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Experimental Investigation of Mechanical Characterisation of Al6061 Reinforced With Molybdenum Disulphide (MOS_2)-A Review

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Abstract— In the present study, based on the literature review the individual aluminium alloy and combined effect of reinforcements on aluminium alloy discussed. For preparation of composites Al6061 taken as base metal and varying weight percentage of Molybdenum disulphide (MoS2). The composite of Al6061 and MoS2 is prepared by stir casting technique. A series of mechanical tests are conducted on fabricated composite specimen and compare the result of different percentage composition with the base alloy. Optical microscope is used for microstructure studies and grain size measurement. Mechanical and tribology properties like stiffness, tensile strength and hardness improved due to composite fabrication. Due to this aluminium metal matrix composite with reinforcement increase application in aerospace, underwater, high temperature application and automobile.

Keywords—Al6061, Molybdenum disulphide (MoS2), Metal matrix composites, stir casting, Mechanical testing.

I. INTRODUCTION

Metal matrix composite(MMC) is the combination of two or more materials in which desired properties are achieved by systematic combination of different constituents i.e. composites are combination of continuous phase and discontinuous phases. The continuous phase called as matrix and discontinuous phase in the form of fibers, wiskers or particles called as reinforcement. Commonly used matrices are Al, Mg, Ti, Cu and their alloys and the reinforcements are MoS2, SiC, Al_2O_3 and B4C. Based on the matrix material which forms the continuous phase, the composites are broadly classified into

Metal matrix composites (MMC)

It consist of two components, one is the metal matrix and the second component is reinforcement. It has advantage over PMC's include higher operating temperature, non flammability and greater resistance to degradation by organic fluids.

Ceramic matrix composites (CMC)

It consists of ceramic fibers embedded in a ceramic matrix. The matrix and fibers can consist of any ceramic material. Carbon and carbon fibers can also be considered as ceramic material.

Polymer matrix composites (PMC)

It consists of polymer resin as matrix and fibers as reinforcement. PMC's are used in greatest diversity of composite application [1].

Different literatures had fabricated materials to form composites and made observations as - Mitesh Kumar *et al.* fabricated Al 6061 with MoS2 and observations made as the hardness of composite material increases, density of composite material increases, and ultimate tensile strength decreases when increasing the weight percentage of MoS2. Pure material has low strength, stiffness and density. In order to overcome these difficulty metal matrix composites are used. Aluminium alloys are extensively used in aerospace and automobile industries. Low weight aluminium alloy lead to reduction of weight resulting in improves economically. Aluminium and its alloys play an important role in the production of MMC. Aluminium composite material has greater advantage due to their high specific strength, stiffness, wear resistance and dimensional stability. Lubricating particles like MoS2 also added to improve the tribology behavior of different materials by providing a solid lubricating layer. The addition of these particles considerably affects the mechanical behavior of composites [2].

Kalidaas D. *et al.* suggested that the optical micrograph of composites by stir casting methodology such that the allocation of MoS2 particulate in the metal matrix is homogeneous. The porosity of the test material increases with in different weight fraction of reinforcement particles [3]. Bhargavi Rebba *et al.* evaluated the mechanical properties of Al6061 reinforced with MoS2 as Hardness of composites found high at higher weight percentage of MoS2 , optical micrograph revealed that the MoS2 particles were well distributed in Aluminium matrix and presence of MoS2 particles in the composites with homogeneous dispersion.[4] Kannappan Somasundara Vinod *et al.* had fabricated Al6061 and MoS2 and stated that- a uniform distribution of MoS2 is observed on the

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optical micrographs and also the wear resistance of the composites is better than the alone Al6061.[5]

II. EXPERIMENTAL DETAIL

A. Selection Of Matrix Material

Aluminium i.e. Al6061 is used as matrix material since it is one of the most abundant metallic element on the earth and most economic as well. The chemical composition of Al6061 matrix material is as shown in following table

Mg	*Si*	*Fe*	*Cu*	*Ti*	*Cr*	*Zn*	*Mn*	*Be*	*V*
0.92	*0.76*	*0.28*	*0.22*	*0.10*	*0.07*	*0.06*	*0.04*	*0.003*	*0.01*

Table 1.Composition of Al6061

This Al6061 is chosen since it has strength and damage tolerance at elevated and cryogenic temperature. It is an age hardenable alloy suitable for high temperature and high strength applications like structural components and high strength weldments [3].

B. Selection Of Reinforcement Material

The MoS_2 is used as reinforcement material because it has excellent lubricity. By adding 0%, 2%, 4%, 6% by weight of MoS_2 into the matrix. We can change properties like hardness, tensile strength, density, yield strength and properties of composite. The composition of MoS2 is as shown

Element	*Fe*	*Pb*	*MoO2*	*SiO2*	*H2O*	*KOH*	*OIL*
Weight	*0.3*	*0.2*	*0.2*	*0.2*	*0.2*	*0.5*	*0.5*

Table 2.Composition of Molybdenum Disulfide (MoS_2)

C. Preparation of Composite by Stir Casting

Different techniques used for the composite development are stir casting, powder metallurgy, spray atomization and co-deposition, plasma spraying and squeeze-casting. From the above all techniques stir casting is the most economic technique. This technique offers good matrix-particle bonding due to stirring action of particles into the melts. Homogeneous mixing and good wetting obtained by this process by selecting appropriate parameters like stirring speed, time and temperature of molten metal.



Fig 1.Electric resistance casting furnace

For the preparation of composites first of all sand mould is prepared. The four main components for making a sand casting mold is base sand, a binder, additives and a parting compound. In this casting process a pattern is made in desired shape i.e. cylindrical shape. This pattern is made of metal. Stir casting technique is used for the preparation of composites. This process is one of the most economical to fabricate composites which have been adapted recently. In this method matrix alloy (Al6061) first superheated above its melting temperature and preheated MoS2 is added to molten Al6061 and stirred well by stirrer. After this the melted and

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superheated composite material is poured into die of cylindrical shape and kept for cooling. Then the testing made on fabricated specimens for determining mechanical properties [4] - [5].

III.DIFFERENT TYPES OF MECHANICAL TESTING

A. Tensile Testing

A tensile test is also known as tension test, is probably the most fundamental type of mechanical test performed on material. As the material is being pulled along its axis we can find tensile strength of material. In tensile testing due to continuous pull on the material it will breaks and obtain a good, complete tensile profile. The point of highest load is called as its "Ultimate Tensile Strength".

B. Yield Strength

Yield strength of material is defined as the stress applied to the material at which plastic deformation starts to occur while the material is loaded.

C .Hardness Test

Hardness test is defined as the resistance of material to permanent deformation of its surface. The deformation may be in the form of scratching wear indentation of cutting. Indenters are in the form of sphere and cones are used. A hardness test consists of pressing the surface of materials with a sharp edge indenter.

D. Wear Test

Wear test is defined as damage to a solid surface, most of time in the form of gradual material removal from a surface by the action of relative motion with a contacting substance. Wear is caused by disintegrating of interacting machine components as a result of over stressing of material in the immediate vicinity of the material. It may result in dimensional change of the components or surface damage and this cause secondary problem such as vibration or misalignment. [4] - [6].

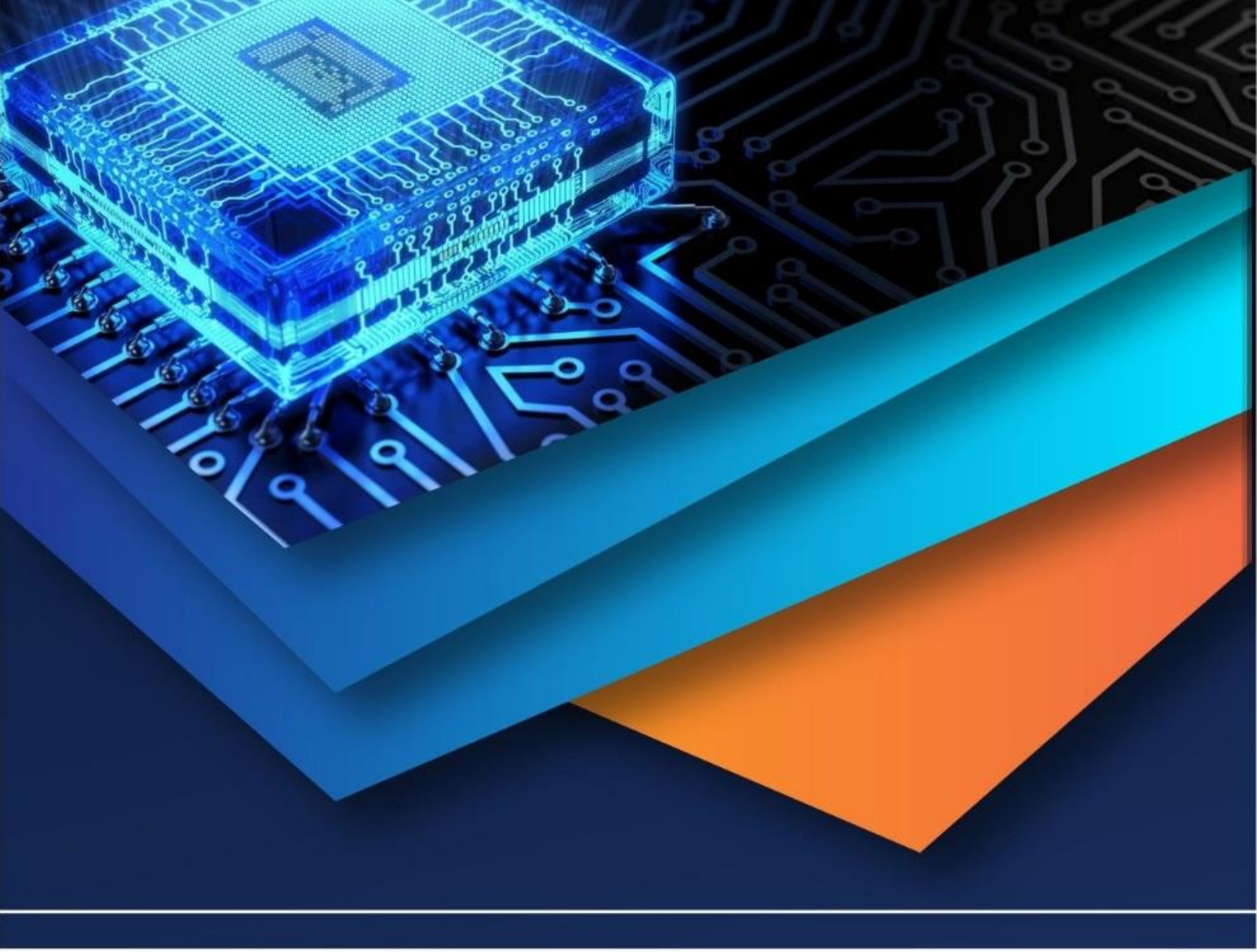
IV.CONCLUSIONS

The literature survey presented physical and mechanical properties of aluminium alloys improved by using different types of reinforcement. Reinforcement like MoS2 improves physical and mechanical properties of composite. The composite of Al6061 and MoS2 is prepared by stir casting technique. Different type of mechanical test is conducted on composite specimen. The result of different percentage composition compare with the base alloys. A further study in this respect is needed particularly by varying weight percentage and particle size of reinforcement by using low cost manufacturing stir casting technique.

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