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Study on Wear and Friction Characteristics of Brake Rotor made of A359- B_4C_P Composites

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Abstract: Brake technology is just like suspension & fuel system technology has come a long way in recent years. The Automobile braking systems normally use brake discs, which are paired with composite organic brake pads.These materials are suitable for use in braking systems with moderate loads, but vehicle manufacturers are disposed to design vehicles with more braking power. A history of high operating costs for on - highway vehicles and for aircrafts has encouraged designs for weight reduction with long service of braking systems. Redesigning of the braking system by swap of lighter material like aluminium and carbon composite brakes primarily have been responsible for brake discs, which are being used in aircrafts and formula one racing cars and two wheeler bikes .The requirements of the materials are light weight, high strength, abrasion resistance and corrosion resistance. Composite materials provide such unique combination of properties. In my study the alternate materials for automobile brake disc applications with special consideration to Aluminium and Boron carbide MMC .The mechanical properties were determined as per ASTM standards and compared the results. The wear and friction behavior were determined using pin on disc apparatus. The wear resistance of the composites increased with increasing content of B_4C particles, and the wear rate was significantly less for the composite material compared to the cast iron. The coefficient of friction decreased with increased B_4C content and reached its minimum at 20 Wt. percentage of B_4C.

Keywords: Metal matrix composite, Wear, Stir casting, B_4C particles.

1.0 Introduction and Experimental Procedure

Metal matrix composites have many potential applications, as the unique property combinations that can be achieved (1, 2). Metal matrix composites (MMCs) have been developed to respond to the demand for materials with high specific strength, stiffness, and wear resistance (3). Aluminium is preferred as a matrix material in MMCs because of its low density, good engineering property, and easy fabricability. The fabrication of MMCs can be achieved by the accumulation of reinforcement phase to the matrix. Proper methods are powder metallurgy (4), spray atomization and co-deposition (5, 6), plasma spraying (7, 8), stir casting and squeeze casting (9). B_4C is an attractive reinforcement material because of its good chemical and thermal stability. B_4C has lower density and higher hardness compared to Al_2O_3 and SiC (10). Al–B4C composites can be processed by low cost casting routes (11, 12). The controlling of the interface of the Al–B_4C is also important in the production of sand cast brake rotor made of A359–B_4C composites manufactured by using a low-cost stir casting technique. The influence of load range of 10–80N and speed range of 4.7124 m/**s** on the tribological behaviour of MMC brake rotor material was investigated.

In this experiment, a commercial grade aluminium alloy Al 359 was used as the matrix material, with B_4C particles as the reinforcement. The aluminium MMC were manufactured with 5, 10, 15, 20 and 25 Vol% B_4C particles were used as the reinforcement. The chemical composition of Al 359 was shown in Table 1.

Table 1: Chemical composition of AA 359.

Alloy	Si	Cu	Mg	Mn	Zn	Ti	Fe	Al
A359	8.5- 9.5	0.20	0.5-0.7	0.10	0.10	0.20	0.2	remaining

The hardness tests were carried out according to ASTM E10-00 standards using Brinell hardness testing machine with a 2.5 mm ball indenter and 10 kg load. The test was conducted at room temperature and the measurement of hardness was taken at different places on each sample to obtain an average value of hardness. The wear behaviour of the samples was investigated using a pin on-disc wear test machine. The pin test sample dimensions were 10 mm diameter and 30 mm height.

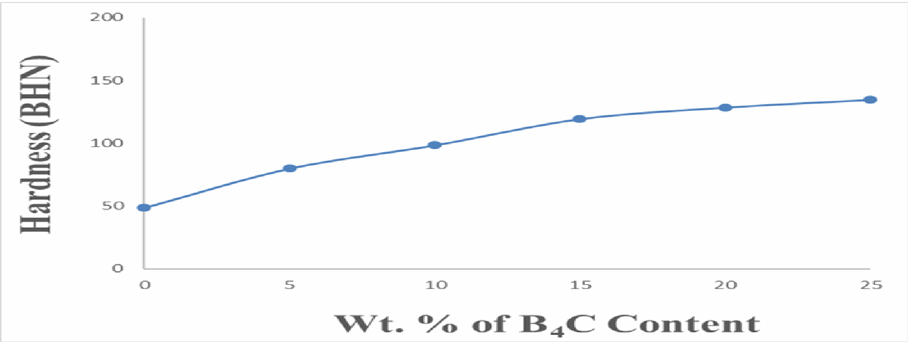

Fig. 1. Variation of hardness with varying content of the B_4C.

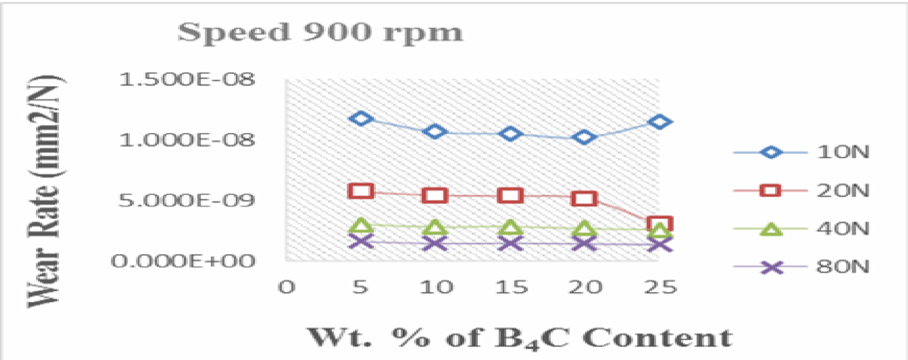

Fig. 2. Wear rate with varying B_4C content.

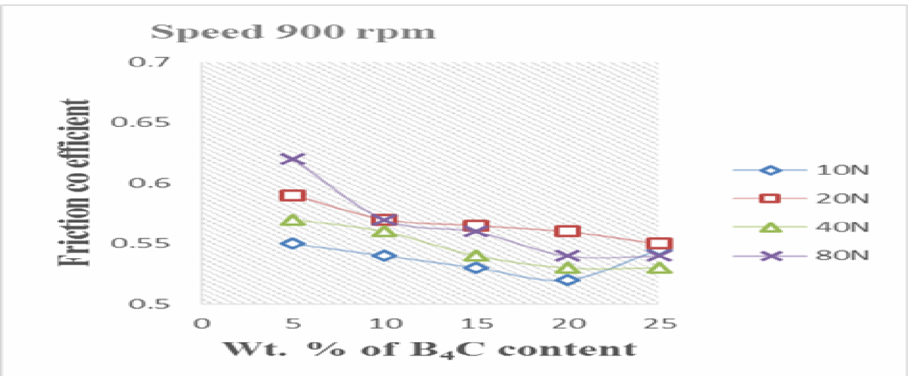

Fig. 3. Friction co efficient with varying B_4C content

2.0 Results and Discussion

The results of the hardness tests of the Al–B_4C composites and base alloy are presented in Fig. 1. The hardness values of 5, 10, 15, 20 and 25 Wt.% B_4C are markedly higher than that of the base alloy. The increased strain energy the hardness of the composites is increased at the peripheral of the particles dispersed in the matrix (13).

Fig. 2 shows the wear rate of the composites for varying wt.% of the B_4C. The wear rate decreases with increasing wt.% of B_4C and touches a minimum at 20 wt.% B_4C. It is observed from the above that the wear behavior of the Al 359/B_4C composites is significantly improved with reinforcement of B_4C particles, and the wear rate decreases with increasing wt.% of B_4C. Due to the increasing volume fraction of the B_4C particles the matrix area in contact with the mating surface was decreased. The unreinforced aluminium alloy was softer than the B_4C reinforced composites. Fig.3 Shows the coefficient of friction decreases on increasing the B_4C particle content, and reaches a minimum of 0.53 at 20 Wt.% B_4C.

3.0 References

1. Modi OP, Prasad BK,Yegnewaran AH,Vaidya ML.,Dry sliding wear behavior of squeeze cast aluminium alloy –silicon carbide composites.,Mater Sci Eng A, 1992,151:235–44.
2. ZhangZ,Zhang J,Mai Y.,Wear behavior of SiCp/Al–Si composites,Wear,1994,176:231–7.
3. Toptan F, Kilicarslan A, Kertil I.The effect of Ti addition on the properties of Al–B4C interface: a microstructural study, Mater Sci Forum, 2010, 636–637,192–7.
4. Bhanu Prasad VV, Prasad KS, Kuruvilla AK, Pandey AB, Bhat BVR, Mahajan YR. Composite strengthening in 6061 and Al–4 Mg alloys,J Mater Sci, 1991,26(2):460–6.
5. Wu Y, Lavernia EJ. Proc. Conf., advancements in synthesis and processes, Toronto, 20-22 October 1992., Toronto: Society for Advancement of Material and Process Engineering; 1992.
6. Srivatsan TS, Lavernia EJ. , Use of spray techniques to synthesize particulate reinforced metal-matrix composites, J Mater Sci , 1992, 27(22), 5965–81.
7. Tiwari R, Herman H, Sampath S, Gudmundsson B., Plasma spray consolidation of high temperature composites., Mater Sci Eng A, 1991,144(1–2),127–31.
8. Berndt CC, Yi JH. , Mater Sci , 1988, 34–36:469.
9. Mortensen A, Jin I. , Solidification processing of metal matrix composites, Int mater Rev 1992, 37(28), 101–28.
10. Aizenshtein M, Froumin N, Shapiro-Tsoref E, Dariel MP, Frage N. ,Wetting and interface phenomena in the B4C/(Cu–B–Si) system, Scripta Mater, 2005, 53, 1231–5.
11. Kerti I, Toptan F. Microstructural variations in cast B4C-reinforced aluminium matrix composites (AMCs), Mater Lett, 2008, 62, 1215–8.
12. Zhang Z, Chen X-G, Charette A. Particle distribution and interfacial reactions of Al–7%Si–10% B4C die casting composite, J Mater Sci, 2007, 42, 7354–62.
13. Kalaiselvan K, Murugan N, Parameswaran Siva., Production and characterization of AA6061–B4C stir cast composite, Mater Des, 2011, 32, 4004–9.

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