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Dry Sliding Wear Analysis of Aluminum 2618 HMMC Material by Tauguchi Method

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ABSTRACT

Research is a continues process which always finds better solutions to many complex problems, man always eager to find new things and it is natural. The research on material is also a continuous process which leads to find new type material which is necessary for some specific applications. Today aerospace industries and automobile industries need high strength materials with low weight and higher resist to fatigue, wear, and high temperature. This can be fulfilled by composite technology; composites are the material with blend of two or three materials with varying magnitude. There are many methods to manufacture composite but getting uniform distribution reinforcement particle is a big challenge which can accomplished by stir casting technology. For this research we selected aluminum (Al2618) as a matrix material, Boron Carbide (B_4C) and Graphite (Gr) as reinforcement material (Al2618+7B_4C+3Gr).

The wear test carried on pin on disk machine for composite by considering load, sliding speed, sliding distance as a parameter. The analysis was done using a Tauguchi technique (L9) and ANOVA by using Minitab software and the percentage of contribution on wear rate by each parameter is calculated. From the analysis it was conclude that as the load and sliding distance increases the wear rate also increases and wear rate decreases with increase in speed.

Key Words: HMMC, B4C, Gr, OM, ANOVA

1. INTRODUCTION

Composites are the natural or artificial materials with wide range applications in automobile and aerospace industries. When any material added to the monolithic materials then it is called as a composite, thus composite material is a combination of any two materials or more than two materials.

MMC are very important type of composite materials used in aerospace, automobile industries and in other industrial applications.

2. MATERIAL SELECTION

2.1 Aluminum 2618

Aluminum 2618 is high ductile and high corrosion resistance material. It starts to melt at lower temperature with constant heat supply. At lower temperatures their strength can drastically improved.

Element	Content (%)
Aluminium	93.7
Copper	2.30
Magnesium	1.60
Iron	1.1
Nickel	1.0
Silicon	0.18
Titanium	0.07

Table 2.1 Chemical composition of Al 2618

2.2 Reinforcement materials

2.2.1. Boron Carbide

Boron carbide is very hard material usually denoted by B_4C, it is produced by reacting carbon with B_2O_3 and it usually milled and purified.

2.2.2. Graphite

Graphite widely used in many applications it can act as both metal and non metals depend on the condition. It has the properties of greasing up and dry greasing up which is desirable in many modern applications.

3. Fabrication by stir casting technology

The stir casting machine is extensively designed for the fabrication of ALMMCs. Many researchers conclude that this production method gives better dispersion than any other production methods. It consist a cylindrical graphite crucible as it withstand against very high temperature up to 900^0C. And also graphite is not reacting with aluminum alloys

4. Wear Test of Aluminum 2618+ $7B_4C$+3Gr

The addition of graphite increases wear resistance which is more compare to the bilateral composite.

Load (Kg)	Speed (rpm)	Sliding distance(m)	Wear rate (mm^3/min)	S/N Ratio
3	250	500	0.003968	48.0286
3	500	1000	0.006742	43.4268
3	750	1500	0.007910	42.0365
4	250	1000	0.1520	16.4782
4	500	1500	0.2490	12.0760
4	750	500	0.13120	17.6546
5	250	1500	0.37814	8.4502
5	500	500	0.18921	14.4708
5	750	1000	0.22340	13.0729

Table 4.1 Wear test of al 2618+$7B_4C$+3Gr

The signal-to-noise ratio can be deliberate by using MINI TAB software, it can be seen that for upper load with higher sliding distance there is less S/N ratio which means at that condition wear is maximum.

Table 4.2 Response table

Level	Load (Kg)	Sliding velocity(rpm)	Sliding distance
1	44.50	23.32	26.72
2	15.40	2332	24.38
3	12.00	24.25	20.85
Delta	32.50	0.99	5.86
Rank	1	3	2

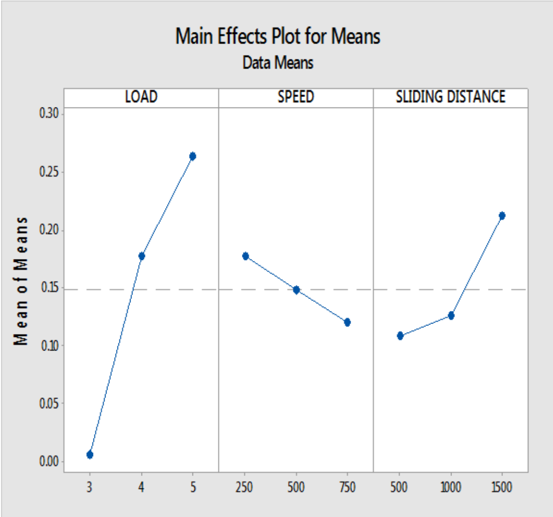

Fig 4.1: Wear v/s different parameter

Delta is the difference between maximum and minimum value of the response factor. The rank is assigned on the basis of the value of delta.

From the graph it is clear that as the load increases wear rate also increases and wear also increases with increase of sliding distance but wear rate decreases with increase in the sliding speed this is due to fact that the less contacting time between disk and specimen decreases.

5. CONTOUR PLOT ANALYSIS

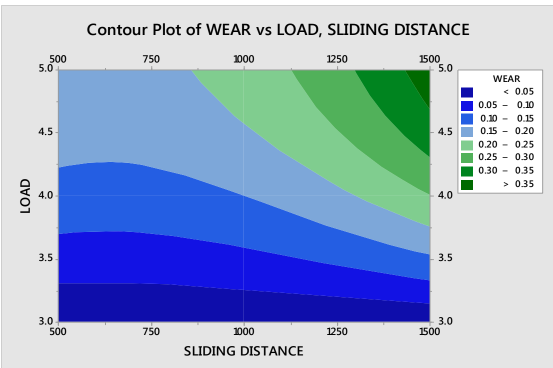

Fig 5.1 Wear rate v/s load, sliding distance

Above fig shows that there is higher wear rate at load 5kg and sliding distance 1500 m

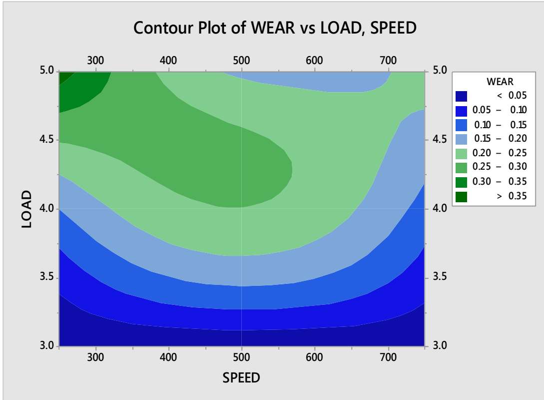

Fig 5.2 Wear rate v/s load, speed.

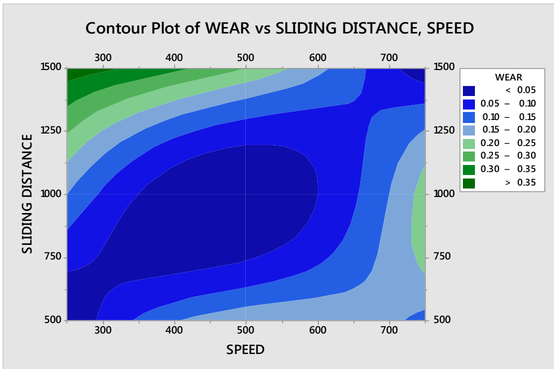

Fig 5.3 Wear rate v/s speed, sliding distance

The above shown diagram shows that there higher wear rate below speed 500m/s and sliding distance above 1000 m.

6. SEM Analysis

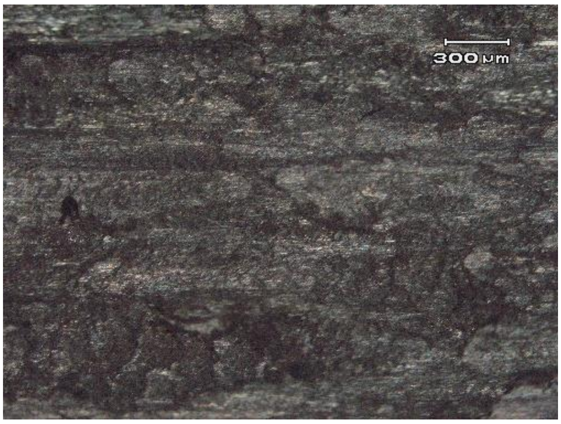

Fig 6.1 Wear analysis at higher load

The above fig shows the lower wear rate compare to bilateral composite and monolithic material this is for the case L=3 Kg, S=750rpm, SD=1500m

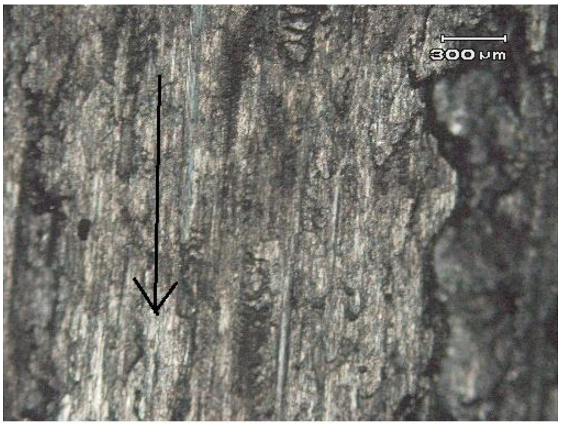

Fig 6.2 Wear analysis at higher load

The above fig for the case L=5 Kg, S=250rpm, SD=1500m for this condition wear mechanism is high. The arrow in the image indicates that direction of wear, there is some chemical composition of aluminum, steel, boron carbide, graphite.

7. CONCLUSION

1. The hardness of aluminium alloy 2618 is increases with increase in percentage of the boron carbide up to certain level.

2. For the hybrid AMMMCs the addition o 3% graphite with 7% of boron carbide will also increases the hardness of the composite

3. The addition of the reinforcement cause decrease in the density of composite

4. The wear test revels that wear rate of Al2618 is higher compare to the two composites, again wear rate decreases with addition of graphite

4. Load has highest impact on wear of the composites.

5. As the sliding speed increases the wear decreases this is due the fact that there is no time for sufficient contact between the steel disk and specimen, and also there is oxide formation which avoids the contact.

6. Sliding distance is directly proportional to wear as it increases the wear also increases

5. The Tauguchi technique revels that load has highest percentage of contribution on wear rate of the composite and speed has lowest percentage of contribution.

6. By the SEM analysis it is clear that there is good dispersion using bottom pour stir casting machine

7. After wear the hardness of composite is increased because of the mechanically mixed layer (MML), MML has the many chemical composition as the interaction of aluminum 2618 and its constituents, boron carbide, graphite and steel plate wear testing machine

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