Investigation On Properties of Metal Matrix Composite Aluminum Reinforced with Silicon Carbide

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Abstract - **This study investigates the effects of adding SIC particles to aluminum 8011 alloy. The composite was prepared with different weight percent (3.5, 7 and 10) SIC particles by stir casting technology. The density of the composite is increased due to the higher particles density of SIC compared to the aluminum 8011 alloy. Hardness, Impact (Izod) and Tensile tests are performed to investigate the mechanical properties of composites. Hardness and tensile strength have been significantly improved to 10% of weight of SIC particles. What new about this archiving work is the fact that few experiments have been performed on aluminum 8011 /SIC composites, and the experiments performed provide importance information about stir casting.**

keywords - **Aluminum 8011, Sic, Metal matrix composite, Mechanical properties.**

I.INTRODUCTION

In the recent years, the demand for light weight, low cost and high-quality performance composite materials have increased. Many researches are done to develop new materials that meet these requirements. one among the newly developed materials is aluminium metal-matrix composites (Al-MMCs). Sicily, there are three styles of MMCs particle reinforced, whisker reinforced and continuous fibre MMCs Metal-matrix composite (MMCs) are widely employed in industry due to their excellent mechanical properties. Nowadays, there are various products. . this can be due to their high strength, high modulus, and low co-efficient of thermal expansion, light weight, low thermal shock, good wear resistance and plenty of more advantages. Metal Matrix Composites (MMCs) have evoked a keen interest in recent times for potential applications in aerospace and automotive industries as a result of their superior strength to weight ratio and hot temperature resistance. The widespread adoption of particulate metal matrix composites for engineering applications has been hindered by the high cost of manufacturing components. Although several technical challenges exist with casting technology yet it is often wont to overcome this problem.

II.COMPOSITES

A composite is a structural substance made up of two or more coupled constituents that are not soluble in each other on a macroscopic level. The matrix is one of the constituents, while the reinforcing phase is one of the elements.. Fibber's, particles, or flakes can be used as reinforcing phase material. Materials in the matrix phase are usually continuous. Concrete reinforced with steel and epoxy reinforced with graphite fibre are examples of composite systems. Composites are made up of two materials, one of which is termed the reinforcing phase and is made up of fibres, sheets, or particles that are embedded in the other, called the matrix phase. The matrix and the reinforcing substance.

III.ALUMINIUM 8011

AL8011 alloy is used where the fluidity and corrosion resistance of 8011 are required with high strength and hardness. It is equally suitable for sand and permanent mould casting and is extensively used for low pressure castings, for cover plates and instrument cases. It is useful for electroplated componentsAL8011 can be anodized by any of the common processes, the resulting protective film ranging in colour from grey to dark brown, depending on the method employed.

IV.CHEMICAL COMPOSITION OF ALUMINIUM 8011

Copper	0.10
Magnesium	0.20
Silicon	0.90
Iron	0.60
Manganese	0.42
Nickel	0.002
Zinc	0.10
Lead	0.009

Tin	0.002
Titanium	0,01
Aluminium	Remaining

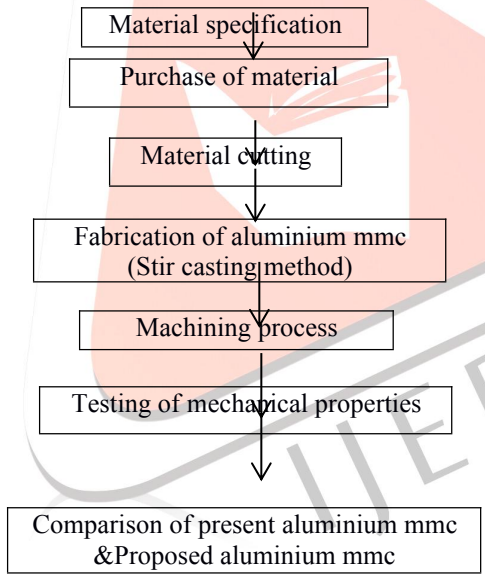
V. SILICON CARBIDE

Silicon carbide is a semiconductor containing silicon and carbon with chemical formula Sic. Moissanite, an incredibly uncommon mineral, is found in nature. . Grains of silicon carbide can be bonded together by sintering to form very hard ceramics that are widely used in application requiring high endurance, such as car brakes, car clutches and ceramics plate in bulletproof vests. Electronic applications of silicon carbide such as light emitting diodes (LEDs) and detectors.

Basic properties of silicon carbide

Insulator	Sic
Structure	Amorphous
Melting point (°C)	1600°C
Density (g/cm²)	2.2
Thermal expansion coefficient(°C-1)	5*10
Thermal conductivity(W/cm-K)	0.014
DC resistivity(0-cm) At 25°C-500°C	1014-1016

VI.METHODOLOGY



VII. STIR CASTING

Stir casting is widely regarded as a very promising method for fabricating discontinuous metal matrix composites, and it is currently used commercially. Its benefits include its simplicity, versatility, and application to large-scale production. It's particularly appealing since, in theory, it allows for the use of a standard metal processing route. The contents in the flat bottom, cylindrical graphite crucible was melted and mixed in an open-hearth furnace. The distributional mixing of the reinforcement inside the matrix is accomplished using traditional mechanical stirring. To produce MMC, a particularly innovative stir caster was devised for the project. This stage's mixing equipment included a drive motor capable of producing a rotation speed of 400rpm, as well as an effect part for vertical movement.

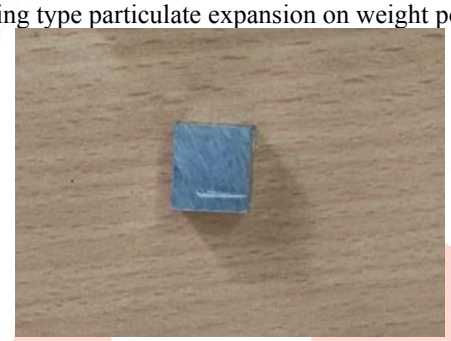
VIII.TEST

1.Tensile Test

Malleable test is a horrendous test process that gives data about the elasticity, yield strength, and malleability of the metallic material. It estimates the power expected to break a composite or plastic example and the degree to which the example extends or stretches to that limit. Malleable testing of composites is by and large as fundamental strain or level sandwich pressure testing as per guidelines, for example, ISO 527-4, ISO 527-5, ASTM D 638, ASTM D 3039, and ASTM C 297. Such tests produce pressure strain outlines used to decide malleable modulus

2.Hardness test

The hardness testing was done on a Brinell Hardness Tester. The hardness of composites was tried by utilizing hardness analyser. For each example, five hardness readings were taken haphazardly from the outer layer of the examples. Hardness upsides of various weight division % of sic particulate containing aluminium combination and charts were plotted between the hardness esteem and comparing type particulate expansion on weight portion premise.



3.Impact test

The Izod influence test is a standard test that actions the effect energy expected to break a material. This test assists designers and researchers with surveying the break properties of a given part or part. The data got from the Izod influence test is utilized to decide what different materials will perform when exposed to mean for stacking.

IX.RESULT

Test Name : TENSILE TEST	Test Type : Normal	Test Mode : Tensile
Elongation Device : CrossHead	Test Parameter : Peak Load	Test Speed [mm/min] : 2.00

Sample No.	CS Area [mm²]	Peak Load [N]	%Elongation	UTS [N/mm²]		
000001	42.000	2858.879	20.090	68.072		
000002	42.000	3182.060	20.590	75.763		
000003	42.000	3075.386	20.720	73.222		

Summary Report :

	CS Area [mm²]	Peak Load [N]	%Elongation	UTS [N/mm²]		
Min	42.000	2858.879	20.090	68.072		
Max	42.000	3182.060	20.720	75.763		
Avg	42.000	3038.775	20.467	72.352		
Std Dev.	0.000	164.671	0.333	3.919		
Variance	0.000	27116.701	0.111	15.355		
Median	42.000	3075.386	20.590	73.222		

Hardness Test (Brinell Test)

S.No	Hardness HV (BHN)	Average HV (BHN)
1	55.857	58.974
2	56.791	
3	64.273	
4	59.946	62.461
5	62.707	
6	64.731	
7	63.371	60.923
8	55.125	
9	64.273	

Impact Test (Izod Test)

S.No	Izod impact value in J for given thickness
1	7.10
2	7.00
3	7.30

X.CONCLUSION

Stir casting method can be successfully used to manufacture aluminium matrix composite reinforcing Sic with desire properties. Reinforcing Sir with aluminium alloy in the respective percentages (3.5%, 7 %, 10%,) has shown an appreciable increase in its mechanical properties. The hardness and tensile strength were increased with respect to the addition of weight percentage of Sic particles. Wear rate for 10% composition of Sic is minimum compared to other samples from this study it reveals that addition of Sic in aluminium alloy result in better hardness and increase in wear resistance.

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