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Dry Sliding Wear Analysis of Composite Prepared by A Novel Method with Different Furnace Temperature

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Abstract: Particulate reinforced Composites made of aluminum and Silicon Carbide may be considered as suitable replacement for steel in industrial and automotive applications. The high strength and good wear properties makes the composites useful. Magnesium is used to increase the wet properties of Silicon Carbide to mix with aluminum. The furnace temperature effect during the composite manufacturing was studied experimentally to test for wear properties .The manufactured composites in liquid route were tested in DUCOM wear testing machine at sliding speed of 2.5 m/s with load 30N and at different sliding distance in atmospheric conditions . The furnace temperatures are maintained at 700⁰C, 800⁰C and 900⁰C for composite preparations. The samples are tested for wear behavior and specific wear rate was compared for different composites.
Keywords: Plunger technology, composite, hardness, wear test.

I. INTRODUCTION

High strength and light weight material are always required in industrial and structural applications specifically in automobile industries and aerospace uses. Metal matrix composites made of Aluminum as base metal reinforced with Silicon Carbide particulates are very useful in the above mentioned applications[1-2,15-17].There are different route to manufacture the composite but in liquid route with stir casting apparatus is very efficient. To increase the wetting property of Silicon Carbide, Magnesium Powders are added with high recovery in the Aluminum melt. Sliding wear property is very essential for brake shoe material in all automobile sectors [3- 8]. The composites manufactured at different furnace temperature are tested for wear properties in dry conditions with different sliding distance. The Sp. Wear Rate was calculated as per the formula given below to compare the wear property [9-12, 16-17]. In the solid state contact, wear occurs excessively due to high co-efficient of friction .So, high hardness & high strength materials are preferable for brake materials [13-14]. Silicon carbide reinforced with Aluminum as base metal can be very useful for this kind of materials. The manufacturing route in liquid state is highly efficient by modified stir casting method which is also called as Plunger Technique. For suitable industrial application, wear test is conducted in dry sliding conditions and it is compared with different sliding distance [15-17]. The furnace maintenance temperature during composite manufacturing method has great impact on wear property. It has been shown in the graph for impact assessment of furnace temperate and sliding distance.

II. EXPERIMENTAL PROCEDURES

Modify the stir casting technique to produce Al-Mg-SiC composite

1) To test the product for its hardness.
2) To test for dry sliding wear and its effect due to different furnace temperature.

Aluminium-1%Mg-silicon carbide composite was manufactured by plunger technology which has been published elsewhere. Here plunger rods are used to introduce silicon carbide particle to the Al-Mg alloy melt and the composites are manufactured as per required composition. The furnace temperature has great influence on hardness and wear properties. Sliding wear is conducted in dry condition using Pin-On–Disc method where pin is the sample. The instrument used is DUCOM-WEAR TEST apparatus as shown in Figure-i and Figure-ii. The pin (sample) and disk (EN31 steel) was cleaned by Emory paper so that smooth contact will take place between pin and disk. The test was conducted using the standard ASTM G-99 at room temperature.

The mass loss of the sample made of prepared composite is calculated by measuring the initial mass and final mass using the weight balance. The sp. wire rate is calculated using the formula-1.

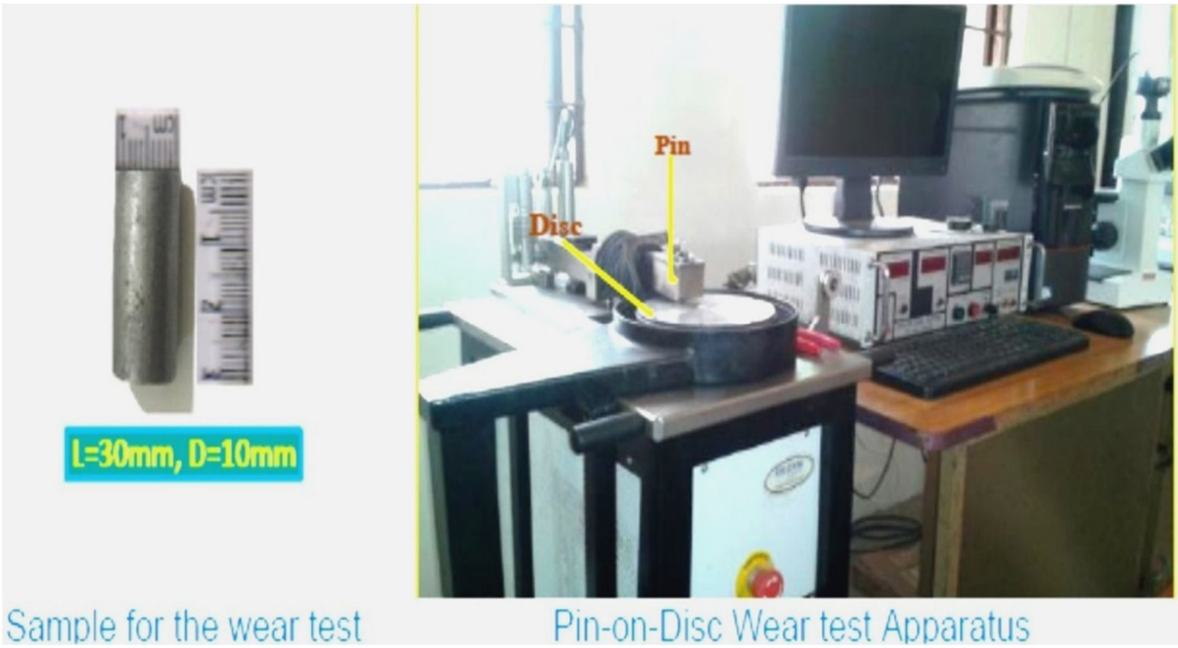

Fig. 1: Sample and dry-sliding-wear-test apparatus for wear-test.

Samples of size length 30mm and diameter 10mm was fitted as pin and EN31 steel was taken as disc. The dry sliding wire test was conducted at sliding velocity 2m/s and load 20N for different sliding distance such as 500m, 700m, 900m, 1100m, 1300m, 1500m. The wire rate was calculated as follows.

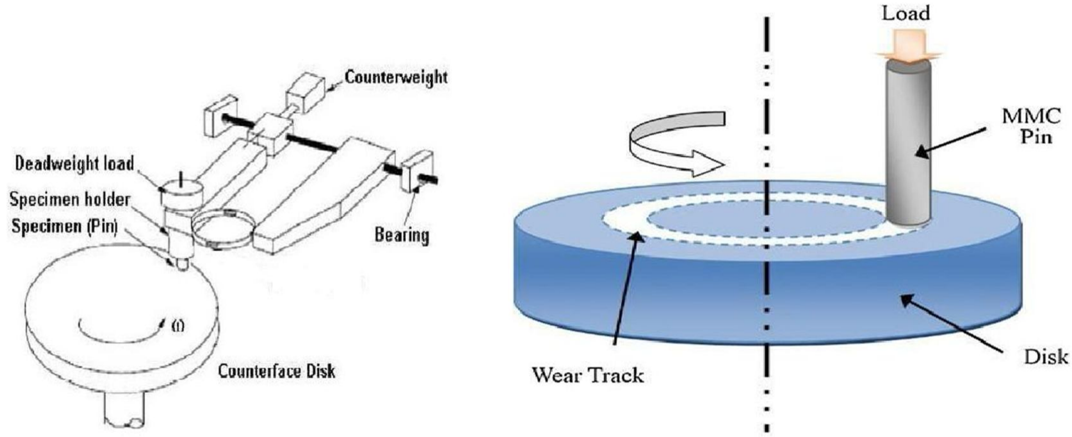

Fig. 2: Spin-on-disk apparatus schematic diagram

III. RESULT & DISCUSSION

The Sp. Wear Rate (SW_r) of materials were calculated by

$$SWr = \frac{\Delta w}{FL\,\rho} \quad \text{In mm}^3/\text{mN} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Δw= Weight loss of the pin (AMMC) in mg

L= Sliding distance in meter

ρ = Density of the AMMC in mg/mm^3

F= Load in N

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TABLE-1: AT 700°C, Velocity 2.5m/s and Load 30N

Exp no	Sliding distance (m)	Specific Wear rate [mm^3/mN (× 10^{-3})]
1	300	0.09317
2	600	0.08126
3	900	0.01501
4	1200	0.06231
5	1500	0.04912

TABLE-2: AT 800°C, Velocity 2.5m/s and Load 30N

Exp no	Sliding distance (m)	Specific Wear rate [mm^3/mN (× 10^{-3})]
1	300	0.08672
2	600	0.07136
3	900	0.06212
4	1200	0.05427
5	1500	0.04316

TABLE-3: AT 900°C, Velocity 2.5m/s and Load 30N

Exp no	Sliding distance (m)	Specific Wear rate [mm3/mN (× 10–3)]
1	300	0.09816
2	600	0.08632
3	900	0.07135
4	1200	0.06246
5	1500	0.05891

Figure-III: Variation Sp. Wear Rate at different sliding distance and at different furnace temperature

IV. CONCLUSION

A. Aluminum 1% magnesium and 10% SiC COMPOSITE was made successfully using plunger technique.
B. The composite is manufactured at different temperature (i.e. 700^0C, 800^0C and 900^0C) and dry sliding wear test was conducted which is very useful in Automobile sector.
C. The Sp. Wear Rate is measured and compare with different composite manufactured.
D. The Sp. Wear Rate of the composite manufactured at 800^0C is much less than the composite manufactured at 700^0C and 900^0C. Automobile sector may use this result for future applications.

V. ACKNOWLEDGEMENT

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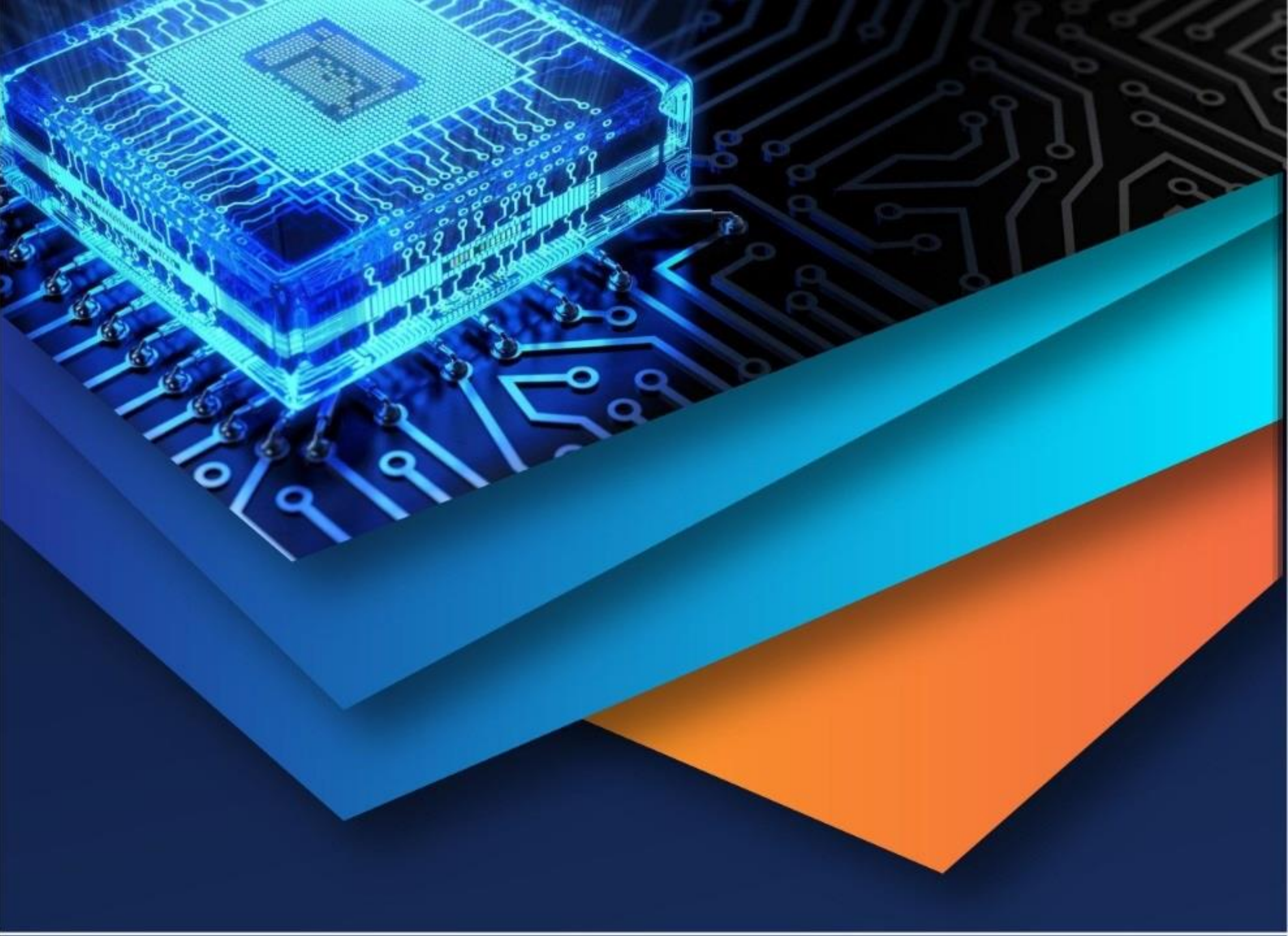

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