COMPARATIVE STUDY OF AA7075-SIC AND AA7075-TIB_2 IN-SITU COMPOSITES

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ABSTRACT

The present work is focused to fabricate and compare AA7075-6%SiC and AA7075-6%TiB_2. Taking aluminium metal as base matrix and by adding 6% weight of SiC and TiB_2 two specimens were fabricated. By using stir casting these two specimen were fabricated. Vickers hardness testing machine was used to find out the hardness of the fabricated specimens. By observing the results of Vickers hardness test, the hardness value of AA7075-6% SiC composite is higher than AA7075-6% TiB_2 composites. Various mechanical testing is compared on the compressive samples prepared from the two cast composite specimens. It has been observed from compressive test results that compressive strength of AA7075-6% SiC composite is 14% higher than AA7075-6% TiB_2 composite. To study the wear resistance behaviour of AA7075-6% SiC and AA7075-6% TiB_2 composites wear test is carried out. From the results of wear test it has been observed that wear resistance of AA7075-6% SiC composite is 26% higher than the AA7075-6% TiB_2 composites.

IndexTerms **- AA 7075 alloy, TiB_2, SiC, metal matrix composite, In-situ, hardness test and wear rate**

I. INTRODUCTION

Composites are widely used in defence, aerospace and automotive industries because of its exclusive properties like high hardness value, high specific strength, wear resistance, strength-to-cost, strength-to-weight, etc.[1]. Now a days due to the requirement of materials with enhanced wear resistance, raised strength and higher temperature performance various reinforcements compatible with aluminium metal matrix are under research. In this research is carried out to introduce SiC and TiB_2 are taken as reinforcement with AA7075 metal matrix. This is due to the reason that SiC and TiB_2 reveals exceptional features such as high hardness, high elastic modulus, high melting point and good thermal stability. To avoid the brittle reaction near the reinforcement matrix interface, TiB_2 ceramic particles doesn't react with molten aluminium. Also AA7075 reinforced with TiB_2 is known for its high wear resistance property [2]. Jhony James.S in his paper, "Comparative Study of Composites Reinforced with SiC and TiB_2" the composite Al/ TiB_2 and Al/SiC were successfully fabricated by the in-situ stir casting procedure. The manufactured Al-SiC composite shows higher values of hardness, wear resistance than the Al/ TiB_2 [3]. This new effort clearly demonstrates the outstanding properties of SiC and TiB_2 in an AA7075 metal matrix composite with respect to hardness, compressive strength and wear.

II. EXPERIMENTAL PROCEDURE

Matrix Material

The characteristics that the metal matrix should are low specific weight, machinability, formability and high strength to weight ratio. AA7075 alloy possess the above mentioned characteristics suitable for the study.

Reinforcement choice

The main criteria for selecting the reinforcement is the material should have high strength and durability which should be characterized by relatively high melting point, hardness, wear resistance and strength to density ratio. Based on the above mentioned characteristics TiB_2 is chosen. TiB_2 finds its applications in impact resistant armour, cutting tools, and wear coating

The chemical compound of carbon and silicon is Silicon carbide which has outstanding abrasive properties has been produced and used in grinding wheels. The material is developed in to high quality technical grade ceramic with good mechanical properties which is used as abrasives, ceramics, refractories and other high performance applications

Stir casting

Fig 2.1 Stir Casting

Stir casting is one of the cheapest processes to fabricate aluminium matrix composites. There are several parameters, which affect the mechanical properties and final microstructure of the composites. In this study, TiB_2 and SiC particles were used as reinforcement to fabricate AA7075-6%TiB_2 and AA7075-6% SiC composites at two casting temperatures (750 ^{0}C and 850 ^{0}C). In this process of making composites, first the scraps of aluminium were heated for 1 or 2 hours at 850 ^{0}C and SiC or TiB_2 powder also heated with 750 ^{0}C and both mixed with each other below their melting point. After complete the process the slurry has been taken in to the die mould within 30 seconds allow it to solidify.

II. RESULT AND DISCUSSION

Hardness test of AA7075-6%SiC and AA7075-6%TiB_2

In the graph, the hardness values are plotted. From graph it has been observe that the Vickers hardness value of AA7075-6% SiC is higher than AA7075-6% TiB_2 composite. In disparity a rise in Vickers hardness value was expected for TiB_2. This reduction in hardness value for TiB_2 composite shows a reduction in the work of indentation, which might be related to the distribution of compressive stresses in the ceramics. Also small cracking may leads to drop in hardness value due to the work of indentation is reduced through the closing of micro cracks [4]. This might be the reason of decrease in hardness value when an increase was expected. The hardness value of AA7075-6%SiC is 12% more than the AA7075-6% TiB_2.

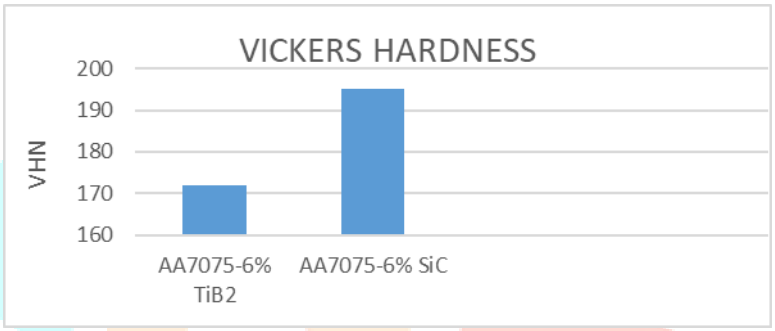

Fig 3.1 Vickers Hardness Test

Deformation Behaviour

Compression tests were carried out on AA7075-6%SiC and AA7075-6% TiB_2 composite. The improvement in compressive property of the composites can be attributed to the contact between particles and dislocations; under the load reinforcement particles operate as obstacles to the movement of dislocation develops higher compressive strength of composites. Comparing the results of compression test of AA7075-6% SiC and AA7075-6% TiB_2 composites we can observe that there is increase compressive strength of composites than the base material. This is mainly because of SiC and TiB_2 particles are equally dispersed in the matrix. The AA7075-6% SiC composite reveals higher strength than AA7075-6% TiB_2 composite. The substitution of SiC in place of TiB2 exhibits 14% increase in compressive strength. This comparative study concludes SiC composites have higher compressive strength than TiB_2. Fig. shows the comparison of compressive strength of AA7075-6%SiC with AA7075-6% TiB_2 composite which clearly portrays the 14% rise in compressive strength of SiC composite.

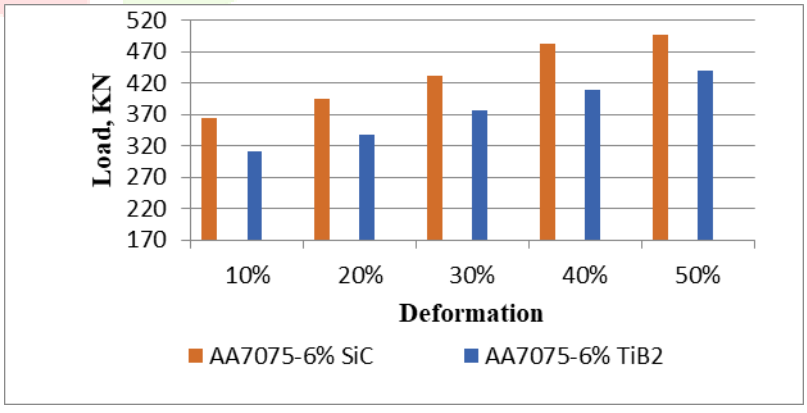

Figure 3.2 Compressive Test

Wear test

Wear test was conducted on AA7075-6% SiC and AA7075-6% TiB_2 in order to compare the wear resistance behaviour of the fabricated composites and the experimental results are plotted in a graph (Fig.3.3). The fabricated specimens are cut about 5 mm diameter by using wire EDM. These specimens weight was checked before and after the wear test. Wear test was carried out for 10 minutes, 20 minutes and 30 minutes with a distance of 2 km, 4 km and 6 km and load is taken as 2 kg and the results of AA7075-6% TiB_2 and AA7075-6% SiC as shown in Fig 3.3. By the results we can observe that wear resistance behaviour for

AA7075-6% SiC is 26% higher than AA7075-6% TiB_2 composites. In the volume of wear test specimen, due to the lack of reinforcement this adverse results may be obtained.

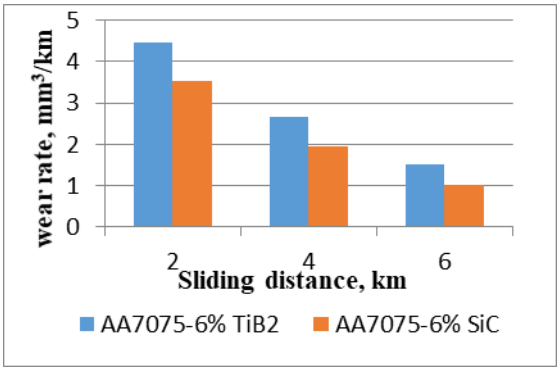

Figure 3.3 Wear Test

CONCLUSION

1. The AA7075-6% SiC and AA7075-6% TiB_2 metal matrix composites were effectively fabricated by using stir casting route.

2. From Vickers hardness test, it has been concluded that the hardness value of AA7075-6% SiC is 12% more than the AA7075-6% TiB_2 composite.

3. From compression test, the comparison of compressive strength of AA7075-6%SiC with AA7075-6% TiB_2 composite which clearly portrays the 14% rise in compressive strength of SiC composite.

4. From wear test, it has been concluded that the wear resistance behaviour of AA7075-6% SiC is 26% more than the AA7075-6% TiB_2 composite.

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