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Synthesis and Mechanical Characterization of Aluminium Based MMC with SiC as Reinforcement

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ABSTRACT

Aluminium based metal matrix composites are playing a vital role in almost all areas automobile, aerospace ,agriculture and all other industrial applications why because their higher strength ,lower density and better wear resistive capability when compared with other materials. In the present work aluminium metal matrix composites are prepared by stir casting route which is the best way among all casting techniques. The reinforcement used in this work is silicon carbide (SiC) with different proportions. AMC's are prepared by varying the SiC weight in the percentage of 0,4,8, and 16%. After that tensile test and hardness test are performed on the specimen the results shown that with increase of SiC Concentration the Hardness and tensile strengths were increased and 16% SiC specimen has maximum tensile strength and hardness.

Keywords: *Aluminium, SiC, Stir casting, UTM ROCKWELL HARDNESS TESTER, tensile Strength, and Hardness*

INTRODUCTION

Composite material may be defined as the combination of two or more materials which gives the better results than the indusial. Depending upon the matrix composite materials are classified into several types such as polymer matrix composites, metal matrix composites, ceramic matrix composites etc.[1]..

Metal Matrix composites are found applications in aerospace, agriculture and automotive industries.

Aluminium composition includes Ferrous 0.16%, Silicon 0.19%manganese 0.01%, copper 0.01% and magnesium 0.01% remaining 99.62% Aluminium. A hybrid metal matrix composite (HMMC) consists of three or more composites mixed with the matrix. The AMMC can be manufactured by various manufacturing techniques such as stir casting, powder metallurgy, pressure infiltration, squeeze casting [6], chemical vapor deposition etc. Amongst all the processes, stir casting is the most common method used by the researchers [3]

Aluminium metal matrix composites (AMMC) are the composites in which Aluminium is used as the matrix and several reinforced materials are embedded into the matrix. Some of the reinforced materials are silicon carbide, graphite, fly ash, particulate alumina, red mud, cow dung rice husk etc. AMMC are in demand due to their properties like low density, high specific strength, high damping capacity, high thermal conductivity, high specific modulus, and high abrasion and wear resistance [4], low density, good mechanical properties, low thermal coefficient of expansion, better corrosion resistance [5], high strength to weight ratio and high temperature resistance [6] etc. Aluminium metal matrix composite provides lesser wear resistance when compared to steel and hence it is widely used as a matrix metal.

Tamer Ozbenet al. [7] investigated the mechanical and machinability properties of SiC particle reinforced Al-MMC. With the increase in reinforcement ratio, tensile strength, hardness and density of Al MMC material increased, but impact toughness de- creased. Sedat Ozdenet al. [7] investigated the impact behavior of Al and SiC particle reinforced with AMC under different temperature conditions. The impact behavior of composites was affected by clustering of particles, particle cracking and weak matrix-reinforcement bonding. The effects of the test temperature on the impact behavior of all materials were not very significant. Srivatsan et al. [8] conducted a study of the high cycle fatigue and in- vestigated the fracture behavior of 7034/SiC/15p- UA and 7034/SiC/15p-PAmetal matrix composites. The modulus, strength and the ductility of the two composite microstructures decreased with an in- crease in temperature. The degradation in cyclic fatigue life was more pronounced for the under-aged microstructure than the peak-aged microstructure Also, for a given ageing condition, increasing the load ratio resulted in higher fatigue strength. Maik Thunemann et al. [9] studied the properties of performs. Polymethylsiloxane (PMS) was used as a binder. A polymer content of 1.25 wt.% conferred sufficient stability to the preforms to enable composite processing. It is thus shown that the PMS- derived binder confers the desired strength to the SiC preforms without impairing the mechanical properties of the resulting Al/SiC composites. Sujan et al. [10] studied the performance of stir cast Al2O3 and SiC reinforced metal matrix composite material. The result showed that the composite materials exhibit improved physical and mechanical properties, such as low coefficient of thermal expansion as low as 4.6x10 -6 / C, high ultimate tensile strength up to 23.68%, high impact strength and hardness. The composite materials can be applied as potential lightweight materials in automobile components. Experimentally it is found that with addition of Al- SiC reinforcement particles, the composite exhibited lower wear rate compared toAl-Al2O3 composites. Zhang Peng et al. [11] studied the Effects of Particle Clustering on the flow behavior of SiC particle reinforced Al MMCs. The

results revealed that during the tensile deformation, the particle clustering has greater effects on the mechanical response of the matrix than the elastic response and also the plastic deformation is affected very much.

3 .PREPARATION OF THE AMMC:

Aluminium is taken as the matrix material and silicon carbide as the reinforcement materials in this work. The process adopted for making composites is stir casting technique. Initially Aluminium was melted in a furnace and when the temperature of Aluminium reaches up to 760^0 c some magnesium is added in it why because to increase the wettability of SiC during casting Process. Silicon carbide particles were preheated at 850°C for around two hours. An electrical protection heater collected with graphite impeller utilized as stirrer was utilized for blending reason. After SiC expansion, the fluid metal-fortifications blend was mixed for 15 minutes at a rpm of 700. At long last composites were poured in preheated metal molds at 690°C. The dissolve was permitted to harden in the form.

4 .EXPERIMENTATION

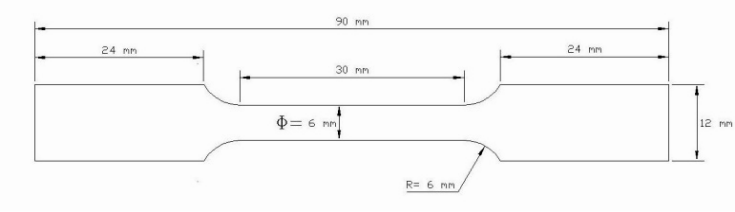
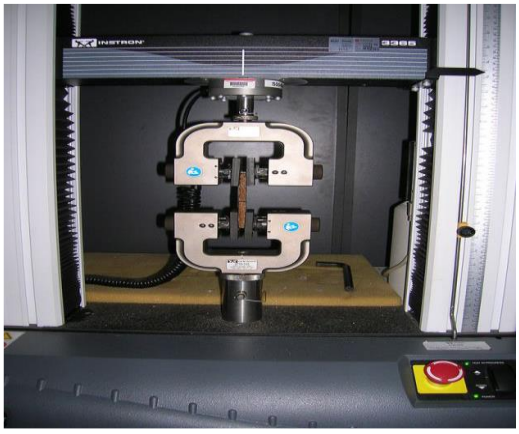


Figure : Specimen

As shown in above figure specimen prepared for tensile strength in Universal Testing machine .



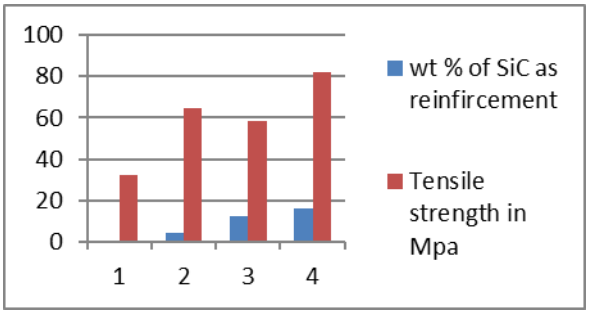
UNIVERSAL TESTING MACHINE

ROCKWELL HARDNESS TESTER

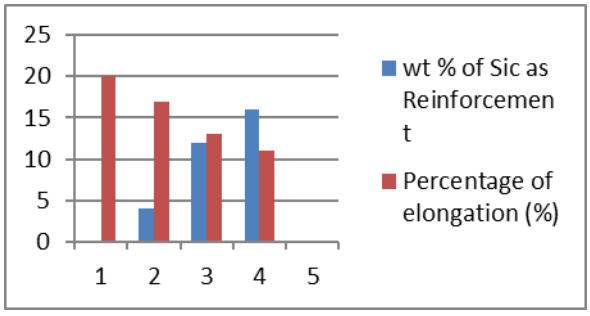
5 RESULTS AND DISUSSIONS:

UNIVERSAL TESTING MACHINE RESULTS:

s.no	composite	Ultimate tensile strength(Mpa)	percentage of elongation (%)
1	Al With 0% SiC	32.34	20
2	Al With 4% SiC	64.42	17
3	Al With 12% SiC	58.26	13
4	Al With 16% SiC	82.14	9



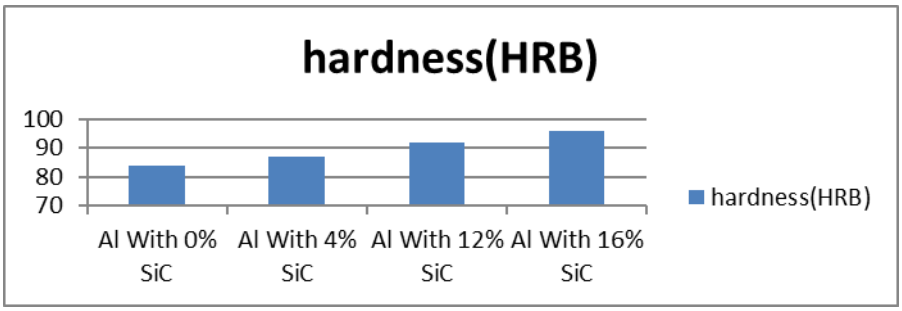
Tensile strength of sic Reinforcement



Percentage of Elongation of specimens

ROCKWELL HARDNESS TEST RESULTS

S.NO	COMPOSITE	HARDNESS(HRB)
1	Al With 0% SiC	**84**
2	Al With 4% SiC	**87**
3	Al With 12% SiC	**92**
4	Al With 16% SiC	**96**



Graph between Wt % of Sic vs Hardness

6 CONCLUSION

The following conclusions are drawn from the current work

- The Aluminium based metal matrix composites with silicon carbide as the reinforcement were prepared successfully.
- Tensile strength and Hardness of Different proportions of the SiC were obtained.
- It is clear that as reinforcement concentration was increased the Tensile strength and Hardness are also increases.
- Among all the 16% SiC composites have better properties when compared with 4%,8% and 12% Sic composites.

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