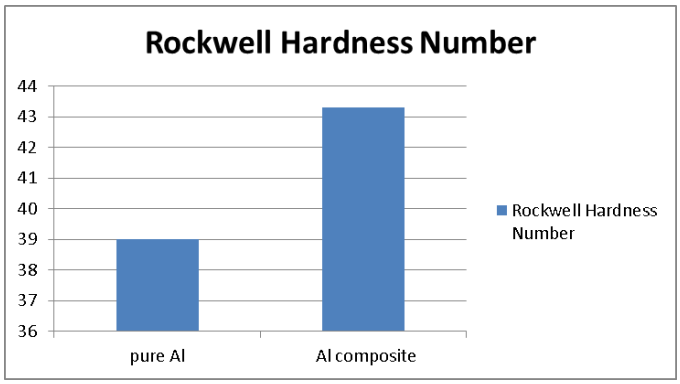
The three tests are performed on the Al composite specimen. The results from the test are giving the brief idea about the tensile strength, hardness and the wear of the composite plate. Following values are obtained from the tests:



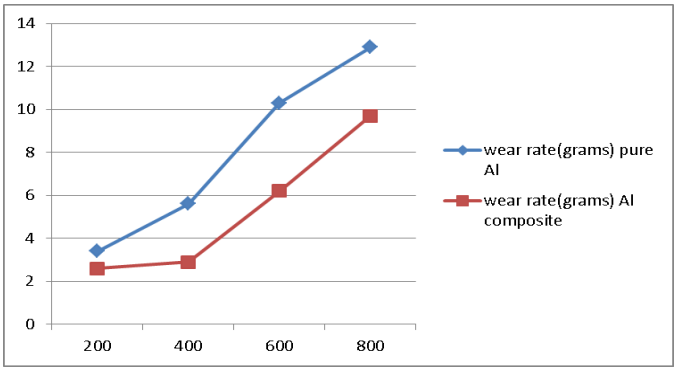
Graph 1 : Comparison of UTS between pure Al and Al composite



Graph 2 : Comparison between %elongation with Al and composite Al



Graph 3 : Comparison of hardness between Al and composite



Graph 4 : Wear vs composite varying load

Test	Pure aluminium	Composite aluminium
Tensile test	110MPa	139.1 Mpa
Hardness test	39 RHN	43.3 RHN
% elongation	6.61	5.53
Wear test	$3.4*10^{(-6)}$ grams	$2.6*10^{(-6)}$ grams

ACKNOWLEGDEMENT

I would like to thank Dr. P. M. Sonwane for valuable guidance and contribution in developing this innovative concept.

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