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EXPERIMENTAL STUDY OF CHARACTERIZATION OF AA6061 WITH SIC AND CSA

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Abstract: The area of composite material is one of the most fascinating topic to many researchers of Material Science. This paper is written to draw some more interest in the field of composites. The aluminum and aluminum alloys are most dominant when composites are prepared. The behavior of Aluminum alloy 6061 composite with coconut shell ash and Sic is determined in this paper. The different quantities of CSA and Sic chosen and composites are prepared. AA 6061 selected due to its excellent property of hardness, wear resistance, ductility and good strength to weight ratio. The fabrication of product is done by most appropriate one i.e. stir casting in electric furnace. The composite then formed is machined to desired shape and the part is tested for tensile, compressive, hardness and impact strength. The experiment showed very good result and ultimately enhances the property of Aluminum Alloy 6061.

Keywords: Aluminum 6061, CSA- Coconut Shell Ash, MMC-Metal Matrix Composites, Sic –Silicon carbide, Stir Casting, Mechanical Properties.

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INTRODUCTION

The emergence of alloy took place due the inefficient property of monolithic material and the emergence of composites took place due to demand of more efficient material which an alloy could not be fulfilled. In this paper a new composite material is prepared which helps in advance application such as aerospace, health care, defense and space research. Aluminum gains the interest due to its light weight property along with rust proof tendency. To add some extra property or to increase its strength to weight ration aluminum alloy is used. According to the study made and the application area identified Aluminum Alloy 6061 is selected. After selection of appropriate material, the method to make MMC is Stir Casting which is supposed to be most suitable method to prepare such reinforcement. [5]

The reason of selection of these materials is due to following properties:

Al 6061T6: Chemical composition:

Table No.-1

S. No.	Component	Amount (% wt.)
1	Aluminum	Balance
2	Magnesium	0.8 - 1.2
3	Silicon	0.4 - 0.8
4	Iron	Max 0.7
5	Copper	0.15 - 0.40
6	Zinc	Max 0.25
7	Titanium	Max 0.15
8	Manganese	Max 0.15
9	Chromium	0.04 - 0.35
10	Others	Balance

Key properties of AA 6061:

1. Medium to high strength.
2. Good toughness
3. Good surface finish
4. Excellent corrosion resistance to atmospheric conditions
5. Good corrosion resistance to sea water
6. Can be anodized
7. Good weldability and brazability
8. Good workability
9. Widely available [2]

Physical Properties:
Density: 2.7 g/cm^3
Melting Point: Approx. 580°C
Modulus of Elasticity: 70-80 GPa
Poisson's Ratio: 0.33
Mechanical Properties:
Ultimate Tensile strength=260-310 MPa
0.2 % Proof Stress=240-276 MPa
Brinell hardness number (500 Kg load, 10mm ball) =95-97
Elongation (50mm dia. %) =9-13 [3]

Silicon Carbide Key properties:
1. Low density
2. Low thermal efficiency
3. High strength
4. High thermal conductivity
5. High elastic modulus
6. High hardness
7. Excellent thermal shock resistance
8. Superior chemical inertness

Coconut Shell Ash Composition:

Table 2

Element	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO
%	15.6	0.57	12.4	0.52	16.2
Element	Na_2O	SiO_2	MnO	ZnO	
%	0.45	45.05	0.22	0.3	

Key Properties of CSA:
1. Low Cost
2. Light weight MMC achieved
3. Good thermal resistance
4. High hardness [4]

Experimental Procedure
Composition and parameters selected:
Materials used for preparing of Composite materials:
1. Silicon Carbide Powder 800 mesh-360g
2. Coconut Shell Ash-120 g

3. Aluminum 6061- 1.52 Kg

Casting Parameters:

Table 3

S.No	Aluminum 6061 (weight in gm)	Sic (weight in gm)	CSA (weight in gm)
1	368	24	8
2	336	48	16
3	304	72	24
4	272	96	32
5	240	120	40
	Total= 1520g	=360 g	= 120 g

- 400 g comes from the calculation of weight with the help of density of Aluminum 6061 and the volume required by the specimen. After finding the overall weight required the variation in the % wt. is made to prepare different samples for testing.
- Sic taken from the range from 6% to 30% by weight.
- CSA taken from the range from 2% to 10% by weight.

III Casting Parameters and Method

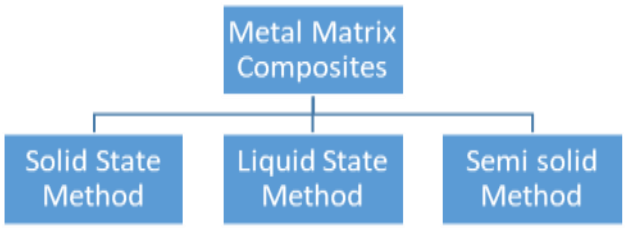

Fig 1 Methods of making composites

There are various methods are available to prepare the composite but the most suitable and easy method is Stir Casting.

Fig.2 Stir Casting Setup [1]

This setup contains an electric furnace on the top of which a stirrer is attached at one end and another end is connected to a motor. This furnace helps in attaining the required temperature of 700^0C within 15-20 minutes to melt the Aluminum. The motor is set at low rpm of 60-80 rpm to get the reinforcement uniformly distributed.

Process involved:

1. The furnace is started and the temperature is set at 700^0C.
2. The block or rod of Aluminum is kept in the furnace.
3. After 15-20 minutes when the Aluminum is melted the reinforcement is poured with the help of funnel in the furnace.
4. The motor of stirrer is allowed to start at the set rpm of 60-80 rpm which helps in proper mixing of the components added.
5. The molten matrix is then poured to the mold and after solidification the required casting is prepared.

IV All mechanical tests

Although mechanical test consists of various tests i.e. Tensile, compressive, hardness, fatigue, stiffness, bending etc. But the application area selected is the fuselage skin and automobile chassis. According to the application area all tests are not required because all properties are not evident here. The tests which is relevant in this account are tensile, hardness and impact tests.

Test 1: Tensile Test

Table 4

S.No.	Component	Tensile Strength (MPa)
1	Al 6061	138
2	Al 6061 +5% Sic+3% CSA	156
3	Al 6061 +10% Sic+6% CSA	168.8
4	Al 6061 +15% Sic+9% CSA	170.2
5	Al 6061 +20% Sic+12% CSA	144.4
6	Al 6061 +25% Sic+15% CSA	162

Test 2: Hardness test

Table 5

S.No.	Component	Brinell Hardness No.
1	Al 6061	75
2	Al 6061 +5% Sic+3% CSA	89
3	Al 6061 +10% Sic+6% CSA	94
4	Al 6061 +15% Sic+9% CSA	102
5	Al 6061 +20% Sic+12% CSA	100
6	Al 6061 +25% Sic+15% CSA	98

Test 3: Izod Impact Test

Table 6

S.No.	Component	Impact Test (Nm)
1	Al 6061	8
2	Al 6061 +5% Sic+3% CSA	10
3	Al 6061 +10% Sic+6% CSA	12
4	Al 6061 +15% Sic+9% CSA	17
5	Al 6061 +20% Sic+12% CSA	14
6	Al 6061 +25% Sic+15% CSA	13

Test 4: Elongation Test

Table 6

S.No.	Component	Elongation %
1	Al 6061	12
2	Al 6061 +5% Sic+3% CSA	3.2
3	Al 6061 +10% Sic+6% CSA	4
4	Al 6061 +15% Sic+9% CSA	4.2
5	Al 6061 +20% Sic+12% CSA	3
6	Al 6061 +25% Sic+15% CSA	2.5

V Result and Discussion

Following charts shows the results obtained from tests conducted on the composites.

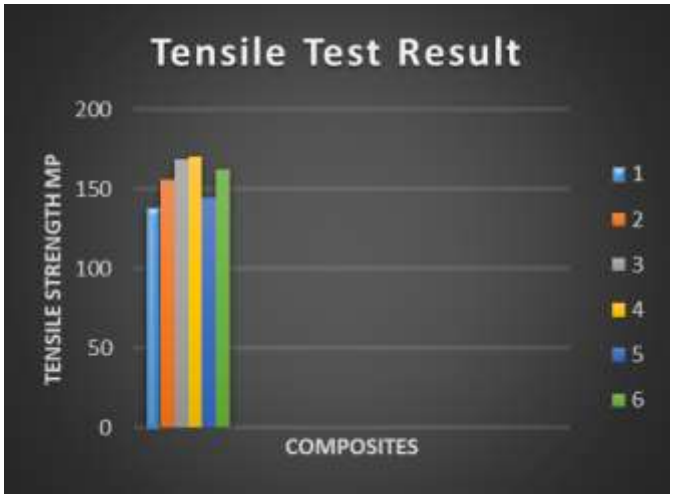

Fig 3 Tensile Test Result

Tensile test shows a gradual improvement on the strength when the reinforcement is increased but a sudden fall at specimen 5 is observed, then again value increases.

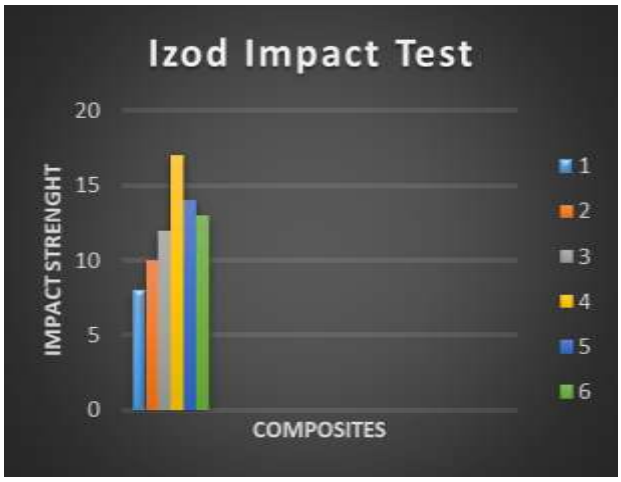

Fig 4 Impact Test Result

Impact test shows a gradual improvement on the strength when the reinforcement is increased but a sudden fall at specimen 5 is observed, which goes on decreasing further.

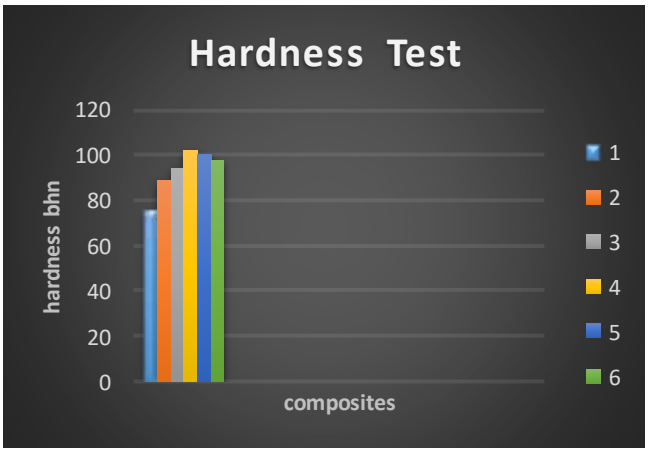

Fig 5 Hardness Test Result

Hardness test shows a gradual improvement on the strength when the reinforcement is increased but a sudden fall at specimen 5 is observed, then again value increases.

Above tests signifies that the best combination of the composites is the specimen 4 which contains Al 6061 +15% Sic+9% CSA.

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