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IJIEMR Transactions, online available on 12th Febraury 2018. Link :
http://www.ijiemr.org/downloads.php?vol=Volume-7&issue=ISSUE-02

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Volume 07, Issue 02, Page No: 345 – 348.

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EXPERIMENTAL INVESTIGATION OF MECHANICAL PROPERTIES OF MAGNESIUM MATRIX COMPOSITE REINFORCED WITH SILICON CARBIDE

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ABSTRACT:-
In the present study focused on the low density magnesium 1.74 g/cm3 is considered to be the lightest of all structural metal for application like an automobile, aerospace, marine, electronic industries because of their low density, high specific strength, good, machine ability , weld ability, and cast ability. On the other hand the density of magnesium (1.74 g/cm3) is substantially less than density of aluminum (2.7g/cm3). The magnesium matrix (AZ31B) can be strengthening by reinforcing with hard ceramic particles of silicon carbide (SiC). An effort is made to improve the mechanical properties likes ultimate tensile strength, impact, hardness of magnesium matrix by reinforced with SiC- particles of different weight percentage of magnesium (AZ31B) alloy such as 2.5%, 5%,7. 5%, 10%.
Keywords: Magnesium-matrix composite; Stir casting; Mechanical properties; silicon carbide.

1. INTRODUCTION

A material which is composed of two or more different material bonded together with one serving as the continuous matrix and other as reinforcing material. Depending upon the form reinforcing phases , composite material can be classified as fiber reinforced composite, particulate reinforced composite , dispersion reinforced composites, laminates and based on matrix materials, composites are classified as polymer matrix composite, metal matrix composite , ceramic matrix composites Wight reduction has been most important applications in the modern engineering. In automobile industries there is a vast demand for lightweight materials. In past few year Aluminum alloys were used for weight reduction in air, ground transportation and space vehicles.. High strength, aluminum and polymers are already being used to reduce the Wight significantly, but additional reduction can be achieved by utilizing low density magnesium an its alloys .The density material approximately one quarter of zinc, two third of that of aluminum, and one fifth of steel as compared to density of magnesium. The magnesium alloys offer very high specific strength in conventional engineering alloys.

Magnesium Aluminum, copper , and titanium are few examples for matrix materials and secondary phase material are few examples for SiC, ,Al2O3SiO2, WC, TiB2.The secondary phase material is adding to the matrix materials ,the specific strength of pure metals, composite metals or alloys can be improved Magnesium having a density of 1.74 g/cm3 is considered to be the lightest and all excellent candidates for construction structure metal for application like a automobile, aerospace, marine, electronic industries because of their low density, high specific strength, good cast ability, weld ability, and machine ability. the density of magnesium (1.74 g/cm3) is substantially less than aluminum (2.7 g/cm3) A transportation carries light weight and high strength materials important in the weight reduction. Silicon carbide having good mechanical properties like low density, high strength, high elastic modulus and high hardness compare other particles and high quality technical grade ceramic of Silicon carbide particle and produces a strong material and very hard. The temperature up to 800°C SiC is not attacked by any molten salts, acids or

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alkalis of Silicon carbide particles For a large number of complex shaped components are manufacturing in foundry casting method,. Plates, sheet, and bar and different form are producing magnesium AZ31B alloy widely available when compared to other magnesium alloys..The stir casting technique used for fabricated the composite materials. The manufacture of near net shape composite in a simple and cost effective manner in stir casting method .The MMC's composite, depend strongly on both matrix and reinforcement. From the literature, it is clear that the mechanical properties of magnesium matrix (AZ31B) are significantly enhanced by the other type reinforcement of SiC,,Al2O3,SiO2, WC,TiB2. The magnesium matrix (AZ31B) can be strengthening by reinforcing with hard ceramic particles SiC. The objective of the work is to manufacture magnesium matrix (AZ31B) composite reinforcement with silicon carbide by the stir casting method and study of mechanical properties like a Impact strength, ultimate tensile strength(UTM), and Hardness(HRB), of the composite in terms of weight percentage of reinforcement.

2. EXPERIMENTAL WORK

2.1. Specimen preparation

The magnesium matrix composite (AZ31B) reinforcement with silicon carbide composites were
fabricated by the stir casting technique.Magnesium AZ31B used for matrix material in the present study, and details of chemical composition are given in Table 1 and Table 2 provides the details of the Sic particulates, which were used as reinforcements. The temperature reached 500-800°C in magnesium (AZ31B) stir casting machine, in the furnace. The metal introduced into the furnace slowly melts and argon gas was supplied inside the furnace continuously, since magnesium is in flammable at high temperature. The requirement amount of SiC(micro) by using digital weighing machine. Finally the magnesium (AZ31B) melted, the stirrer provided to rotate above 600 rpm to blend all the molten metal gather. The weight % of sic in total composite considered as 2.5%,5%,7. 5%, 10%, once the mixing is over then the preheated reinforcement particles were added in the furnace and stirred well with the liquid metal. The molten metal was poured perfectly into the molten metal solidified through natural convection. For solidification the molten metal pouring into die and die was preheated before pouring.

2.2.Hardness measurement

Hardness of specimen was performed in Rockwell hardness tester with a ball diameter of 1/16 inch
and a load of 100 kgf. The hardness test was performed in different regions on the surface of sample. Table3 shows the hardness (HRB) of the samples.

2.3 Impact strength testing

Impact strength of specimen were performed on the izod impact testing machine. Test specimen was prepared as per standard.Table-3 show the impact strength of the samples. To find out impact strength of sample using equation written below

$$\text{Impact strength} = .\frac{K}{A}\ \text{J/mm}^2$$

Where k is the energy absorbed specimen

A is the area of cross section mm2

2.4. Tensile strength testing

Tensometer machine is used to find out Ultimate Tensile Strength (UTS) value. Test specimens are
prepared as given standards and the tensometer machine using 20 KN load and speed of 0.3 mm/min. The Ultimate Tensile Strength values of the samples as shows in the Table 3.

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Table-1
Chemical composition of AZ31B of matrix alloy

%	Mg	Al	Zn	Mn	Si	Ca	Cu	Fe	Ni
AZ31B	97	2.50-3.50	0.60-1.40	0.20	0.10	0.0.50	0.040	0.0050	0.0050

Table 2
Details of reinforcements.

S.NO	AZ31B%	SIC%
1	100	0
2	97. 5	2. 5
3	95	5
4	92. 5	7. 5
5	90	10

Table-3
Mechanical properties of the samples

Composition (wt%)	Impact strength (j/mm^2)	Hardness (HRB)	Ultimate tensile strength (N/mm^2)
AZ31B	0.068	49	118.2
AZ31B/2.5wt%SiC	0.0858	53	143.8
AZ31B/5wt%SiC	0.11046	57	146.1
AZ31B/7.5wt%SiC	0.1250	62	149.2
AZ31B/10wt%SiC	0.16360	70	153.2

3. RESULTS AND DISCUSSION

3.1Impact Test Results:-

Impact strength value of the samples are shown in the table 3..The developed magnesium alloy composite exhibited increase impact strength with the increase in the weight percentage SiC reinforcement particle of the sample size. The increase weight percentage of SiC reinforcement to magnesium alloy as increased absorbed energy of the sample size The material has high impact strength at a AZ31B/10wt%SiC. The variation of graph is shown in fig-1

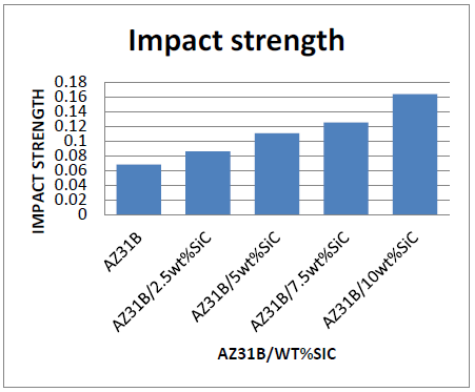

Fig-1 Impact strength of samples

3.2Ultimate Tensile Test Result:-

Ultimate tensile strength value of the samples is shown in the table 3. The addition of any secondary hard phase actually can increased tensile strength .Under an external tensile load, a strong internal stress can be developed inside a material, and localized damage may occur when the local stress is beyond the strength of the material The developed magnesium alloy composite exhibited increase ultimate tensile strength with the increase in the weight percentage SiC reinforcement particle of the samples size. The observe that the material has high ultimate tensile strength at a AZ31B/10 wt%SiC. The graph show variation of ultimate tensile strength in the fig-2

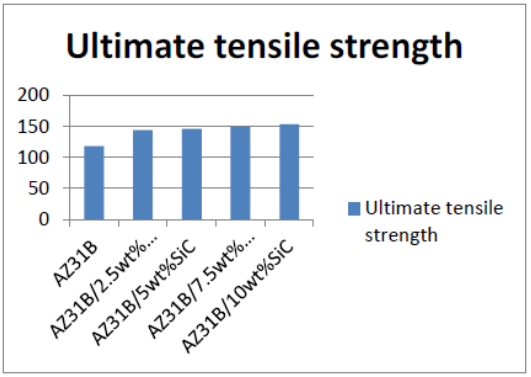

Fig-2 Ultimate tensile strength of samples

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3.3Hardness Test Result:-

Hardness values of the samples are shown in the table 3.. The developed magnesium alloy composite exhibited increased hardness with the increase in the weight percentage SiC reinforcement particle of the samples size. The observe increases in hardness of the composite is attributed to the interactive influence of the presence of SiC phase which restrict the localized matrix deformation during indentation and finer grain size of the composite. Reduction in hardness of the SiC particles. The material has high hardness at a AZ31B/10wt% The graph show variation of hardness in the fig-3

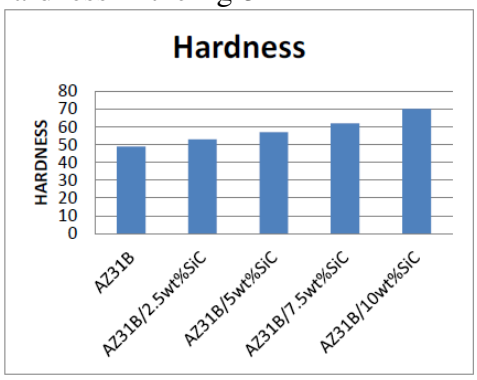

Fig-3 Hardness of samples

4. CONCLUSION:-

AZ31B-Sic composite has been successfully developed by Stir casting technique. The ultimate tensile strength, Hardness, impact strength, were evaluated. As compared to magnesium (AZ31B) alloy, the impact strength of magnesium AZ31B-Sic composite is increased with increases weight percentage of reinforcement of Silicon carbide. Hardness value of AZ31B/Sic composite exhibited increased hardness with the increase in the weight percentage of SiC reinforcement particles as compared to AZ31B alloy. Ultimate tensile strength value of AZ31B/Sic composite is increased with increased weight percentage of SiC reinforcement particles as compared to AZ31B alloys. Finally, As the weight percentage of reinforcement increases ,mechanical properties such impact strength, hardness and ultimate tensile strength were increased.

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