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Experimental Investigation of Sliding Wear And Tensile Behavior Of Al27 Reinforced With SiCp And Graphite Hybrid Metal Matrix Composite

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***ABSTARCT* – In recently automotive industries are attracting toward the use of aluminum and silicon carbide metal matrix composite due to the metal matrix composite we found at very good characteristic such as high strength to weight ratio good thermal conductivity corrosion resistance and best tensile strength.**

In this paper dry sliding wear behavior and tensile test of Al-27 base alloy composite reinforce with sicp (5 to 10), gr (3 to 9), mg (1to3) and mos_2 (1%)according to weight % fabricated by powder metallurgy. wear test conduct by using pin on dish (TR20PHM400) apparatus and taguchi technique was used to estimate the parameter affecting the wear significantly and compare with pure Al -27 pin of alloy is prepared in size of diameter 8 mm and length 30 mm as per ASTM: G99-05(2010). The testing is done on above material by varying load, speed and sliding distance at high temperature after conducting the test it was observe that wear rate varies linearly with normal load compared to base material. it was found from experimentation that the wear rate decrease with the increase in % of sicp. the result has been obtained at 10% weight fraction. same as when we conducting the tensile test of above composite the we found that the tensile strength of the aluminum silicon carbide metal matrix composite increase gradually as increase the % of sicp.

Keywords—design of expert (DOE),Sliding distance(sd).

I. INTRODUCTION

Life of the machine component is an important design consideration, various of parameter affect the life of bearing and selection of bearing material, the choice of material varies according to application and different variable like cost density and operating condition. The principal attraction for the use of MMCs in the automotive industry can be summarized as follow: reduction in mass, especially in engine part, improved wear resistance or lubrication characteristic, improved material properties, partially stiffness and strength, providing either increased component durability or permitting more extreme severe condition reduced thermal expansion coefficient.[3]

The journal bearing in water feed pump by using in boiler operating this will result in higher operating temp with increase in wear and lead to replacement of bearing in pump hence wear is one of the most important parameter to improve the life of bearing. so the concentration on development of hybrid reinforced composite material that can improve the property of bearing or wear rate. Additional reinforcement in al-27, so improvement in tribological properties as well as mechanical property in bearing or component. AL-27 alloy is competitive bearing alloy used for high temperature at (60 to 80^0 C), it shows that improvement in both mechanical and tribologoical properties compare with plane Al-27.

The composite specimen is prepared by powder metallurgy method with the help of ball mill and hot extrusion process, with the help of ball mill the mixture of composite is properly mixed with the % in material reinforcing with sicp in base material to improve wear resistance as well as hardness of the composite material the particle remove out and fracture the mechanism observed for small and longer reinforcement size.

The three variable parameter are consider when conducting test on pin on disc[5]

1. Load
2. Sliding Distance
3. Sliding Speed

II. LITERATURE REVIEW

S.C. Sharma, B.M. Satish, B.M. Girish, D.R. Somashekar [8] studied tribological properties of metal matrix composite in which silicon carbide particles were reinforced in copper.

The above literature review we conclude or state that when we add the SICP in AL27 for journal Bering tribological property increase but mechanical property are decrees (S.C.Sharma) SEM images of worn surfaces reveal that the HT helps in reducing the cracking tendency of the sample and leads to form a stable lubricating layer Wear volume loss increased with an increase in the applied load, sliding speed and sliding distance. On the contrary, wear resistance improved with the increase in aging duration and Sicp with Gr content. (T.S.Kiran)and t.s.kiran use as Taguchi techniques for optimization.

III. PROBLEM STATEMENT

The sliding and rotating components intended to work in lubricating conditions may eventually end up working in semi-lubricated or dry conditions. This will result in higher operating temperature with increase in wear and lead to quicker replacement of components. Hence, wear is one of the major problems that need to be tackled in order to improve the life of the component.

IV. OBJECTIVES

The main aim of this project was to check feasibility of the Aluminum based silicon carbide metal matrix composite for vehicle braking pad. The main objectives of this project are listed below:

To get information and do comparative study about friction and wear behavior of journal bearing, Al cast alloy and Al cast alloy-Sicp (5 to10%) metal matrix composite as pin materials against grey cast iron as disc material having chemical composition similar to that of brake disc of actual journal bearing on pin on disc apparatus

To conduct wear test of pin materials by varying normal load, sliding velocity and know the results
To study effect of temperature on wear, coefficient of friction for pin materials

To carry out Scanning Electron Microscopy of pin samples

V. DESIGN OF EXPERIMENTS

When we start a new project or research work it is necessary to first decide a path or to make a prototype model of experiment. it is necessary experiment have to be conducted in proper sequence with it is different steps so that your process performance is easy to understand some important level on steps are considered and varied in a strategic manner the data can be acquired in an orderly way by DOE based on taguchi techniques.[4]
Taguchi techniques are classified into three main stages.
1. Planning phase.
2. Conducting phase.
3. Analysis phase.
above three phases planning phase is important where the factors and levels are decides the result obtained from experiment are analyzed or compare for better understanding.

III. Experimental Procedure

A) Specimen preparation and wear test

First we select the al-27 as base material and reinforce with sicp (5 to 10 % wt.) in three step (5, 10, 15) in 45 µm and gr (3 ,6 ,9) % wt with 25 µm in size. the composite specimen was prepared by powder metallurgy by using a ball mill Which has 32 ball with the dry sliding wear behavior of specimen were evaluated with pin on disc apparatus at 60 to 80^0 C temperature.

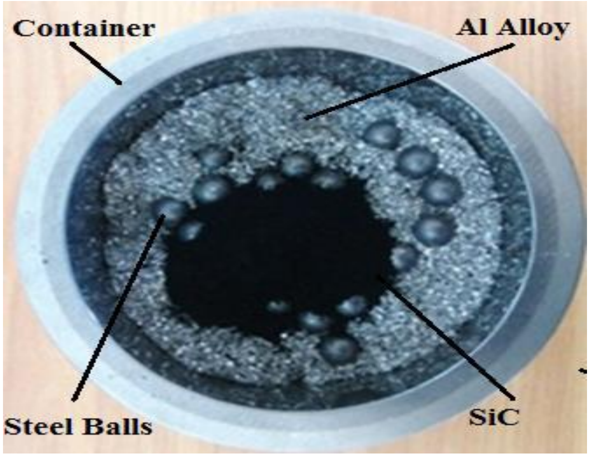

Fig 1 Ball milling set up

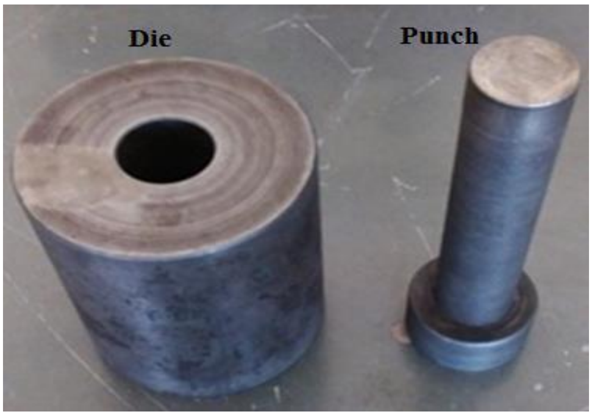

Fig 2: Compaction die set up

B) Hot Extrusion

After compaction to improve the bonding and strength the samples were soaked at temperature of 580oC for 2 hours and hot extrusion was done. After extrusion the sample length was increased from 30 mm to 70 mm while, diameter was decreased from 30 mm to 20 mm as shown in Figure

Fig 3: Final Specimen of Composite after machining

3.2 Plan of Experiments

Dry sliding wear test is conducted on pin on disc and the base alloy and composite specimen compare with three different parameter applied load, sliding speed, sliding distance, the experiment were planned based on standard L27 orthogonal array.

Table1

Level	Load(N)	Sliding Distance(D)	Sliding speed
1	20	1000	0.60
2	50	3000	1.90
3	80	5000	3.50

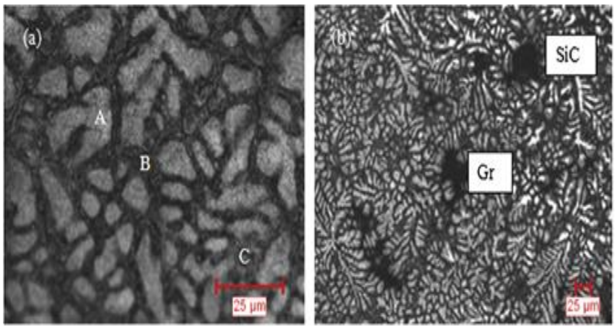

Fig 5: Microstructure of metal matrix Composite

Fig 6: Pin on Disc Apparatus (TR20PHM400)

IV. Result and Discussion

Test	Load (N)	Distance (m)	Speed (m/s)	Wear volume loss in mm3			
				Alloy		Composite	
				Experimental	Calculated	Experimental	Calculated
1	15	1000	0.63	1.4	.93	0.5	0.48
2	15	1000	1.88	1.6	1.29	0.8	0.77
3	15	1000	3.14	2.2	1.66	1.2	1.07
4	15	3000	0.63	1.5	1.57	0.7	0.60
5	15	3000	1.88	2.4	2.21	1.0	0.98
6	15	3000	3.14	3.2	2.84	1.6	1.36
7	15	5000	0.63	2.5	2.22	0.9	0.73
8	15	5000	1.88	3.3	3.12	1.2	1.9
9	15	5000	3.14	4.6	4.03	1.8	1.65
10	45	1000	0.63	1.7	2.08	0.9	0.96
11	45	1000	1.88	2.3	2.6	1.1	1.38
12	45	1000	3.14	2.7	3.65	1.5	1.80
13	45	3000	0.63	2.7	3.03	1.4	1.32
14	45	3000	1.88	2.7	4.08	1.7	1.82
15	45	3000	3.14	4.1	5.15	2.1	2.33
16	45	5000	0.63	3.8	3.98	1.3	1.69
17	45	5000	1.88	4.6	5.29	1.9	2.27
18	45	5000	3.14	6.1	6.62	2.6	2.86
19	75	1000	0.63	3.5	3.23	1.5	1.43
20	75	1000	1.88	4.6	4.43	2.1	1.98
21	75	1000	3.14	6.5	5.64	2.8	2.53
22	75	3000	0.63	.7	4.48	1.9	2.04
23	75	3000	1.88	5.9	5.98	2.6	.67
24	75	3000	3.14	7.7	7.42	3.2	.30
25	75	5000	0.6	5.9	5.73	2.7	2.65
26	75	5000	1.88	7.9	7.46	3.8	3.36
27	75	5000	3.14	9.5	9.21	4.1	4.06

V. Conclusion

Flexible multi-body engine valve train dynamic analysis is carried out to predict engine speed at which the valve train components lose their contacts and optimized the valve spring design. In order to capture the dynamic behavior of the valve train system closely, each coil of the nested valve springs is modeled as separate flexible body and the contacts between coils of these flexible bodies are also established. An iterative logic is used to optimize the valve spring parameters by imposing constraint on the space availability, stress limit and natural frequency of the system. A comparative valve train dynamics analysis is also carried out with the existing and optimized valve spring combinations. The comparative study reveals that the proposed optimized valve spring configuration works properly even beyond the engine speed of 5000 rpm where the valve train component separation will be observed in case of existing valve spring combination. The effective working engine speed of the valve train with the optimized valve spring should be 5000 rpm which will be approximately 20% increase when compared to the valve jump speed with the existing spring configuration.

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