Investigation on properties of metal matrix composite aluminum 6063 reinforced with Silicon carbide and manganese

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***Abstract*—This study looks at how adding silicon and manganese particles to aluminum alloy 6063 affects its performance. Al 6063 is a lightweight metal with high specific strength, impact strength, and mechanical properties. It was used as the base metal for this product. The composite specimens were made with three different weight percentages of silicon carbide: manganese (3.5%:0.1%, 7%:0.2%, 10%:0.3%). This technique was used to create them. The addition of silicon and manganese to aluminum metal matrix composites has resulted in enhanced mechanical properties. The hardness, impact and tensile tests were performed to investigate the mechanical properties of each of the samples.**

Keywords: Aluminium 6063, Sic, Mn, Metal matrix composite, Mechanical properties

I. INTRODUCTION

Recently, the demand for lightweight, low-cost, and high-performance composites has increased. The aluminum metal matrix composites are relatively new, and are used to make various products. These properties are due to their high strength, high modulus, low co-efficient of thermal expansion, light weight, low thermal shock, and good wear resistance. There are three types of MMCs - molecular-reinforced, hair-reinforced and continuous fiber-composite (MMCs) are widely used in industry due to their excellent mechanical properties Aluminum is the basic material from which SiC and Mn were added to create metal matrix composites. The electric furnace is used to stir cast at a temperature range between 700 and 800 degrees Celsius. The addition of SiC and Mn particles has enhanced the mechanical, chemical and physical properties.

A. Methodology

The purpose of this research is to help reinforce aluminum-based metal matrix composites with silicon carbide and manganese particles. The specimens were made using a stir casting process using an electric arc furnace. Three different ratios of silicon and manganese were added to a specimen. The odds of getting a three, five, or seven were 3.5, 7.2, or 10.3. The three specimens were subjected to testing under mechanical pressure. The tests results from tensile, hardness, and impact were analyzed.

B. Composites

Composite materials are defined when two or more different materials are combined to form a material that has distinct physical properties. These materials don't dissolve into one another, meaning that they remain separate and identifiable. The mixture of different ingredients in the composites provides the materials with unique properties that are different from the individual ingredients. Composites are commonly found in many different types of products. For example, they are used in building and engineering projects, medical applications, energy and transportation, sports, aircraft, and automotive industries. Some typical examples of materials that are less expensive, lighter, stronger or more durable are compared to common materials. Their use is growing in general automotive applications.

C. Aluminium 6063

Grade 6063 aluminum is a medium-strength alloy and one of the most popular alloys in the 6000 series. Aluminum is most commonly used as an architectural alloy, meaning that it is beneficial for building structures. This grade of aluminium is best suited for the production of extrusions with complex contours This alloy is well-suited for electrical applications within the T5, T52, and T6 temperature ranges due to its good electrical conductivity. The alloy 6063 has a good finish and high corrosion resistance. The welds easily and can be anodized.

D. Silicon Carbide

Silicon carbide (SiC) can be a semiconductor that contains silicon and carbon Moissanite is a rare mineral found in nature. Carbide grains are also bonded together through sintering to form very complex ceramics that are widely used in software applications that require excessive endurance, including vehicle brakes.hard drives, vehicle clutches and ceramic plates in bulletproof vests Electronic programs of silicon carbide comprise LEDs and detectors.

E. Mangenese

Iron is a hard, brittle, silvery-white metallic element that is commonly found in minerals along with other elements. Manganese is a versatile metallic material used in a variety of industrial applications, especially in stainless steel. This product improves strength, workability and wear resistance. Manganese oxide is used in glass manufacturing, fertilizers and ceramics as an oxidant and as a rubber additive. Manganese sulfate can be used as a disinfectant. Manganese helps metals work better at high temperatures by forming refractory sulfides that prevent the formation of liquid iron sulfide at particle boundaries.

F.Stir casting

Stir casting is extensively seemed as a completely promising approach for fabricating discontinuous steel matrix composites and it`s miles presently used commercially. Its advantages consist of its simplicity, versatility and alertness to largescale production. It is specifically attractive since, in theory, it permits for the usage of a trendy steel processing route. The contents with inside the flat bottom, cylindrical graphite crucible become melted and jumbled together an electric powered arc furnace. The distributional blending of the reinforcement in the matrix is performed the usage of conventional mechanical stirring. A state-of-the-art agitation casting plant has been specially developed for the project to manufacture MMC. This phase is performed in combination with manual machining and ultimately creates a steel matrix composite

G. Tensile Test

The Temperable Check is an effective test method that provides statistics on the elasticity, yield strength and formability of steel materials. Estimate the energy expected to destroy a composite or plastic instance and how much the instance will expand or expand to its limits. Formable composite tests are medium and large scale, such as regulatory mandatory stress or step sandwich stress tests. For example, ISO 5274, ISO 5275, ASTM D 638, ASTM D 3039, and ASTM C 297. Such tests generate stress-strain contours that are used to determine the malleable modulus.

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		

Before Tensile Test

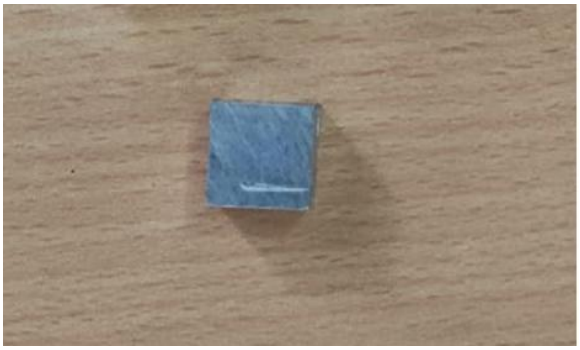
After Tensile Test

H.Hardness Test

The hardness test is performed on a Brinell hardness tester. The hardness of a composite material is checked using a hardness analyzer. For each sample, three hardness readings are taken from the outer layer of the sample. Hardness values and graphs for various weight classes of Sic particles, including aluminum aggregate, are displayed under Hardness Rating by Weight Component and Particle Expansion Mode Ratings.

S. No.	Hardness HV (BHN)	Average HV (BHN)
1	93.746	92.496
2	88.368	
3	95.373	
4	84.119	83.126
5	76.490	
6	91.770	
7	70.373	75.475
8	77.085	
9	78.913	

Before Hardness Test



After Hardness Test

I.Impact Test

A representative sample of steel matrix specimens was run on the IzodV Notch effect tester. The pendulum of the device can be freely swung at a specific angle. Little energy was used to interrupt the sample, and the energy was immediately recorded in the amount attached to the device. The effect of looking at the sample is shown in the figure. The sample was machined to 8mmx90mm and had a 45 ° notch in the center.

Before impact(Izod)Test

After impact(Izod)test

S. No.	Izod impact value in J for given thickness
1	7.20
2	7.40
3	7.10

VII. CONCLUSION

The agitation casting process can be used in the production of aluminum matrix composites by fortifying Sic & Mn with the desired properties. Reinforcing SiC and Mn with aluminum alloys in their respective proportions (3.5: 1%, 7: 2%, 10: 3%) significantly improves their mechanical properties. Hardness increased in component 1 (sample 1). Impact strength and tensile strength increased in Component 2 (Sample 2). Better results were obtained for mechanical properties such as hardness, impact strength and tensile strength. This will allow these components to be used in defense and automotive applications.

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REFERENCES

[1] Polmear I.J., Edward A., Light Alloys (Metallurgy of light metals), Second edition, 1993, p. 124-167.

[2] Polmear I.J., Edward A., Light Alloys (Metallurgy of light metals), Third edition, 1995, p. 134-160.

[3] Sindo K., Welding metallurgy, 2nd edition, New York, John Wiley & Sons, 2003.

[4] Ravikumar E., Arunkumar N., Sunnapa G.S; Characterization of Mechanical Properties, Characterization of Mechanical Properties of Aluminium (AA 6061-T6) By Friction Welding, 3rd International Conference on Mechanical, Automotive and Materials Engineering (ICMAME 2013), Singapore, 2013, p. 127-131.

[5] Abdulwahab M., Studies of the Mechanical Properties of Age–hardened Al-Si-Fe-Mn Alloy, Australian Journal of Basic and Applied Sciences, 2008, 2(4), p. 839-843.

[6] Madugu I.A., Abdulwahab M., The Mechanical Properties of As-cast Al-Si-Fe Alloy, Nigerian Journal of Research and Production, 2007, 10; p. 72-80.

[7] Honarbaklhsh R., Ghazvinloo H.R., Shadfar N., Influence of Friction Stir Welding Variables on Hardness, UTS and Yield Strength of Joints Produced in SSM Cast A356 Aluminium Alloy, Australian Journal of Basic and Applied Sciences, 2010, 4(8), p. 3010-3015.

[8] Lancaster J.F., Metallurgy of welding, 5th edition, London, Chapman and Hall Publisher, 1994.

[9] International Standards for Materials – ASTM, Trends Welding Research in the United States, Ohio Materials Park, 2003.

[10] Robert B.R, Metallic material specification handbook, 4th edition, Dordrecht Netherlands, Chapman and Hall, 1994.