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EVALUATION OF SLIDING WEAR BEHAVIOUR OF AL 6082 AND BRASS 247 METAL MATRIX REINFORCING SIC COMPOSITES

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ABSTRACT

This paper investigates comparing the sliding wear behaviour of Aluminium 6082 and Brass 247 metal matrix composites reinforcing Silicon carbide fabricated by stir casting method. In this paper comparing sliding wear performances on the Al 6082 and Brass 247 Metal matrix reinforcing silicon carbide by pin on disc method. Different loads, sliding speeds, constant load, constant sliding speed and varying wear rate. Three different specimens of Al 6082 and Brass 247 SiC MMCs have been conducted pin-on disc wear tester apparatus, wear rates are calculated. Al 6082/SiC used in brake pad system. Commercially available brake pads were used as the pin material. SEM used to characterize the Al 6082/SiC materials before the Wear test.

Keywords*: Sliding wear, Al 6082, Brass, SiC reinforcement.*

1. Introduction

Metal-matrix composites (MMCs) are finding increasing application in many of today's industries. In particular, the high specific strength and stiffness of Aluminium 6082 based MMCs have recommended their use in many aerospace and automotive components. Wear –resistant ceramic-reinforced Aluminium 6082 metal matrix composites have also been used in tribological applications such as brake rotors, piston rings and cylinder liners in automobiles. However, the relentless attempt by the aerospace and automotive sectors to push performance limits invariably confronts the crucial issue of weight reduction.

Brass is a metal alloy made of copper and zinc.it is a substitution alloy atoms of the two constituents may replace each other with in same crystal structure.

2. EXPERIMENTAL SETUP

- Clamping the crucible
- Mold gap is arrested by binder mixture.
- Preheating the silicon carbide particle at 650°C and 450°C in heating furnace.
- Preheating the mold in hot air oven up to 2hr.
- Preheating the crucible in stir casting furnace at 850°C.

3. PREHEATING SILICON CARBIDE

During processing of SiC particle reinforced aluminium matrix composites, the particles are preheated at 450-650°C for 2 hr in order to remove the volatile substances and to maintain the particle temperature closer to melt temperature of 750°C.also in SiC particles preheating leads to the artificial oxidation of the particle surface forming SiO_2 layer. This SiO_2 layer helps in improving the wettability of the particles.

4. STIR CASTING PROCEDURE

The Aluminium chips were charged in to the furnace and melting was allowed to progress until a uniform temperature of 750°C was attained, subsequently degassed by passing hexachlorophene (C_2C_{l6}) solid degasser.

The melt was then allowed to cool to 600°C to a semi-solid state. At this stage the silicon carbide mixture was added to the melt and manual stirring of the slurry was performed for 20 minutes. The stirring operation was performed for 10 minutes at an average stirring rate of 400 rpm. casting was then performed n prepared sand moulds at a pouring temperature of 720°C.after effective degassing the molten metal was then poured into permanent moulds for casting.

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Fig 1. Al 6082/SiC molten metal poured in to the mould

Fig.2 Brass 247/SiC molten metal poured to mould.

The brass 247 were charged in to the furnace and melting was allowed to progress until a uniform temperature of 850°C was attained, subsequently degassed. The melt was then allowed to cool to 600°C to a semi-solid state. At this stage the silicon carbide mixture was added to the melt and manual stirring of the slurry was performed for 20 minutes. The stirring operation was performed for 10 minutes at an average stirring rate of 400 rpm. casting was then performed n prepared sand moulds at a pouring temperature of 720°C.after effective degassing the molten metal was then poured into permanent moulds for casting.

By following above casting procedures finally got Aluminum ingot and brass ingot. These ingot is subjected to machining process.it is cut in to small pieces with the help of wire cutting machine and centre lathe having four way jaws.

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1. Tensile test
2. Impact test
3. SEM test

Fig.3 Aluminum ingot is prepared

Fig.4 Brass 247 ingot prepared

Table 1.Comparing tensile test report Before reinforcing SiC

Properties	Value
Ultimate Tensile Strength	120 TO 330 MPa
Yield Strength	90 TO 280 MPa

Table 2. After reinforcing SiC

Specimen	*Peak Load KN*	*UTS* MPa	*Yield Strength* MPa	*% Of Elongation %*
1	3.635	129	110	9
2	1.425	50	40	3
3	3.24	115	90	7

$$\text{Area} = \pi/4\,(d)^2$$

$$= \pi/4(6)^2$$

$$=28.286\ mm^2$$

5. IMPACT TEST

The charpy impact test also known as impact test as the charpy v-notch test is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture.

Before reinforcing SiC

Energy absorbed in charpy test=10.3 J

After reinforcing SiC

Energy released for 1st specimen=7 J

Energy released for 2nd specimen=8 J

Fig.5 Wear test specimen Al 6082/SiC

Fig.6 Wear test specimen Brass 247/SiC

6. PIN ON DISC APPARATUS

Fig.7 Pin on disc apparatus

Pin on disc wear test two specimens are required.one a pin with a radioed tip, is positioned perpendicular to the other, usually a flat circular disc, a ball rigidly held is often used as the pin specimen. The test machine cause either the disc specimen or pin specimen to revolve about the disc center.in either case the sliding path is a circle on the disc surface. The plane of the disc may be oriented either horizontally or vertically.

6.1 Disc specifications

Disc made up of EN32 metal. The diameter of the disc is 55 mm and thickness is 10 mm and disc hardened value is 54 RC.in this experiment disc is rotating speed of 200,300,400,500 rpm with a load of 10N, 20N, 30N and 40N.

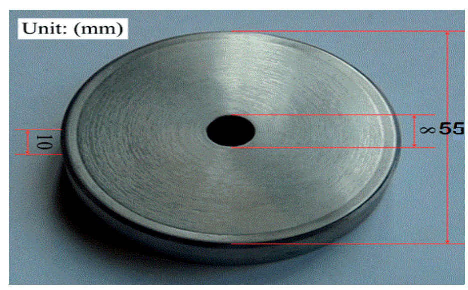

Fig.8 disc image

Table 3. Al 6082/SiC wear rate report in µm Constant load=4kg; N=500 rpm; time=15 min

NO	1 ST	2ND	3RD	4TH
Wear rate	32	17	29	2

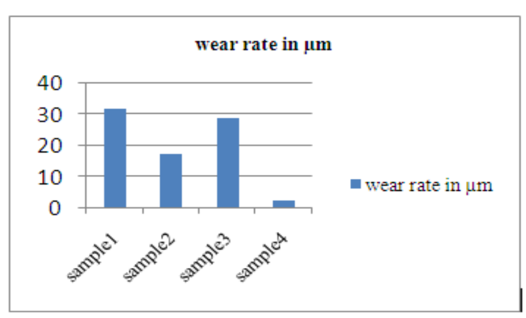

Fig.9 Al 6082/SiC chart

Table.4 brass 247/SiC wear rate report in µm
Constant load=4kg; N=500 rpm; time=15 min

NO	1 ST	2ND	3RD	4TH
wear rate	183	189	181	192

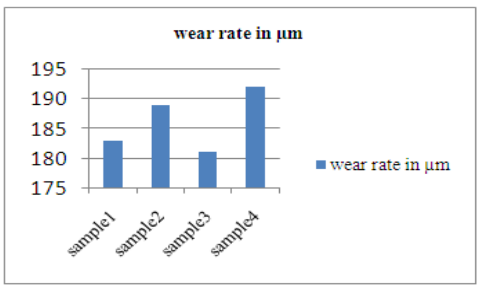

Fig.10 BRASS 247/SiC CHART

Sliding speed =2πN/60
=2*3.14*500/60
=52.33 m/s
Sliding distance =πD* no of revolutions
=3.14*0.02m*500/60
=0.52 m

Fig.11 Constant load vs. wear rate

Table 5. Wear rate report for Aluminum and brass

Specimens	1	2	3	4
Load in N	40	40	40	40
Speed in RPM	500	500	500	500
Time in Sec	900	900	900	900
Wear Rate for Al in mm	32	17	29	2
Wear Rate for Brass in mm	183	189	181	192

Table 6.wear rate report for Aluminum and brass

Specimens	1	2	3	4
Load in N	10	20	30	40
Speed in RPM	200	300	400	500
Time in Sec	900	900	900	900
Wear Rate for Al in mm	11	15.5	13	29
Wear Rate for Brass in mm	25	68	130	181

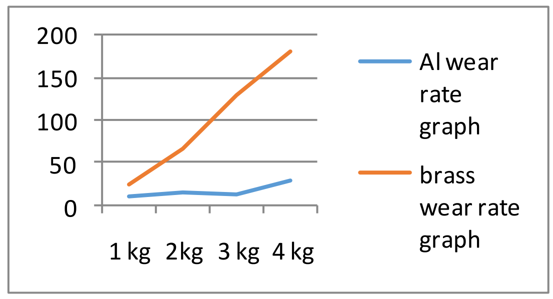

Fig 12.Varying load vs. Wear rate

7. CONCLUSION

Comparing wear behavior of Al 6082 and Brass 247 metal matrix composites reinforcing sic concluded that wear rate is low for Aluminum 6082/Sic with constant load of 40N, sliding speed of 52.33m/s; sliding distance 0.52m is achieved. Wear rate is high for brass 247 reinforcing SiC, Wear test mostly used in hydraulic brake system components. Mechanical properties are changed by reinforcing Sic to Al 6082.

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