International Journal of Engineering Research and Advanced Technology (IJERAT)

E-ISSN : 2454-6135

DOI: http://dx.doi.org/10.7324/IJERAT.2018.3184

Volume.4, Issue 2

February-2018

Wear Behaviour of Aluminium LM13 –MgO Particulate Metal Matrix Composites

C S Ravindra Sagar[1], T. K Chandrashekar[2] and Batluri Tilak Chandra[3]

Research scholar[1, 3],

Department of Mechanical Engineering,

Sri Siddhartha Institute of Technology,

Tumkur-572105, Karnataka, India.

Professor[2],

Department of Mechanical Engineering,

Mangalore Institute of Technology,

Moodabidre, Mangalore- 574225, Karnataka, India

ABSTRACT

Aluminum MMC's are getting to be plainly potential material offering phenomenal mix of properties, for example, high specific stiffness, thermal conductivities, low coefficient of heat development and wear protection. As a result of their superb blend of properties, AMMC's are being utilized as a part of assortments of utilizations in automobile vehicle, aviation and other related segments. In the present examination, Al LM13-MgO composites were created by Vortex technique by differing weight level of support from 0 wt.% to 10 wt.% in ventures of 2. The pin on disk wear tests were directed to analyze the wear conduct of the aluminum LM13 and its composites. T6 heat treatment studied. The outcome uncovers that wear rates of the composite. The wear rate is more in As-Cast LM13/MgO compared to heat treated condition. The consolidation of MgO as support particles in aluminum LM13 composite enhances the Tribological physical characteristics.

KEY WORDS: *Al LM13, Wear Rate, MgO, Pin-on-Disc test rig.*

1. INTRODUCTION

Aluminum is generally utilized as a part of vehicle in automobile, aviation and mineral handling applications, on account of their fantastic properties like low density and thermal conductivity. Aluminum combinations have been utilized as MMC's from its wide applications in mechanical area. To expand the mechanical and Tribological properties, hard support stages, for example, particulate, fiber are consistently appropriated. These materials have developed as the essential class of cutting edge materials giving specialists the chance to tailor the material properties as per their requirements. Basically these materials contrast from the ordinary building materials from the perspective of homogeneity.[1] Aluminum MMC's which are having attractive properties, which incorporate low density, high specific quality, controlled co productive of Heat extension, expanded weariness protection [2]. These materials have developed as the imperative class of cutting edge materials giving specialists the chance to tailor the material properties as indicated by their necessities. The mechanical and Tribological properties of the MMC's was enhanced by strengthening the different reinforcement extending from delicate materials like Graphite to high solidified particulates like SiCp, Al2O3 and so on., [3] as of late, particulate reinforcement aluminum composites manufactured have indicated critical change in Tribological properties,

including sliding wear, and seizure protection [4-5]. The mechanical and physical variables have been recognized as sliding speed and load though the material elements are volume division, kind of reinforcement and size of support. The volume part of reinforcement has the most grounded impact on the wear protection and has been considered by numerous specialists [6-9]. Numerous looks into have been done to expand the wear protection of MMC's by various kinds of reinforcement. The fundamental result of these is that the support enhances the protection from wear [10-11]. Be that as it may, the examination takes a shot at the dry sliding wear of aluminum LM13 alloy containing MgO particles were constrained. Accordingly in the present examination an endeavor is made to think about the dry sliding wear conduct of AlLM13/MgO particulate composites for various weight rates of MgO particles.

2. EXPERIMENTAL PROCEDURE

2.1 Development of Composites

Aluminium LM13 as matrix and MgO as reinforcement the chemical composition are as shown in Tables 1.

Table1.1. Chemical Composition of LM13 alloy

Si	Mg	Cu	Fe	Ti	Cr	Ni	Mn	Al
12.1	1.2	0.8	0.8	0..02	0.07	0.9	0.2	Bal.

Magnesium oxide used as a reinforcement material. It is white fine powder form & hygroscopic in nature.

Table 1.2: Chemical composition of reinforcement MgO

Appearance	White Powder
Solubility	Partly soluble in water
Molecular formula	MgO
Molecular weight	40.30
Density	3.70 g/cc
Melting Point	2800°C

In this investigation the matrix Al LM13 addition of particulates MgO with different wt.% (2 wt.% to 10 wt.% in steps of 2). In stir casting process the development of LM13 is heated to a temperature of 700° C to 800° C in a graphite crucible, then particulates MgO is pre heated to the temperature of 400° C and thoroughly stirred at a speed of 550 rpm at duration of 10 to 15 min. The ready mixed composite is poured to a pre heated cast iron die till it solidifies. The unreinforced and reinforced composite are studied for microstructure analysis and hardness test.

2.2 Heat Treatment

The obtained material is solutionized at 530° C for a period of 2 hours in muffle furnace and quenched in ice l and followed by artificial ageing at 164° C at duration 6 hours.

2.3 Hardness Test

The Brinell hardness tests were done according to ASTM-E10-95 standard. The specimen diameter is 20 mm, the testing specimens is cleaned in various emery papers and the tests were conducted in 3 distinct areas on the hardness round specimens both for as cast and heat treated Al LM13/MgO composite material.

3. RESULTS AND DISCUSSION

3.1 Microstructure analysis

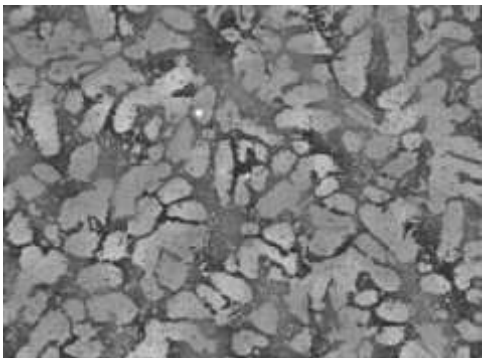

Figure3.1 Micrograph of Al (LM13)/0wt% of MgO

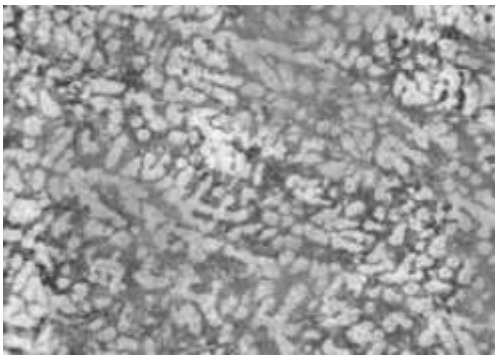

Figure3.2 Micrograph of Al (LM13)/ 2wt% of MgO

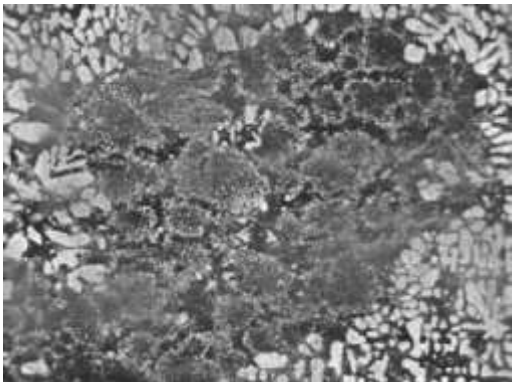

Figure3.3 Micrograph of Al (LM13)/ 4wt% of MgO

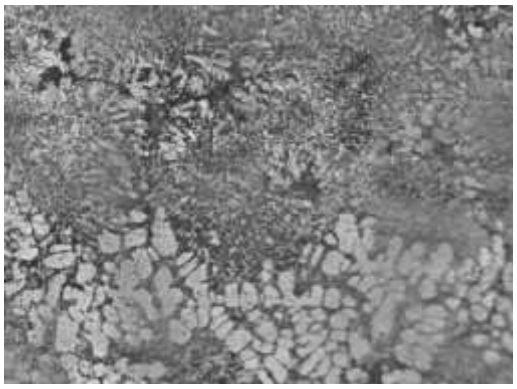

Figure3.4 Micrograph of Al (LM13)/ 6wt% of MgO

The specimen for the minute inspection was set up by metallographic methodology scratched in Keller's specialist, analysed under optical magnifying instrument. The micrographs plan show the confirmation of negligible porosity in both aluminium LM13 and its aluminium LM13 - MgO particulate composites. Micrograph demonstrates the almost uniform dissemination of the particles in the composite.

3.2 Hardness

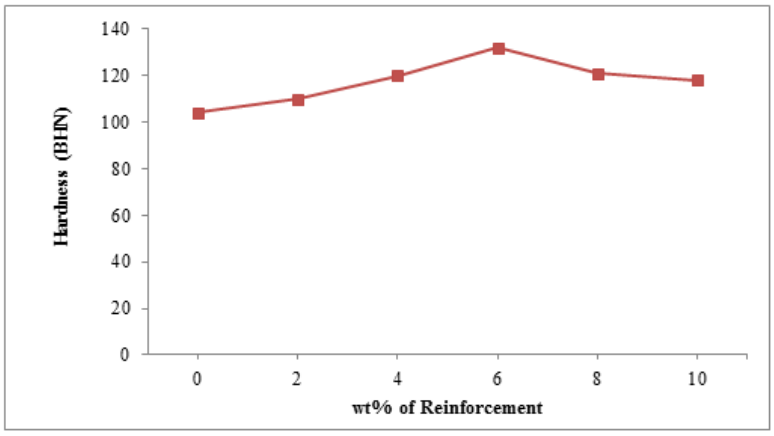

Figure 3.5 Variation of hardness with increase in wt% of reinforcement for aluminium LM13-MgO particulate composites

In the figure 3.5 shows that the increase in the weight percentage of MgO particulate it is found that significant improvement in hardness, it is due to presence of hard ceramic MgO particulate improves the hardness and wear resistance of heat treated Al LM13/MgO composite material [14].

3.3 Wear Characteristics

3.3.1 Effect of Reinforcement

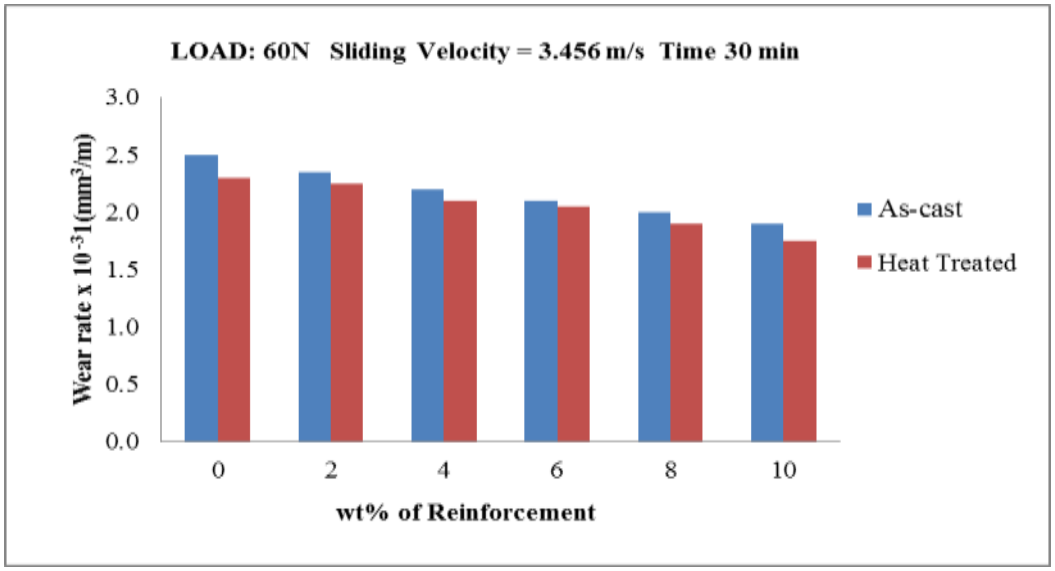

Figure 3.6 Wear Rate for Different wt. % of Reinforcements at Constant Load of 60N

The figure 3.6 shows that at a load of 60 N at constant sliding velocity 3.456 m/s the wear rate decrease maximum in all the weight percentages from 2 to 10 in increments of 2, due to presence of hard MgO particulates. The wear rate is maximum in As-cast compared to heat treated composite.

3.3.2 Effect of Applied Load

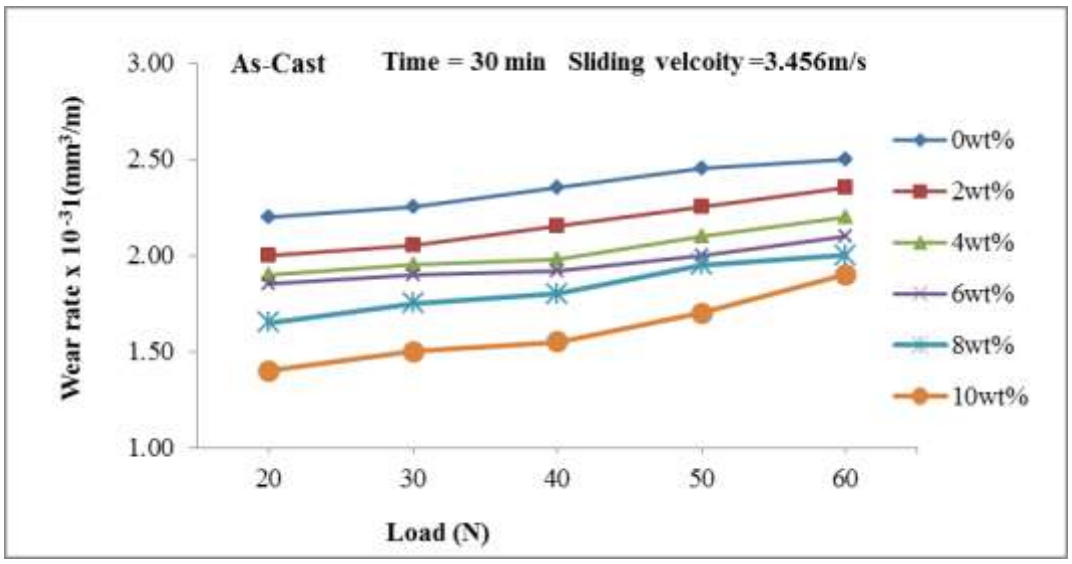

Figure 3.6 Variation of Wear Rate at Different Loads at constant sliding velocity under As-Cast condition

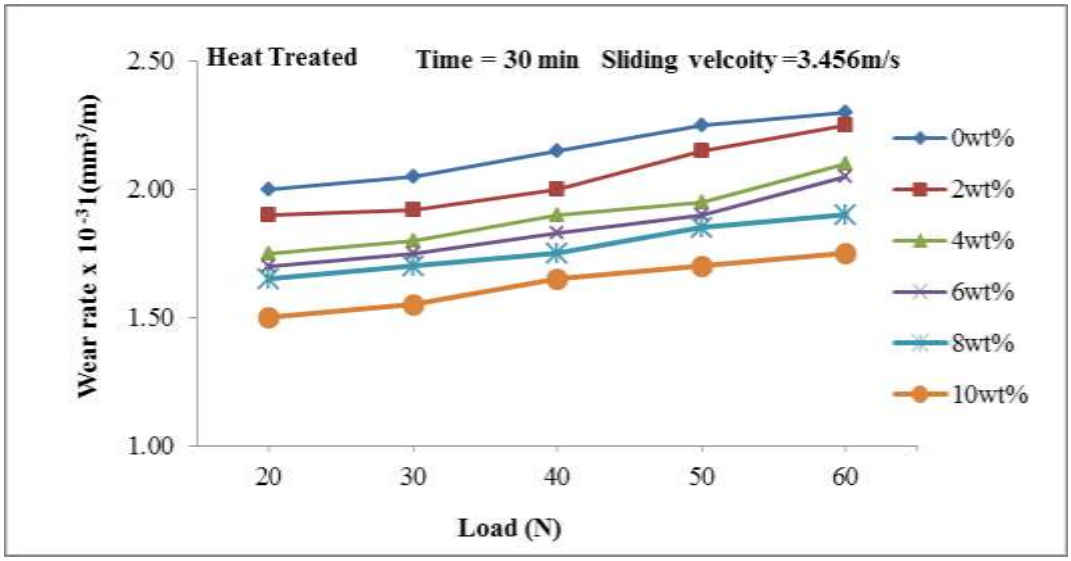

Figure 3.7 Variation of Wear Rate at Different Loads at constant sliding velocity under heat treated condition

Figure3.6 and 3.7 shows that the As-cast and Heat treated composite at constant sliding velocity 3.456 m/s by varying the load 20N to 60N in step of 10N clearly indicates that at 20N minimum wear rate is observed in both As-cast and heat treated composite and wear increase with increases the load. This is due to formation of precipitation in LM13 matrix alloy and its composite while Heat treatment. Further the presence of hard MgO particles resists the wear rate [15].

4. CONCLUSIONS

1. Aluminium LM13 composites have been effectively created with genuinely uniform scattering of MgO particles utilizing vortex strategy.
2. The microstructural examine unmistakably uncovers the about uniform circulation of support particulates in the Aluminium LM13.
3. The hardness of the composites expanded altogether with expanded substance of MgO particles. Warmth treatment significantly affects Brinell hardness of Aluminium LM13 alloy and its composites. Ice extinguishing took after by simulated maturing for 6 hrs. brought about greatest hardness of matrix alloy and its composites.

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