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EFFECT OF OXIDE & CARBIDE ON MECHANICAL PROPERTIES OF AA6082

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ABSTRACT
AA6082 is a structural alloy having intermediate strength and tremendous corrosion resistance. The mechanical properties of this alloy can be enhanced to use in widely applications. For that purpose Al2O3 and SiC are used as reinforcement to form MMC of AA6082 by stir casting. After formation of MMC by optimized stir casting parameters mechanical properties such as UTS and Hardness is measured for different percentages of oxide and carbide. It observed that both the properties improved with increasing amount of reinforcements; but the improvement in properties by carbide is better than oxide.

KEYWORDS: MMC, SiC, Al2O3, Stir Casting.

INTRODUCTION
AA6082 is an aluminium, magnesium and silicon alloy, which have best strength among all 6000 series AA. It is used for machining applications and structural work. The applications of AA6082 can be further increased by improving its strength. To achieve that MMC prepared by stir casting with two different reinforcements Al_2O_3 and SiC. In stir casting the preheated reinforcement power is mechanical stirred with molten metal at a constant rate. Stir casting process can be controlled by controlling various parameters like stirring speed, temperature, time, reinforcement preheated temperature and its feed rate. Al_2O_3 is one of the strongest and stiffest ceramic; also have strong ionic interatomic bonding which makes it useful as reinforcement powder. SiC powder is another broadly used non-oxide ceramic as reinforcement having good strength, hardness, wear and thermal shock resistance.

LITERATURE REVIEW
Mechanical properties of a material are most concerned for its applications. The actions that occur on the surface, such as wear, corrosion or stress concentration create regions lead to crack nucleation, which under static or dynamic loading will eventually lead to most components and structures failures. These result in major losses in repairs or unscheduled maintenance operations [1]. Aluminium matrix composites have drawn immense interest for various applications in making aerospace and automobile components due to their high strength to weight ratio, high stiffness, lower cost, good formability and low coefficient of thermal expansion but it also faces the all above problems. To avoid this, particulate–reinforced Aluminium matrix composites (AMCs) are of particular interest due to their ease of fabrication, lower costs, recyclability and isotropic properties. Overall strength of such particle reinforced AMCs depends on size of the particles, the inter-particle spacing, volume fraction of the particles and the nature of matrix and reinforcement interface [2]. Aluminium alloys have important advantages in relation with other structural alloys, because of their higher specific mechanical strengths and corrosion resistance. When an aluminium alloy is reinforced with ceramic particles, an increase in specific strength and stiffness can be obtained, controlling other interested properties [3]. Aluminium based metal matrix composites have been one of the key research areas in materials processing field in the last few decades. Most of the research work has been dealing with aluminium matrix with Al_2O_3 & SiC reinforcement requiring the light weight in combination of high strength and high stiffness [4]. Aluminium matrix composites with Al_2O_3 reinforcements give superior mechanical & physical properties. Their applications in several demanding fields like automobile, aerospace, defence, sports, electronics, bio-medical and other industrial purposes are becoming essential for the last several decades. Various manufacturing processes e.g. stir casting, ultra-sonic assisted casting, compo-casting, powder metallurgy, liquid infiltration are being utilized for the production of the aluminium matrix composites. These composite materials possess improved physical and mechanical properties e.g. lower density, low coefficient of thermal expansion, good corrosion resistance, high tensile strength, high stiffness and high hardness and wear resistance. The choice of Alumina as the reinforcement in Aluminium composite is primarily meant to use the composite as very good electrical insulation (1x1014 to 1x1015 Ωcm) , Moderate to extremely high

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mechanical strength (300 to 630 MPa), Very high compressive strength (2,000 to 4,000 MPa) ,High hardness (15 to 19 GPa), Moderate thermal conductivity (20 to 30 W/mK), High corrosion and wear resistance, Good gliding properties, Low density (3.75 to 3.95 g/cm3)[5]. This is because aluminium is lighter weight which is first requirement in most of the industries. In addition, impressive strength improvement and the thermal expansion coefficient of Al matrix composites can be adjusted by using Alumina in varying proportion. Al 6063 plate is casted with varying mass of Al_2O_3 (3%, 6%, 9%)**.** [6]. Microstructure of SiC reinforced aluminium alloys produced by molten metal method shows better stability of SiC in the variety of manufacturing processes available for melt was found to be dependent on the matrix alloy involved [7]. Among flashing metal matrix composites, stir casting is generally accepted as a particularly promising route, currently practiced commercially. Its advantages lie in its simplicity, flexibility and applicability to large quantity production. It is also attractive because, in principle, it allows a conventional metal processing route to be used, and hence minimizes the final cost of the product. Composites with SiC exhibits significantly higher wear resistance than the matrix alloy due to the addition of hard SiC particles which acts as a load bearing constituent. As the percentage reinforcement of SiC particles upped, the wear rate of the composite decreases [8-9].

MATERIAL SELECTION AND FABRICATION

AA6082 is selected among the 6000 series as it has good strength, corrosion resistance and can be heat treated to produce tempers with a higher strength but lower ductility; but it cannot be work hardened. For fabricating Aluminium Matrix Composites, Al_2O_3 from oxides group is selected because of high hardness, superior strength, better stiffness, excellent dielectric properties, refractoriness and good thermal properties as reinforcement. Another reinforcement SiC is selected from the carbide group because of its high strength, high hardness and high wear and thermal shock resistance.

On the basis of literature review stir casting is used for fabrication of MMC under the control conditions. Following parameters are selected for stir casting:

Parameter	**Value**
Melting of AA6082	700°C
Preheating of Reinforcement	500^0C for ½ hour
Stir Time	10 minutes
Stir Speed	200rpm

Table1 Parameters for Stir Casting

7% and 14% of the reinforcements of Al_2O_3 and SiC are added to molten AA6082 respectively to form the Aluminium Matrix Composites and it is sand casted.

RESULTS & DISCUSSION

After solidification of MMC the samples are machined for testing tensile strength and hardness of various compositions. Ultimate tensile strength of various compositions is measured by IS 1608-2005 UTM and it is as follow:

Composition	**UTS(MPa)**
Pure AA6082	130
AA+7%Al_2O_3	133.8
AA+14%Al_2O_3	135.4
AA+7%SiC	138.7
AA+14%SiC	145.6

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Table2 UTS of Tested Samples

Brinell hardness test method is used to find out the hardness of fabricated composites. In this method aluminium alloy composites are tested using 250kg test force and a 5mm carbide ball and it is a follow:

Composition	**Hardness(BHN)**
Pure AA6082	40
AA+7%Al_2O_3	42
AA+14%Al_2O_3	46
AA+7%SiC	49
AA+14%SiC	51

Table3 Hardness of Tested Samples

On the bases of measurements it is observed that both the mechanical properties i.e. Ultimate Tensile Strength and the Hardness increased with the increase in percentage of both reinforcements of Al_2O_3 and SiC. But the incease in properties with SiC is better than that in Al_2O_3. The following charts represent the comparison between two:

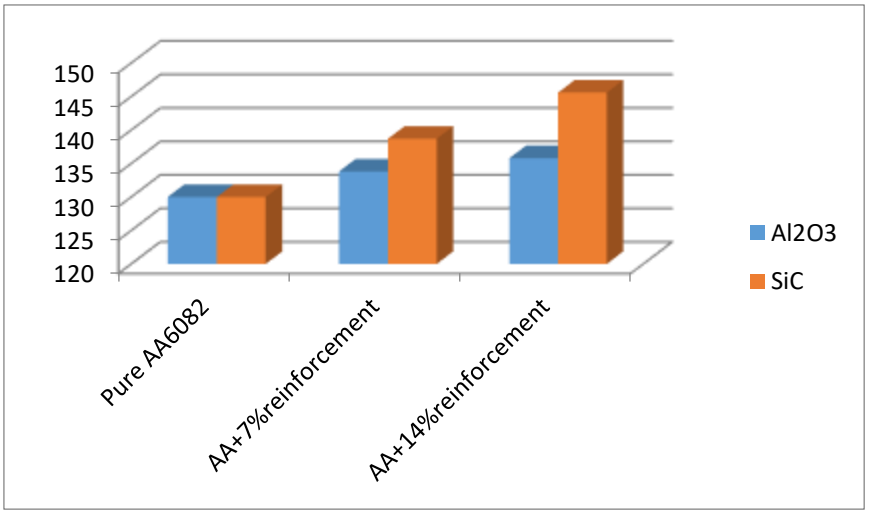

Chart 1 Comparison of UTS for various Compositions

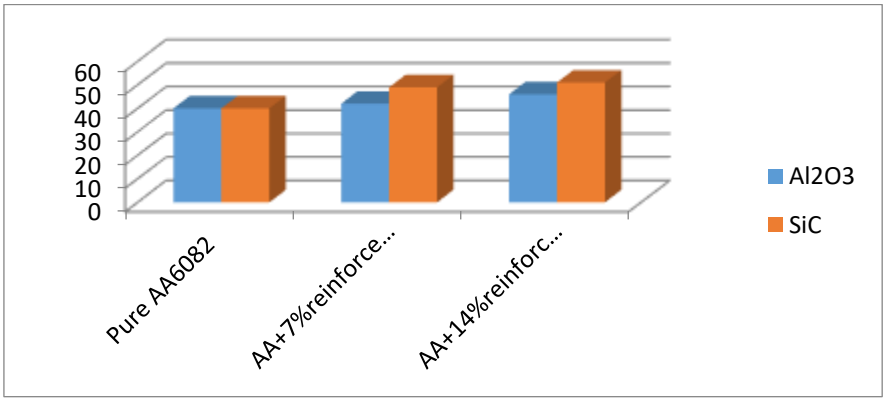

Chart 2 Comparison of BHN for various Compositions

CONCLUSION

Aluminium Matrix Composites of AA6082 is successfully fabricated with various percentages of Al_2O_3 and SiC reinforcements under the controlled stir casting conditions and following conclusions are made:

- Both the Ultimate Tensile Strength and Hardness of MMC increased with increase in amount of Al_2O_3 and SiC.
- The improvement in mechanical properties of MMC is better in case of reinforcement of SiC as compare to Al_2O_3.

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