To study Experimental investigation & wear analysis effects of composite MoS_2 on Al 6082 material

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Abstract – *this paper deals with the study of wear analysis of the AL 6082 with the composite material of MoS_2. The experiment has been investigated by making the pins of material using stir casting process. The wear has been tested on PIN-ON-DISC experimental setup by varying the proportion of the composite material with 2.5 % and 5% of composite material.*

Key Words: PIN-ON-DISC, MoS_2, wear, AL 6082, composite.

1. INTRODUCTION

The compounds are mainly due to an unprecedented demand for technology due to the rapid growth of activities in the aerospace and automotive industries. In-depth studies of the fundamental nature of materials and a understanding between their structural properties have allowed the development of new composite materials with improved physical and mechanical properties. With proper treatment, reinforcement of a metal matrix with various particulate or fibrous reinforcements can provide significantly improved MMC properties (eg, lower density, higher specific modulus and higher specific yield strength), which are ideal for many automotive and aerospace applications.

The use of different types of composite materials increases steadily over the years, as they have better physical, mechanical and tribological properties than matrix materials. Compounds based on light metals such as aluminum, magnesium and zinc are used in many industries, including the automotive industry, due to their low density. Of these, aluminum-based compounds are the most commonly used, and the possibilities of using these components for the production of tribomechanical components have been intensively investigated.

1.1 What is composite?

The volume fraction of the components must be greater than 5% of the total volume and their properties must be different. Normally, the volume fraction of a material is much higher than the volume fraction of another, and this material is called a matrix. The matrix can be ceramic, metal and polymer.

"Compounds are compounds that differ from alloys in that individual components retain their properties but are incorporated into the compound to use only their properties and not their disadvantages" to obtain an improved material

Compounds are systems of multifunctional materials that provide properties that cannot be obtained from a single material.

2. LITERATURE SURVEY

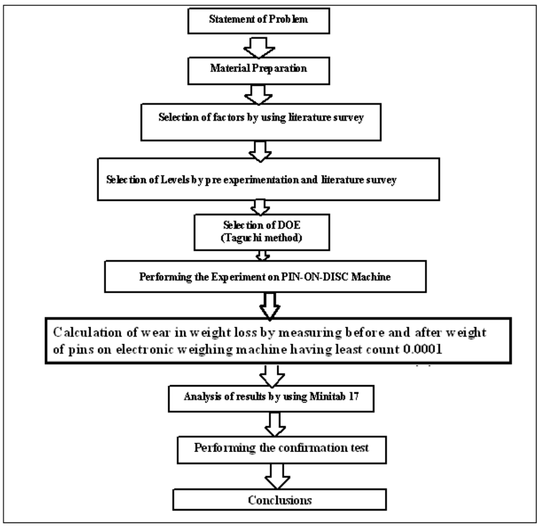
A. Thangarasu used the FSP technique to produce AA6082 / TiC surface AMCs and to analyze the effect of TiC particles on the microstructure and on the dry sliding wear behavior. Surface AMCs containing five fractions of different volumes were created (0.6%, 12%, 18% and 24%). The FSP was performed using a tool with a rotation speed of 1200 rpm, a translation speed of 60 mm / min and an axial force of 10 kN to produce a surface compound. The microstructure of AMC AA6082 / TiC was studied by scanning and scanning electron microscopy (SEM). The distribution of TiC particles was quite homogeneous in the composite material, regardless of the volume fraction. AMC AA6082 / TiC showed a reduction in mean particle size during FSP. The wear rate was 0.00693 mg / m at 0 vol. % and 0.00303 mg / m at 22 vol. %

Pardeep Sharma studied the reinforcement percentage that ranged from 0% to 12% in three stages. The percentage of reinforcement, load, slip speed and slip distance was the process variable. The response surface methodology was used to plan and analyze the experiment. The microhardness of the compounds is increased from 49.5 VHN to 44 VHN and macro-hardness from 31.6 BHN to 28.3 BHN, respectively, compared to the percentage by weight of Gr. The wear rate of composite materials decreases. with increasing composite speed. Slip speed and reinforcement and increase with increasing load, slip distance. The wear resistance of the developed composites was lower than that of the AA6082 model in all combinations of reinforcement, load, sliding speed and sliding distance. ANOVA has indicated that the sliding distance is the most influential factor followed by the slip speed, the reinforcement percentage and the load on the wear rate of the composite materials.

Shailesh Singh studied the tribological behavior of AA-6082 aluminum alloy reinforced with silicon carbide particles (3%, 4%, 5%, 6% and 7% by weight of SiC) produced by mechanical washing. agitation. The wear behavior during dry sliding of the samples thrown by shaking was analyzed using a pin in the wear of the disc. The SiC compound reinforced with a defect-free aluminum matrix was produced in the mechanical mechanical molding process. The tensile strength of the material has improved significantly with a larger amount of SiC. This method is the most economical and efficient way to produce an Al-SiCp compound. In the range of test parameters, the wear rate decreases as the SiC percentage increases, while the speed and the normal load increase from the minimum to the maximum limit, the wear rate increases.

P. Ramesh studied the aluminum matrix carbide matrix composite prepared with Al 6082 as base material and SiC as reinforcement material. The weight of the reinforcing material varies from 0 to 10% and several test samples are prepared. Various tests are performed to evaluate the performance of the compound and the results obtained are discussed. The 6082 aluminum alloy is used as reference material for this study. It is a medium strength alloy with excellent corrosion resistance. In the wear test considering four three-level variables of how to perform the experimental procedure. The addition of silicon carbide particles (SiC) causes an increase in density and porosity and further increases with the increase in the percentage of the particle fraction. The hardness of the Al-SiC compound increases with the increase in the percentage fraction of SiC particles

3. METHODOLOGY



3.1 Experimental Study

- **Preparation of composite**

The matrix and the reinforcement materials used were aluminum 6082 Mos2. The LM25 aluminum alloy is used in sliding electrical contacts, cylinder blocks, cylinder heads, brake drums and other crankcase housings.

The reinforcement material is added to the LM 6082 alloy to increase the strength of the work piece. Tables 3.2 and 3.2 show the chemical composition of the aluminum alloy and fly ash. The mos2 used for this study is compiled by Sai Sharada Abretive Pune, India. The size of the mos2 particles used for the study is of the order of 20 µm.

The required amount of 2.5% by weight and 5% by weight of aluminum was absorbed into the powder container. The mos2 was individually preheated in the oven at 350 ° C and kept at temperature before it was mixed with molten aluminum. The weighed amount of aluminum was melted at a desired superheat temperature of 750 ± 10 ° C using an electric crucible resistance furnace with a temperature controller. After the melting was completed, the melting temperature was reduced to 650 ° C to form a suspension at a lower temperature to obtain a uniform mixture of mos2 and to prevent the flow of mos2 out of the matrix material. The required amount of MOS2 particles was added to the molten metal and continuously stirred using a mechanical stirrer to avoid segregation of the MOS2 particles. The stirring time is maintained at 80 seconds at a turbine speed of 300 rpm. Good wetting between the solid and the liquid is essential for the formation of satisfactory bonds between them during casting. It has been found that the addition of magnesium improves the wetting properties of aluminum-based compounds because it also serves as an oxygen scavenger due to its lower surface tension, thus increasing the surface energy of the particles. The melt was poured at 650 ° C to prepare a composite sample.

Table 3.1: Chemical composition of aluminium Al6082 alloy

Compound	Wt%	Compound	Wt%
Si	12.2491	Ti	0.0672
Co	0.0174	Zn	0.0944
Fe	0.4353	Ni	0.0264
Cu	0.0800	Sn	0.0632
Mn	0.1601	Cr	0.0199
Ca	0.0082	V	0.0146
Al	86.7654		

Table 3.2: Standard properties of LM 6082 alloy [33]

Property	Values
Density	2670 kg/m^3
Melting point	615°C
Elastic modulus	71 GPa
Tensile Strength (T6)	250-280 MPa
Percentage Elongation	5-10%
Hardness (T6)	50-55 BHN

3.2 Wear Test Experimental Setup

A single-pin disc spindle tester was used to perform the dry slip properties of the compound in accordance with ASTM G99-95. The tests are carried out at elevated temperature under dry operating conditions. A wear test piece (pin) with a diameter of 12 mm and a length of 25 mm was cut from molded samples and then ground metallographic ally. The sliding speed of the composite material was examined as a function of the load, the speed, the sliding distance and the temperature of the pin.

The loading arm is mounted in a bearing arrangement so that it can load the sample. The friction force is measured by digital redo for some adjustments. The minimum and maximum values are of wear. The specifications of the pen on the disk machine are shown in Table. The different parts of the experimental disk pin machine are shown in Figure and the complete setup of the experimental configuration is shown in Figure

Input Parameters Are As Follows

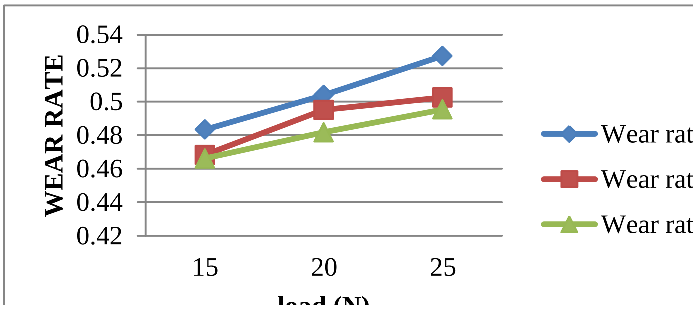
Figure 3.1 : Complete Arrangement of Experimental Set Up

Sr. No.	Load N	Sliding Distance m	Reinforcement	Sliding velocity	Sliding distance
1	15	500	0	2.61	1570.7
2	20	750	0	3.92	2350.19
3	25	1000	0	5.93	3141.59
4	15	750	2.5	3.92	2350.19
5	20	500	2.5	2.61	1570.7
6	25	1000	2.5	5.93	3141.59
7	15	1000	5	5.93	3141.59
8	20	500	5	2.61	1570.7
9	25	750	5	3.92	2350.19

Result

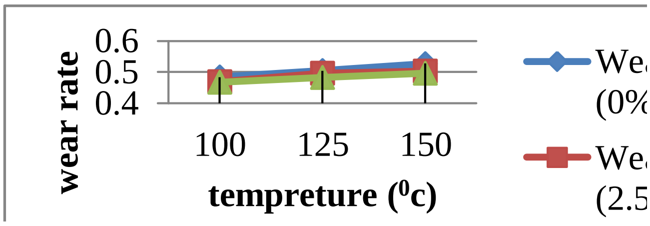
1. Load x wear rate

load	Wear rate (0 %)	Wear rate (2.5 %)	Wear rate (5 %)
15	0.4833	0.4682	0.4661
20	0.5039	0.4951	0.4817
25	0.5273	0.5025	0.4953



2. Temperature x wear rate

Sr. no.	temperature (^{0}c)	Wear rate (0%)	Wear rate (2.5%)	Wear rate (5%)
1	100	0.4833	0.4682	0.4661
2	125	0.5039	0.4951	0.4817
3	150	0.5273	0.5025	0.4953



Taguchi Result

SR NO	%Reinforcement	Load	Rpm	Wear Rate (10^{-3})	S/N RATIO
1	0.0	15	500	0.4833	6.31566
2	0.0	20	750	0.5039	5.95311
3	0.0	25	1000	0.5273	5.55884
4	2.5	15	750	0.4682	6.59137
5	2.5	20	1000	0.4951	6.10614
6	2.5	25	500	0.5025	5.97728
7	5.0	15	1000	0.4661	6.63042
8	5.0	20	500	0.4817	6.34447
9	5.0	25	750	0.4953	6.10263

Conclusions

- The objective of this study is prepare the Al 6082 composite with through liquid metallurgy route to observe the effect of addition of 6082 on the wear properties of aluminium 6082 metal matrix composite. It was found that load, sliding distance, Temperature and reinforcement are most influencing parameters on wear. To analyze these properties, the material is prepared by liquid metallurgy technique.
- The composite with 2.5%Mos2& 5% Mos2of aluminium6082 are successfully prepared using stir casting technique. The wear properties of aluminium6082 metal matrix composite are studied with the different control factors at elevated temperature.

Application

- Aluminium-MoS2 alloys are widely used in engineering structures and components where light weight or corrosion resistance is required. Therefore these alloys have much importance in aerospace and marine manufacturing
- This aluminum alloy finds application in the electrical sliding contacts, cylinder blocks, cylinder heads, brakes, and other engine body castings
- In marine manufacturing industry alloys are used for boat building and shipbuilding and other marine and salt-water sensitive shore applications

Future scope

The present work is carried out for dry and Wet operating condition, to study the effect of MoS2 reinforcement on aluminum AL 6082 alloy by varying the wt.% reinforcement.

One may conduct same work in following different ways.

- The same work can be repeated for different combination of the parameters.
- The work can be repeated by varying the weight percentage of the MoS2 & AL 6082 reinforcement.
- The work can be extended to study the effect of heat treatment on the wear properties of the composite.

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