International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017),e-ISSN:2455-2585
International Conference on
Recent Explorations in Science, Engineering And Technology (ICRESET'19)
Volume-5, Special Issue-March, 2019.

Investigation on Mechanical Properties of Al6063 and Titanium Carbide in Aluminium Metal Matrix Composites

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ABSTRACT - Metal matrix composites, in particular, Aluminium Matrix Composites are gaining increasing attention for applications in aerospace, defence and automobile industries. The use of aluminum metal matrix composites has generated considerable interest as the manufacturing of complicated contours such as dies. The objective of this work is to investigate the mechanical properties such as hardness, Impact and SEM analysis. The Al 6063 metal matrix composite reinforced with 10% Al_2O_3, 5% TiC is used as work material. By stir casting the composition of required samples are formed with the standard testing methods the structure of formed samples are analysed .Tests like SEM analysis, Hardness test, Impact test were taken .The observed values are compared with existing aluminium alloy.

Key words-Al6063, Al_2O_3, TiC, Metal matrix composites, Mechanical properties

I. INTRODUCTION

Aluminum alloys are widely used in automobile industries and aerospace applications due to their great mechanical properties, low density, low coefficient of thermal expansion, better corrosion resistance and wear as compared with conventional metals and alloys. The low production cost and better mechanical properties of composites makes them very useful for various applications in many areas from technological point of view. The particulate reinforcements such as SiC, Al2O3 and aluminide are generally preferred to impart higher hardness. The coating of reinforcements with Ni and Cu, also leads to good quality interface characteristics and hence contribute in improving hardness[1].SiC particles are uniformly distributed in the matrix Al6063 according to the SEM analysys [2] The distribution of Al_2O_3 particles was fairly homogeneous in the composite irrespective of the volume fraction Al6063/ Al203 AMCs exhibited a reduction in the average grain size during FSP.A clean interface was noticed between AL_20_3 particles and the Al6063 aluminium matrix[3].

II.MATERIALS USED

AA 6063 is an aluminium alloy, with magnesium and silicon as the alloying elements. It has generally good mechanical properties and is heat treatable and weldable. The mechanical properties of 6063 depend greatly on the temper, or heat treatment, of the material. Young's Modulus is 10×106 psi (69 GPa) regardless of temper.

2b.Reinforcing material

In the present investigation Silicon Carbide and alumina were used as reinforcing elements. Alumina or Al2O3 (Young's Modulus = 375 GPa, poison ratio = 0.21) [57] is easily available, cost effective ceramic reinforcement, having good thermal properties so that it could be used as refractory material. The strong ionic inter-atomic bonding imparts excellentdielectric properties and higher hardness, higher strength and higher stiffness.Titanium carbide (chemical formula approximately TiC) is an extremely hard boron–carbon ceramic material.

III. EXPERIMENTAL METHODOLOGY

The Aluminium 6063 alloy based ceramic reinforced composites were designed as per selected composition amounting to 100% by weights and prepared using Stir casting technique. Stir casting is a liquid state fabrication method; in which dispersed phase (ceramic particles) is mixed with molten 6061 alloy (melting temperature of 8000C achieved using furnace and graphite crucibles) by manual stirring for ~ 30 s. The mixture is then poured into a sand mold and allows cooling to room temperature. Thereafter, specimens were cut as per standard size for characterizing physical and mechanical analysis.

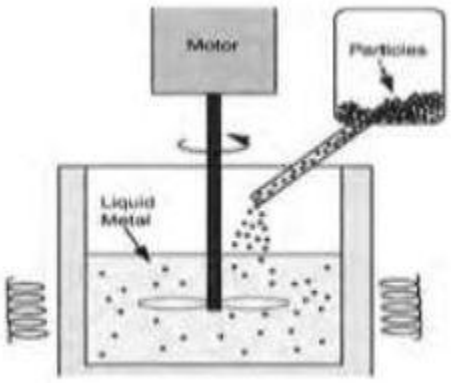


Fig. 3.1 Stirring of composite melt with ceramic particles to minimize settling of the particles during processing

3.2.MATERIAL TESTING

3.2a. SEM Analysis

This test was conducted on a scanning electron microscope at specified test duration .sample and wear tested materials are taken. First work piece is fixed on the machine at one stage. Then closed door. The high vacuum is created on the material .the material wear areas are showed on image. The results are displayed by computer.

3.2b.Hardness Test

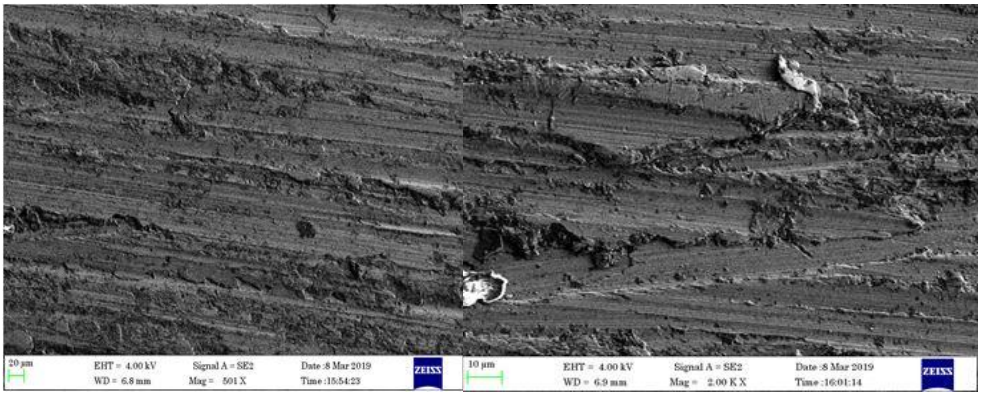
Brinell hardness is determined by forcing a hard steel or carbide sphere of a specified diameter under a specified load into the surface of a material and measuring the diameter of the indentation left after the test. The Brinell hardness number, or simply the Brinell number, is obtained by dividing the load used, in kilograms, by the actual surface area of the indentation, in square millimeters. The result is a pressure measurement, but the units are rarely stated.

3.2c.Impact Test

The pendulum impact testing machine ascertains the notch impact strength of the material by shattering the V-notched specimen with apendulum hammer, measuring the spent energy ,and relating it to the cross section of the specimen.

IV . RESULTS

4.1. Microscopic results



.**Fig.4.1.***Microstructure*

4.2.Hardess results

Table 4.1 *observed values of Brinell hardness test*

Type of Test	Sample ID	Observed Value	Average
Brinell Hardness Test	Test 1	39 BHN	37
	Test 2	37 BHN	
	Test 3	36 BHN	

4.3 .Impact test results

Table 4.2 Results for Izod and Charpytset

S.NO	Test	Observed values in Joules
1	Izod	4.3
2	Charpy	4

V.CONCLUSION

The following conclusions are derived from the Electrical Discharge machining of Al 6063 metal matrix composite reinforced with 10% Al_2O_3 and 5% TiC are as follows.

1. By the analysis of SEM it was concluded that,aluminium oxide and boron carbide was equally dispersed by stiring so the strength of the structure and particle may increased.The structure of the particles was spilted in all zones.It was concluded by identifying in 5 µm,10 µm,50 µm and 100µm.

2. In hardness test the brinellvalues are almost equal in all the places.Three hardness portions were checked only minor deviations in hardness, so it was concluded that increase in hardness of hybrid metal matrix composites.

3. Impact test was checked in medium temperature of samples,it was observed that more elastic deformation has occurred in a broken area under the V-notch.The withstanding ability of material was increased in 6063 metal matrix hybrid composites.

Finally by taking all results and comparison of existing experimental values the composition of casted samples 10% Al_2O_3 and 5% TiC was increasing the mechanical properties.

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