ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 2, Issue 9, September 2017

Experimental Investigation on Wear Rate of Al6061/SiC/Zr Hybrid Metal Matrix Composite

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***Abstract:*-- The emphasis of recent research works in the area of composite materials has been more on improving mechanical properties like tensile strength, micro hardness and wear resistance, fatigue properties etc. The reason is that the desired mechanical properties were not obtained by the ordinary engineering materials. In the present days, significant demand for materials with good wear resistance has been there in automotive, aerospace and military applications. In the present research work, the wear rate of Al6061/SiC metal matrix composite (MMC) has been enhanced by reinforcing Zirconium (Zr) particles to the molten Al6061/SiC metal matrix composites (MMC) by stir casting technique. The wear rate was tested using pin on disk wear tester. An effort has been made to blend 2% of Zr with Al6061 alloy by varying Sic in 10, 15 and 20%. The wear resistance of Al6061/SiC has been improved significantly due to the uniform distribution of Zr particles in the matrix.**

Key words: **Al 6061, SiC, stir casting, wear resistance, Zr particles.**

I. INTRODUCTION

The ceramic particle reinforcement has played an important role while improving the properties of the metal matrix. Matrix materials are usually light in weight and shown good results when combining with ceramic particles [1, 2]. The reinforcing ceramic particles are uniformly distributed in the matrix for improving the mechanical properties like strength, stiffness, micro hardness, wear resistance, creep and fatigue properties etc. MMCs are strengthening by reinforcing the ceramic particles to the matrix during the molten state. The in situ stir casting techniques have been best practice to the uniform distribution of particles in to the metals and also provide the information for thermal stability of the metal matrix. Al 6061 alloy has become strongest metal to improve the mechanical properties of the materials by reinforcing the ceramic particles. The ceramic particles have been used in the form of particles, fibers and whiskers. The metals are strengthening by wear rate phenomenon. Among all the ceramic particles SiC [3,4], Zr are the best practice to reinforcing in to the MMCs due to their high hardness, strength, fatigue, wear resistance to the materials. Devaraju Aruri [5] investigates, the influence of rotational speed on wear properties of the aluminium alloy based surface hybrid composites [(SiC+Gr) and (SiC+Al_2O_3)]. It was observed that high wear rate was finding in the composite due to the presence of SiC and Gr acted as a loading bearing elements. Serajul haque [6] was conducted the experiment to found out the optimum values of wear rates on Al6061-Cu reinforced SiC_p. The optimum values are observed with varying the stirring speed, and pouring temperature as process parameters. S.Nallusamy [7] has made an effort to analysis the wear resistance of metal matrix composites. It was observed that in addition of Al_2O_3 and SiC to Al6061 alloy decreases the range of wear rate.

However, previously no results were found to report on wear resistance of Al6061 alloy by the addition of sic and Zr particles. The main aim of this paper is to investigate the influence of Zr particles on wear rate performance of Al6061/SiC [8, 9] metal matrix composite.

II. EXPERIMENTAL DETAILS

Materials used

The matrix material used in this experimental investigation is al6061. The reinforcing materials are selected as SiC particle as 10, 15, 20% and 2 % of Zr particles. Al alloy was taken in to the stir casting furnace in the graphite crucible. The furnace was initially at the temperature of 650^0C. The temperature of the furnace was raised to 950^0c simultaneously sic and Zr particles were preheated to 450^0C and then added in to the crucible. After adding the ceramic particles the temperature of the casting was raised to 1060^0C and stirring mechanism was adopted by graphite rod before the casting temperature was reached to 1080^0C. For trapping the hydrogen gas during the process the argon was supplied

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to complete the casting. The size of rotating pins of width and depth of 10mm and 3.5mm respectively.

Testing Procedure

The wear test was conducted according to the ASTM: G99-05 standard. Prismatic pins of 10mm diameter were cut from the nugget zone, with axis of the pin normal to the FSP direction. The disk was made of EN31 steel. The diameter of the sliding track on the disk face was 80mm with a thickness of 10mm. the tests pins were loaded with dead weight against disc. The wear tests were carried on the metal matrix composites under dry sliding [10] conditions at different loads of 10N, 20N and 30N. The wear rate was calculated by using the formula:

Wear rate = volume loss during a given time (in mm^3) / load per unit distance (in N/m)

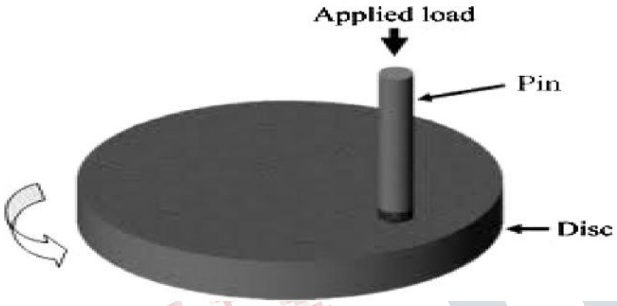

Fig.1 schematic diagram of pin on disc wear tester

III. RESULTS AND DISCUSSION

Wear test

In this present study, the wear test is carried out to give the wear resistance of a material by varying the applied loads. Three samples were studied under different loading conditions for wear resistance of the composites. All the three samples were given significant improve in specific wear rate from 1.47 to 0.32 for 10N, 2.7 to 0.53 for 20N and 3.6 to 0.67 for 30N by increasing the wt% of SiC. Fig.2, fig.3 and fig.4 show the graphical illustration of the specific wear rate of the Al6061/SiC/Zr hybrid composite. The wear rate of the composites was affected by increasing the reinforcement ratio of SiC from 10 to 20% along with 2% of Zr. Generally SiC had only small improvement in wear to metal matrix composites. Zr has become powerful to improve the wear rate of the metal matrix composites for small addition of reinforcement to the matrix. From fig.2, fig.3 and fig.4 it was observed that the decrease on specific wear more in 30N applied load sample which gives the results wear rate from 3.6 to 0.67 when the addition of SiC increases from 10 to 20%. The strength of the composite was increased due to the addition of Zr to the Al6061/SiC metal matrix composite.

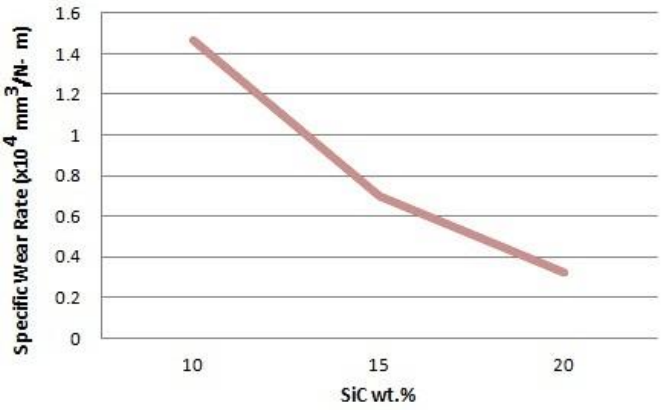

Fig.2 Specific wear rate for Al6061/SiC/Zr hybrid composite with 10N load

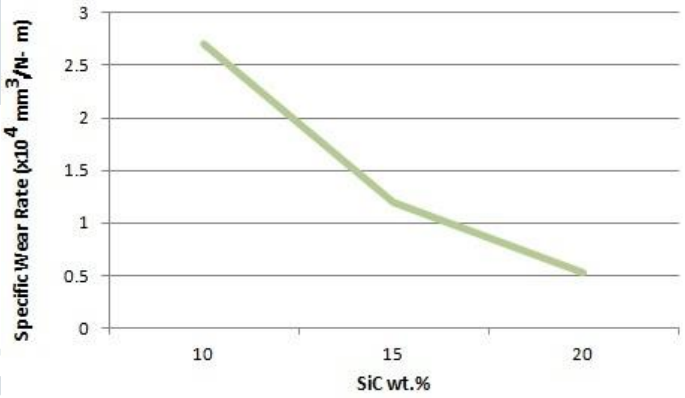

Fig.3 Specific wear rate for Al6061/SiC/Zr hybrid composite with 20N load

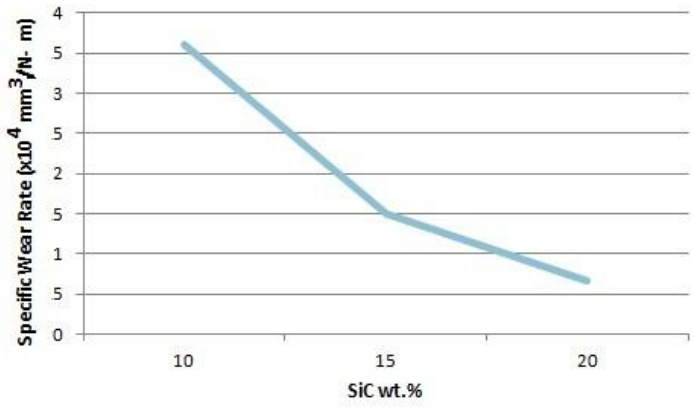

Fig.3 Specific wear rate for Al6061/SiC/Zr hybrid composite with 30N load

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ISSN (Online) 2456-1290

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III. CONCLUSIONS

The Al6061/SiC/Zr composite were produced by keeping 2% of Zr along with varying the reinforcement ration of SiC from 10 to 20% by stir casting technique and wear resistance of the metal matrix composite was evaluated. The wear test was performed by pin on disc wear tester.

Based on the experimental results, it can be concluded that:

- Al6061/SiC/Zr hybrid metal matrix composite was produced successfully.
- The presence of the Zr particles serves as a load bearing elements to improve the wear rate of the composite.
- From the experimental results it was concluded that by varying the SiC reinforcement from 10 to 20% along with 2% of Zr for 10N, 20N and 30N applied loads the wear rate was increased greatly especially in 30N load.

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