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A STUDY ON WEAR BEHAVIOR OF Aa6061-Zrb_2 COMPOSITES BY USING PIN ON DISC

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Abstract— **Aluminum alloy AA6061 reinforced with ZrB_2 particles by stir casting technique. ZrB2 was manufactured by using from K2ZrF6 and KBF4 salts. The reinforcement percentage of ZrB_2 is taken at 9%, 11%, and 13%. The AA6061-ZrB2 composite was manufactured for different stirrer speeds and different furnace temperature. The coefficient of friction of manufactured composite is determined by using Pin on Disc Setup in which the pin is made up of AA6061-ZrB_2 composite.**

Keywords— ***Pin on Disc, Stir Casting*, Coefficient of Friction.**

I. INTRODUCTION

When metals are reinforced with ceramic particles it gives better properties than conventional alloys. Reinforcement material enhances the properties of matrix material such as strength and coefficient of friction with low wear resistance and lightweight. Aluminium Metal Matrix Composites (AMMC) are widely used in the aerospace and automobile industries. AMMC can be manufactured by different methods but in-situ stir casting is the most cost-effective among them.

"Baskaran et. al. (2015) [1] have presented dry sliding friction behavior of TIC reinforced AA7075 in-situ composites. They produced this metal matrix composite by stir casting by using AA7075 alloy, K_2TiF_6 halide salt, and graphite powders as raw materials."

"Kumar et. al. (2015) [2] have studied in situ reaction technique to produce AA5052 reinforced with ZrB2 particles and studied the mechanical properties of the composite. They produce AA5052-ZrB2 composites with different volume percent i.e. 0, 3, 6, 9, and 10 % ZrB2 particles were developed by in-situ reaction of molten AA5052 alloy with two inorganic salts K2ZrF6 and KBF4 at a temperature of 860^0C."

"Ramesh et. al. (2011) [3] have studied the friction and wear behavior of Al 6063-TiB2 in-situ composite. Vicker's microhardness tester is used for hardness tests by applying a load of 100g on a specimen for 10 seconds. Pin on disc apparatus is used to perform dry sliding and wear tests."

"Fakruddinali et. al. (2015) [4] were studied the wear behavior of Al6063-SiC-Gr hybrid composites. This hybrid composite was manufactured by a liquid metallurgy route. They studied the microstructure of composite by using Optical Emission Spectrometer. The wear test of both the matrix alloy and the developed hybrid composites were studied on the standard pin on disc wear test rig using wear-test samples for different loads."

"Kchaou et. al. (2013) [5] have presented different brake friction material characteristics under different loading conditions. Three different tests were conducted by using a pin on the disc setup. They studied the friction behavior of commercial brake pad with brass fiber.

"Suresh et. al. (2017) [6]. have presented wear depth and contact pressure study of Aluminium metal matrix composite in Pin on disk. Tribological properties of composites were studies and analyzed."

II. MANUFACTURING OF COMPOSITE

The AA6061-ZrB2 composite was manufactured by the stir casting technique.

Fig, 1. Stir Casting Furnace

AA6061 has reinforced with Zirconium Diboride with 9%, 11%, and 13% for different furnace temperatures 8250C, 8500C, and 8750C with varying stirrer speed 150, 300, and 450 RPM. By using Taguchi L9 Array in Minitab software following data can be estimated.

Table 1 Experimental Factors

ZrB_2 %	Stirrer Speed (RPM)	Temperature (^{0}C)
9	150	825
9	300	850
9	450	875
11	150	825
11	300	850
11	450	875
13	150	825
13	300	850
13	450	875

In the stir casting technique KBF_4 and K_2ZrF_6 used in the ratio 52:48 to get the required percentage of Zirconium Diboride. The amount of salt poured in the crucible is given in table 1.

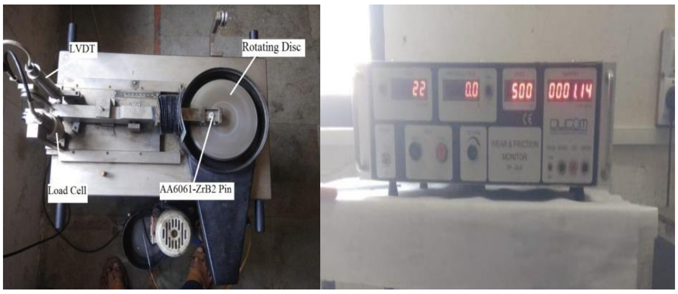
After melting of AA6061, KBF_4 and K_2ZrF_6 salts are poured into the crucible. Then stirrer is immersed into the crucible and its speed is regulated by using variable frequency drive(VFD). VFD has a 1440 rpm speed at 50 Hz frequency. Samples were made for three different stirrer speeds i.e. 150, 300, and 450 RPM. The stirring continues for 10 minutes.

Table 2 Material Weight

Reinfor cement	AA6061 (g)	ZrB_2 (g)	KBF_4 (g)	K_2ZrF_6 (g)
9 %	500	45	117	108
11 %	500	55	143	132
13 %	500	65	169	156

Fig.2. Stirring Mechanism

The hardness test was carried out by using the Brinell hardness tester. Brinell Test methods are carried out in the standards ASTM E10 and ISO 6506 standards.



(a) (b)

Fig.3. (a)DUCOM Pin on Disk Setup (b) Control Unit

The wear test of AA6061-ZrB2 composite was performed by using DUCOM Pin on the disc machine. The cylindrical pin is made up of composite material having a 12 mm diameter and 30mm height while a disc made of EN8 material was used. The results were analyzed by using WINDUCOM 2010 software.

III. RESULTS

The Brinnel hardness test was carried out under 500 Kgf for 30 seconds of dwell. The diameter of the diamond indenter used is 10 mm and the results were plotted by using MINITAB Software

Table 3 Brinnel Hardness Results

ZrB2 %	The diameter of Indentation d (mm)	BHN
0	3.82	41.87
9	3.30	56.85
11	3.15	62.42
13	2.98	70.72

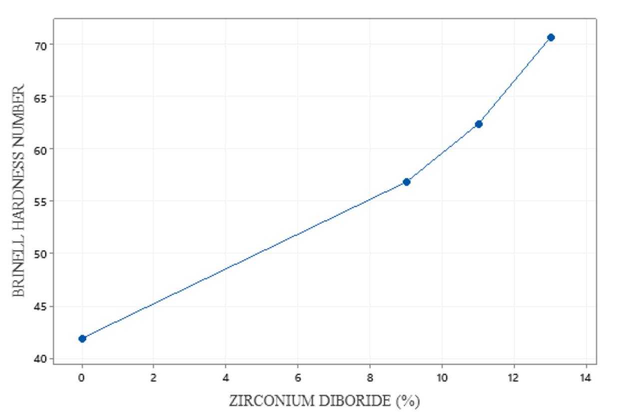


Fig.4. ZrB2 % Vs BHN

The wear test is performed by using DUCOM Pin on Disc Tribometer (TR 20L). The disc is rotated at 500 rpm and 2 Kg load is applied to the pin. The experiment was carried out for 10 minutes.

Table 4 Wear Test Results

ZrB2 %	COF
0	0.43
9	0.57
11	0.58
13	0.61

When we plotted COF vs ZrB2 percentage, we get the following graph.

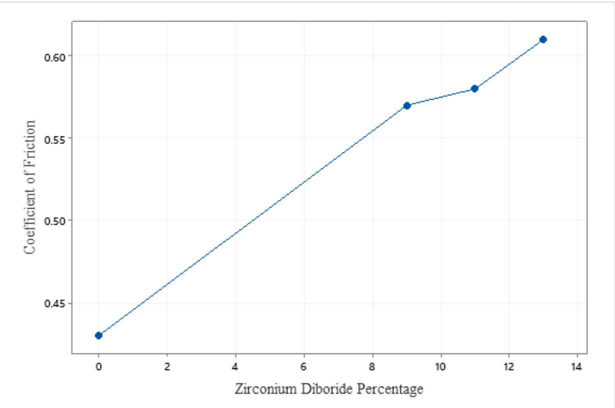


Fig 5 ZrB2 % Vs COF

IV. CONCLUSION

It is observed that manufactured material is more uniform at higher stirrer speed i.e. 450 rpm and high temperature i.e. 8750C. At these conditions, it is observed that there is less formation of slag as compared to lower stirrer speed and lower furnace temperature.

It is observed that the diameter of the indenter is reduced with an increase in the percentage of Zirconium Diboride. So it can be concluded from Brinell Hardness Test that hardness increases with an increase in reinforcement percentage.

Also from the wear test, it is observed that the coefficient of friction also increases with an increase in the percentage of Zirconium Diboride.

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