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FABRICATION & MECHANICAL TESTING OF METAL MATRIX & COMPOSITE MATERIAL

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Abstract

Tensile and hardness tests were performed on Alumimium and Aluminium Molybdenum Disulfide specimens. The tests were carried out using Universal Testing Machine and Brinell Hardness Test for Tensile strength and Hardness strength respectively. The specimens were put to the test in a variety of situations. The maximum hardness was for the specimen quenched with water, however the tensile strength of that particular specimen was the minimum, while the tensile strength of that particular specimen was highest. However, the hardness for slow cooling was the least. While furnace cooling was comparatively higher. The Hardness strength of that particular specimen was the minimum, while the hardness strength of that particular specimen was highest. In this experiment rather than using simple aluminium we deduced that composite of aluminum were having good load bearing capacity. Also increasing percentage of composite material Molybdenum Disulfide in aluminium its load bearing capacity increases. The other specimens had varied tensile strength and hardness and it was not possible to map a relationship of the two.

Keywords

Molybdenum Disulfide, Metal Material Composites, American Society for Testing Materials, Aluminium Alloy 6061, Aluminium Matrix Composites.

Introduction

Advance in the improvement of cutting-edge composites from the times of E glass/Phenol irregular structures of the mid 1940's to the graphite/polyamide composites utilized as a part of the space transport orbiter-is terrific. [1] These materials have a low specific gravity, which means that they have greater quality and modulus than many traditional design materials, such as metals. [2] As a consequence of concentrated studies into the central way of materials and better comprehension of their structure property relationship, it has get to be conceivable to grow new composite materials with enhanced physical and mechanical characteristics qualities. [3] Optical micrographs revealed that the MoS2 particles were well distributed in the aluminium matrix. The presence of MoS2 particles with homogenous dispersion was established by XRD examination. [4] After performing experiments concluded that increase in area fraction of reinforcement in matrix result in improved tensile strength, yield strength and hardness. [5]

Problem Statement

Al6061 has low hardness compared to its composites. Also it has low corrosion resistance, higher cost, and higher weight than its composites. The main objective is to fabricate Aluminium as base material and MoS2 as material reinforcement. Also to study the different volume fraction like 2%, 4%, 6% of MoS2 with Al6061, to determine the mechanical properties of composite material with American Society for Testing Materials (ASTM) standards prepared specimen, to study the microstructure of MoS2 (Molybdenum disulfide) and Al6061 (Aluminium alloy). To perform mechanical tests like tensile test and Hardness test employed. To determine the Tribological properties of composite material with ASTM standards prepared specimen, varying load with constant time.

Experimental Procedure

Material Selection

Aluminium Alloy 6061 is the matrix material (solid form). Molybdenum Disulphide is used as a material reinforcement.

Table Composition of Aluminium and MoS_2

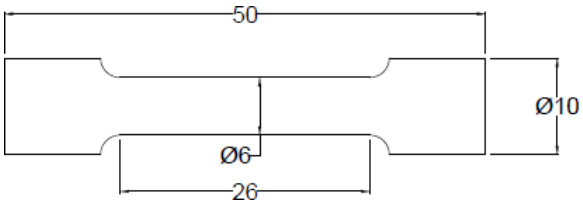
Sr. No.	Composite Composition
1	Pure Aluminium
2	Aluminium + 2% MoS_2
3	Aluminium + 4% MoS_2
4	Aluminium + 6% MoS_2

Mechanical Testing

The following mechanical tests are used in this study for the Al6061-MoS2 specimen Tensile test, Hardness test.

Conduction Procedure of Ultimate Tensile Test

Adjust the Universal Testing Machine (UTM) for the desired load range and place the specimen between the UTM's fixed and movable jaws. Place the dial gauge and extensometer in the



proper positions and set the dial gauge to zero. The machine is turned on, the tensile stress is gradually applied, and the dial

gauge and extensometer readings are recorded. There will be a phase in the needle moment when more force is applied. This point is considered to as the Yield point. The specimen is loaded continually until it reaches the ultimate load, at which point the load reduces and a neck form in the specimen, which should be documented. Further loading causes the specimen to shatter, resulting in the breaking load being recorded and the specimen being removed. Tensile Test is performed to evaluate some of the mechanical properties such as ultimate tensile strength. Finally, the noted results are evaluated and the graphs are plotted.

Universal Testing Machine

Tensile Test is performed to evaluate some of the mechanical properties such as ultimate tensile strength. The material is turned into 10mm diameter in the CNC. The material is then step turn to diameter 10-6-10 for a length of 10-26-10 respectively. The material is then finished turned to a 6mm diameter at the centre on the lathe as shown in figure below. The inner ends are given a 5mm radius fillet.

ASTM Tensile Test Specimen

Specimen after tensile test

Conduction Procedure of Hardness Test

The specimen's position must be chosen carefully in order to provide a reliable indicator of the material's qualities. The type of indenter, size of the indenter selected based on the material to be tested. Here 5mm steel ball is used. The specimen is placed on the anvil so that the surface is normal to the direction of applied load. The anvil is raised by means of the elevating screw. Raise the anvil until the pointer reaches the red dot on the dial. Apply the load of 250Kgf wait for about 30 seconds duration, to ensure the complete application of the load on the specimen through indenter. After 30 seconds, turn off the load. Observe the indentation and measure the depth and diameter and calculate BHN.

$$BHN = \frac{2P}{\prod D[D-\{\sqrt{D^2-d^2}\}]}$$

Where,

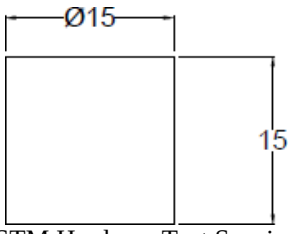
P – applied load

D -dia of the ball indenter.

d - dia of indentation.

Brinell Hardness Test

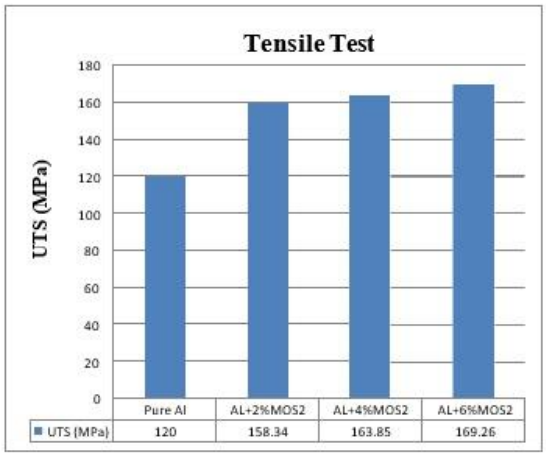
Hardness Test is done to determine the material hardness. The cast composite is machined to 15mm diameter using turning operation on a lathe. It is then cut into pieces of 10mm thick as specimens for hardness test. The end surfaces are faced for a smooth surface finish.



ASTM Hardness Test Specimen

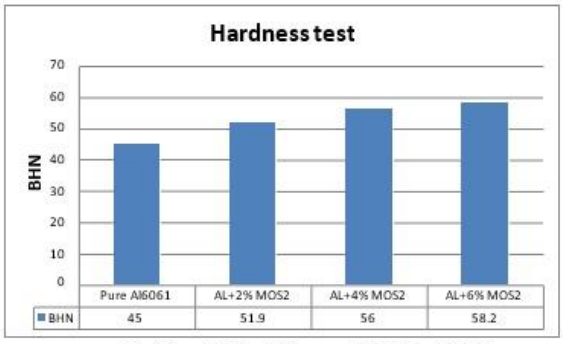

Indentation on hardness specimen

Result and Discussion



Variation of UTS with increased % MoS_2 in Al6061

Initially the ultimate strength of the MoS2 after heat treatment, the tensile strength increased from 120 N/mm2 to 169.26 N/mm2 which is 41.05% increase.



Variation of BHN with increased % MoS_2 in Al 6061

It is roughly 45 BHN for pure alloys that have been heat treated, and 58.2 BHN for Al6061 with 6% MoS2. That example, when reinforcement of up to 6% MoS2 is added to samples, the hardness increases by 29.33 percent. This is because the composite system contains hard MoS2 particles.

Conclusion

A conclusion is where you summarize the findings of manuscript and generalize their importance. It is obvious from the findings that increasing the proportion of MoS2 in metal matrix composites raises the composites ultimate tensile strength by 41.05 %. The hardness of the composite increases by 29.33 % when MoS2 is reinforced with Al6061. As Molybdenum Disulphide a reinforcement material percentage increases in metal matrix overall strength of specimen also increases.

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