STUDIES ON WEAR PROPERTIES OF AL-CU ALLOY COMPOSITE REINFORCED WITH ALUMINA AND SILICON CARBIDE

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***Abstract*- Aluminum alloy Metal Matrix Composites have been in use in industries since quite some time. Various reinforcements have been employed with different aluminum alloys as matrix materials. In the present investigation Aluminum Copper alloy has been used as Matrix material, Alumina and Silicon Carbide have been used as reinforcement materials. Composites have been fabricated by first keeping weight percentage of alumina constant and varying Silicon Carbide and then by keeping weight percentage of Silicon Carbide constant and Varying Alumina. For these composite materials, wear studies have been carried out using Dry Sliding Wear Test by varying the test parameters. The results of the investigation have been presented and discussed.**

***Index Terms*- Aluminum-Copper Alloy, ASTM Standards, Composite, Wear,**

I. INTRODUCTION

Aluminum is an important engineering material used in application requiring highest quality and consistency. Aluminum alloys are used extensively in industrial application like aviation, automobiles, IC engines, Jet and Gas turbines, generally engineering and land born defense vehicle. Principal features of aluminum is its lightness (density 2.7g/cc) only about a third of steel and copper. This added to the fact that it can strengthen by addition of other elements like Cu, Si, Mg, Zn etc., and by appropriate heat treatment produces a series of alloys with a high ratio of strength to weight.

Copper is added to Aluminum to increase the strength hardness fatigue and creep resistance. Mechanical properties of Aluminum copper alloys depend on copper content which varies from 4 to 10 percent. Copper is used, because its one of the few elements that have relatively high solubility in Aluminum. The Aluminum copper solution matrix is mechanically together then a pure Aluminum matrix.

Composite methods are light weight engineering materials which are gaining popularity in recent times due to many advantages over conventional material. Among various types of composite materials, the metal matrix composites are advanced engineering material resulting from two or more material in which one is a metal and another is non metal.

Aluminum metal matrix composites were developed almost 40 years back and still lot of research work is going on in this field. Reinforce material such as Al_2O_3, Zircon, SiC, Gypsum etc., have been used. Of late emphasis is on developing hybrid composites having more than one reinforcement material

In the present research work Al-4%Cu alloy has been selected as base materials. Composites were prepared using this alloy with Aluminum oxide and Silicon carbide as reinforcement materials.

II. EXPERIMENT DETAILS

Al-4%Cu alloy has been selected as base materials. Composites were prepared with varying amounts of Al_2O_3 and SiC by liquid metallurgy route using stir casting method. Specimen were prepared for dry sliding wear test from the casting so produced. Wear tests were conducted on standard dry sliding were testing test apparatus at varying speeds and loads. The

results of the test are reported in the following section.

The details of variables studied are Loads Investigated (P_1=1kg, (P_2=1.5 kg) and Speed Investigated (N_1=600 rpm, N_2=800rpm)

III. RESULTS AND DISCUSSION

3.1 Varying amounts of Al_2O_3

- Fig. 1 to 8 show dry sliding wear tests

carried out on specimens containing 8% SiC and wearing amounts of Al_2O_3 for different speeds and

loads. The study of these figures indicate the following.

Fig 1 shows variation of weight loss with test duration at a speed of 600 rpm and load of 1kg. Percentage weight loss increases with increase in testing time for all specimens.

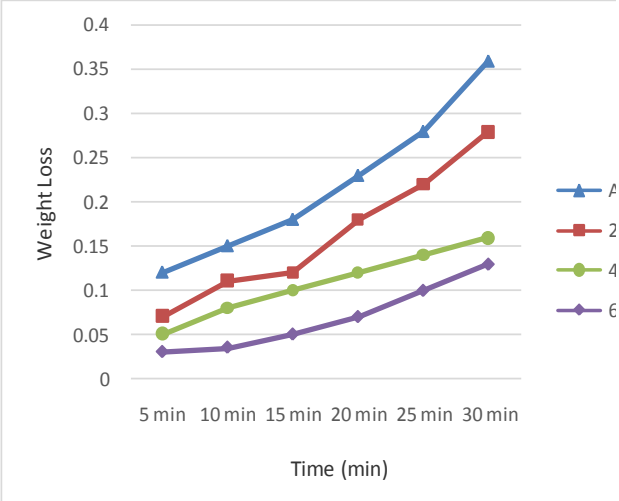

Figure 1 : Variation of weight loss with time for as cast and composite specimens (8% SiC) test speed 600 rpm, test load 1kg

- As cast Al – Cu alloy show higher weight loss at all test durations.
- Fig. 2 shows variation of weight loss with Al_2O_3 content for same test speed and load

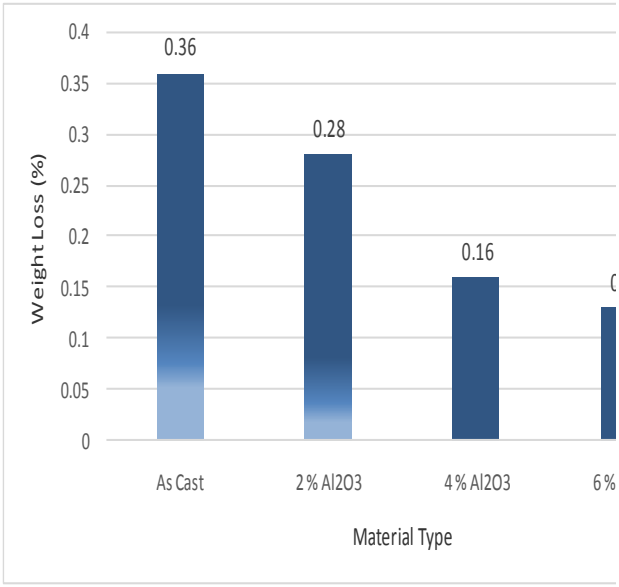

Figure 2 : Variation of weight loss (at the end of 30 min testing) with Al_2O_3content (for 8% SiC) at test speed 600 rpm, test load 1 kg

- Percentage weight loss decreases with increase in Al_2O_3 percentage.
- Minimum weight loss was obtained with composites containing 6% Al_2O_3.
- Fig 3 and 4 show similar graphs at test speed of 600 rpm and test load 1.5 kg.

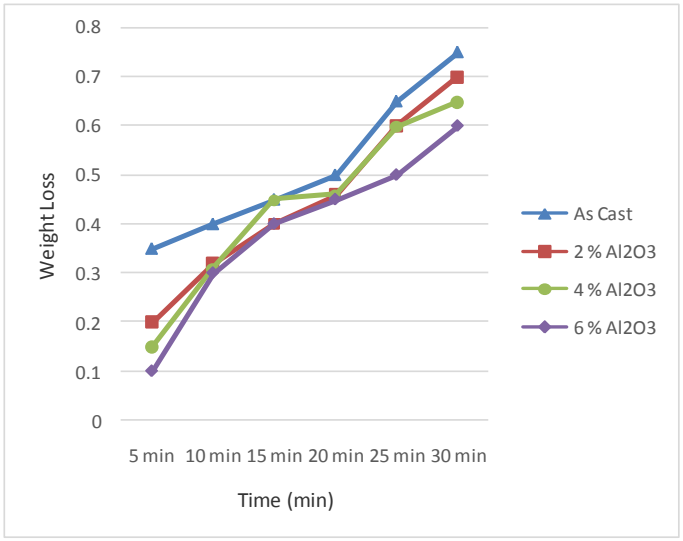

Figure 3 : Variation of weight loss with time for as cast and composite specimens (8% SiC) test speed 600 rpm, test load 1.5kg

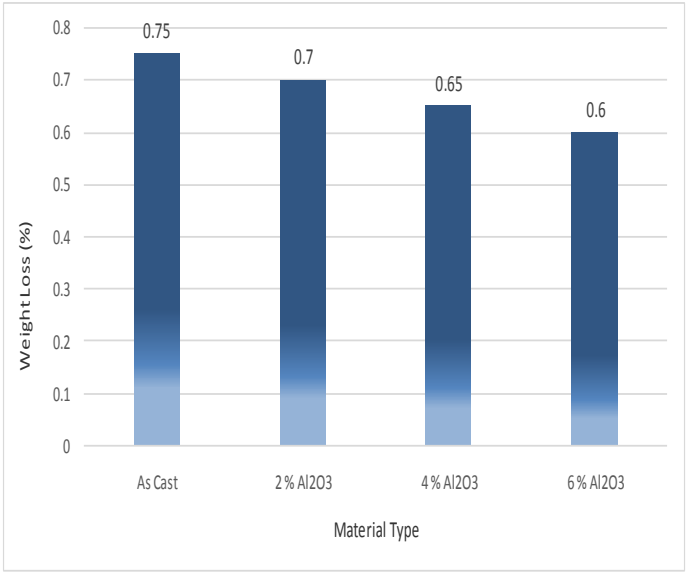

Figure 4 : Variation of weight loss (at the end of 30 min testing) with Al_2O_3 content (for 8% SiC) at test speed 600 rpm, test load 1.5 kg

- In this case minimum weight loss 0.6% was obtained for specimens containing 6% Al_2O_3 .

- Fig 5 to 8 show the wear test results at test speed of 800 rpm and test load of 1 kg and 1.5 kg.

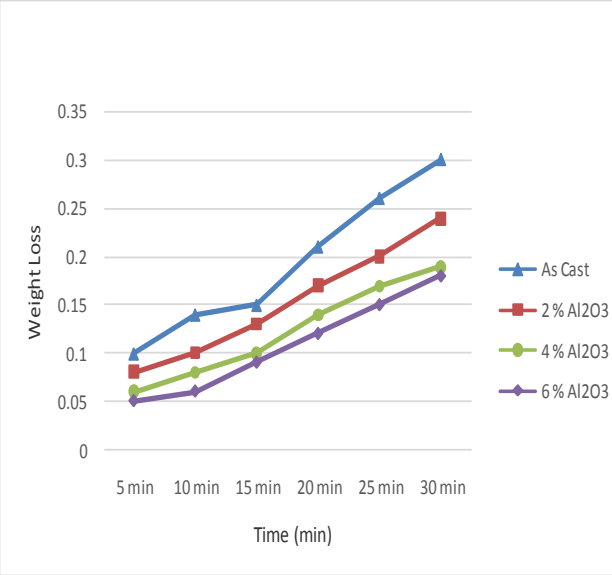

Figure 5 : Variation of weight loss with time for as cast and composite (8% SiC)
test speed 800 rpm, test load 1kg

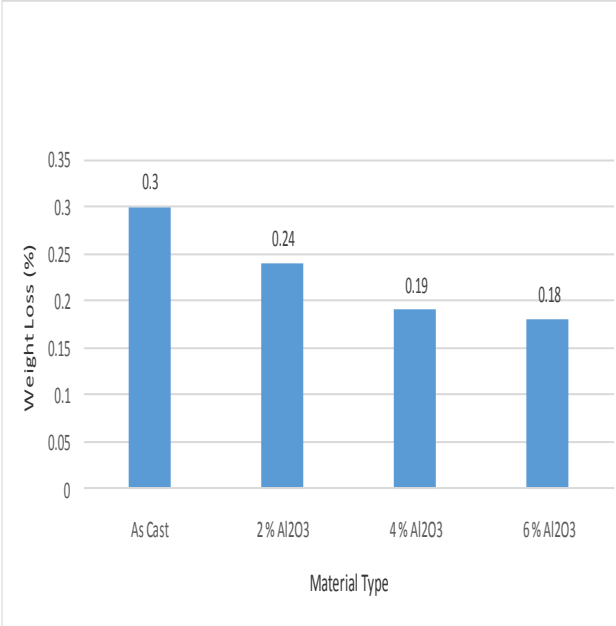

Figure 6 : Variation of weight loss (at the end of 30 min testing) with time for Al_2O_3content (for 8% SiC) at test speed 800 rpm, test load 1 kg

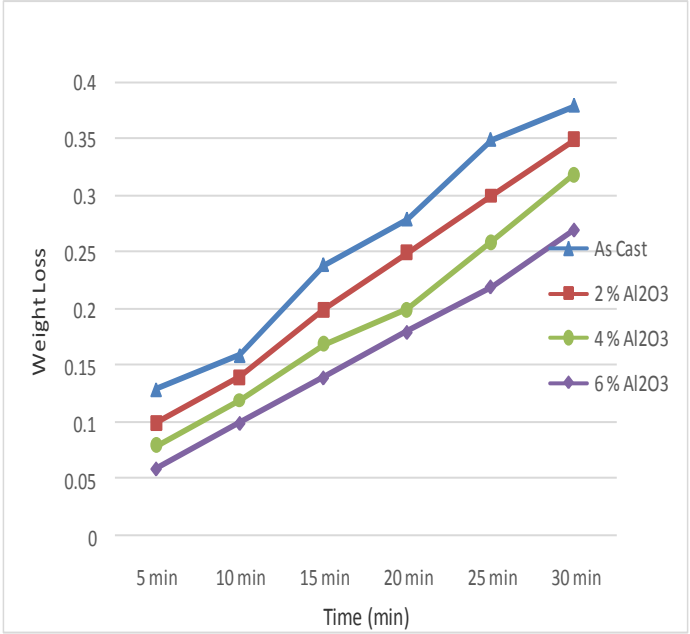

Figure 7 : Variation of weight loss with time for as cast and composite specimens (8% SiC)
test speed 800 rpm, test load 1.5kg

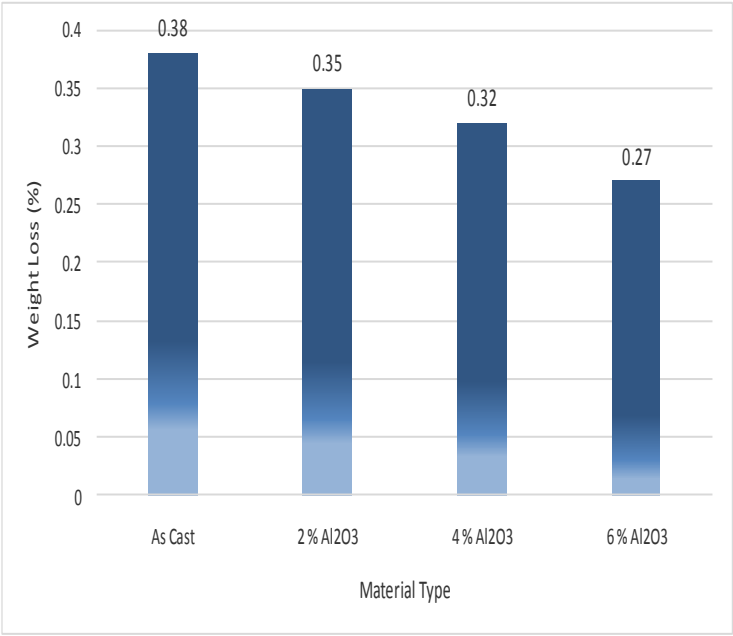

Figure 8 : Variation of weight loss (at the end of 30 min testing) with Al_2O_3 content (for 8% SiC) test speed 800 rpm, test load 1.5 kg

- The results follow more or less the same trend as with the test speed of 600 rpm.

3.2 Varying amount of SiC

- Fig 9 to 16 shows dry sliding wear test results carried out on specimens containing 6% Al_2O_3 and varying amounts

of SiC for different speeds and loads. A study of these figures indicate the following

- Figure 9 shows variation of weight loss with test duration at a speed of 600 rpm and load of 1 kg. Percentage weight loss increases with increase in testing time for all specimens

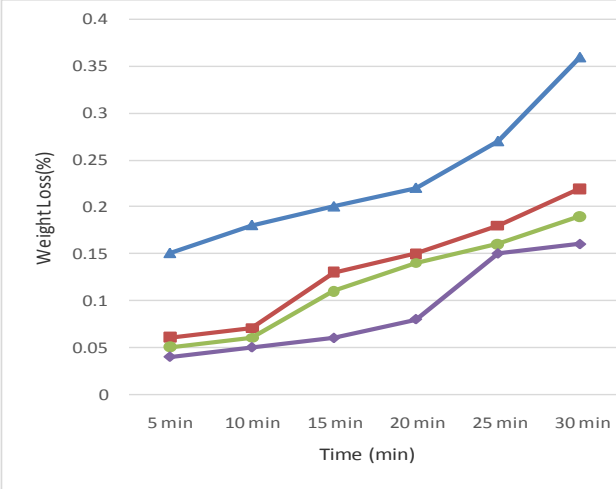

Figure 9 : Variation of weight loss with time for as cast and composite specimens (6% Al_2O_3) test speed 600 rpm, test load 1 kg

- As cast Al-Cu specimens show higher weight loss at all test durations compared to composite specimens
- Figure 10 shows variation of weight loss with Sic content for the test speed of 600 rpm and test load of 1 k

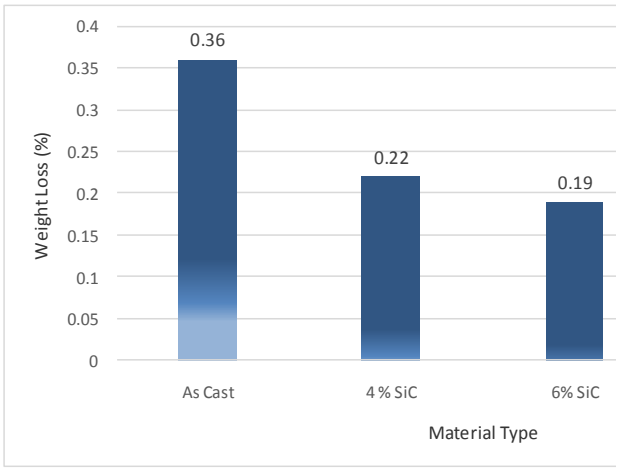

Figure 10 : Variation of weight loss (at the end of 30 min testing) with SiC content (6% Al_2O_3) test speed 600 rpm, test load 1 kg

- This figure indicates that percentage weight loss decreases with increase in Sic percentage
- Composite containing 8% Sic shows minimum weight loss of .16% at the end of 30 minutes testing
- Figures 11 and 12 show similar graphs for test speed of 600 rpm and test load of 1.5 kg

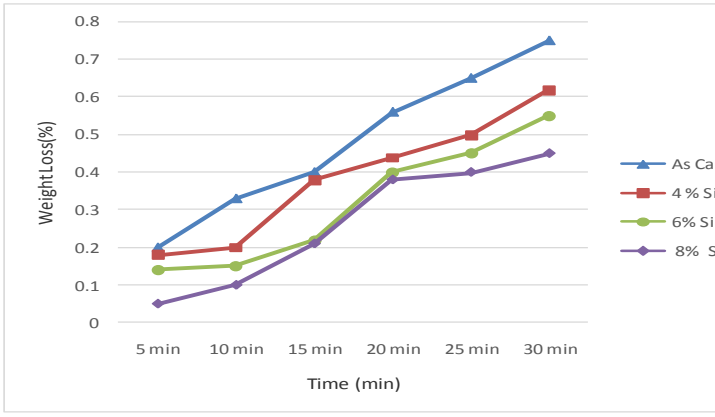

Figure 11 : Variation of weight loss with time for as cast and composite specimens (6% Al_2O_3) test speed 600 rpm, test load 1.5 kg

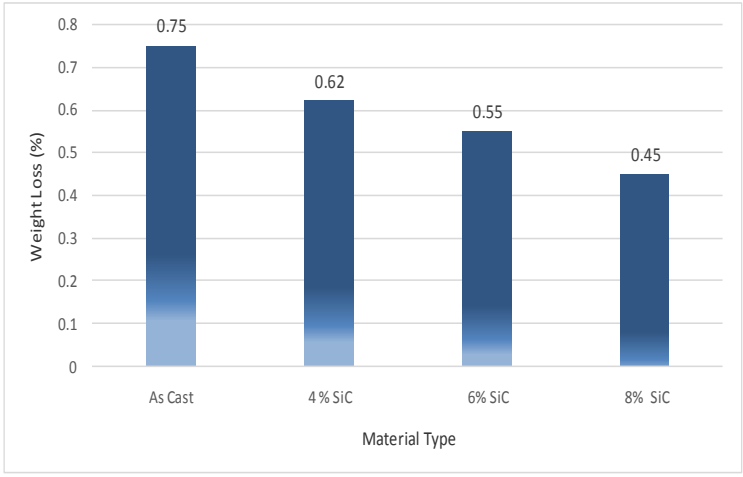

Figure 12 : Variation of weight loss (at the end of 30 min testing) with SiC content (for 6% Al_2O_3) content test speed 600 rpm, test load 1.5 kg

- In this case minimum weight loss of .45% was obtained for specimens containing 8%Sic.
- Fig 13 to 16 show the dry sliding wear test results carried out on specimens containing varying amount of Sic for test speed of 800 rpm and test loads of 1 kg and 1.5 kg

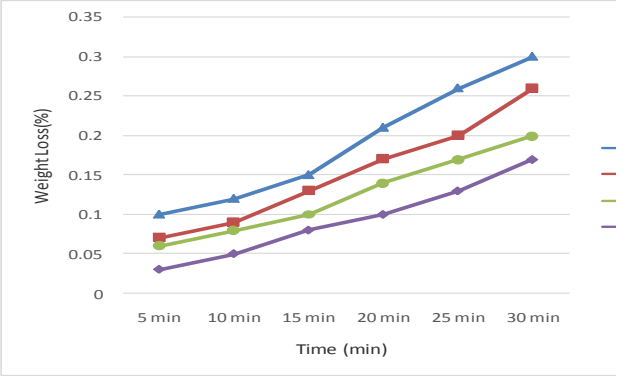

Figure 13 : Variation of weight loss with time for as cast and composite specimens (6% Al_2O_3) test speed 800 rpm, test load 1kg

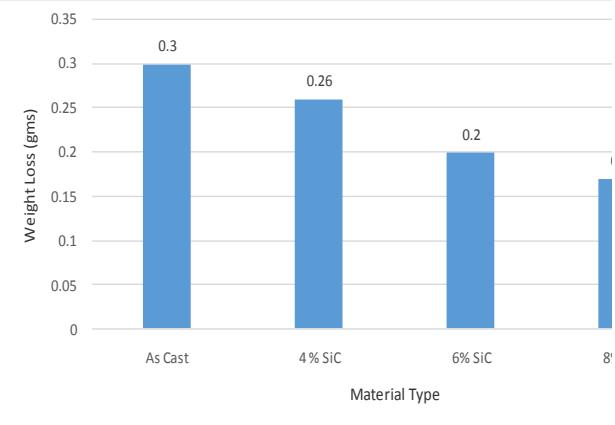

Figure 14 : Variation of weight loss (at the end of 30 min testing for 6% Al_2O_3) with SiC content test speed 800 rpm, test load 1kg

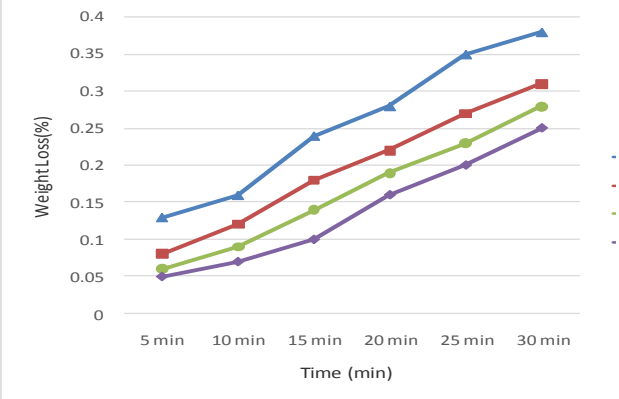

Figure 15 : Variation of weight loss with time for as cast and composite specimens (for 6% Al_2O_3) test speed 800 rpm, test load 1.5kg

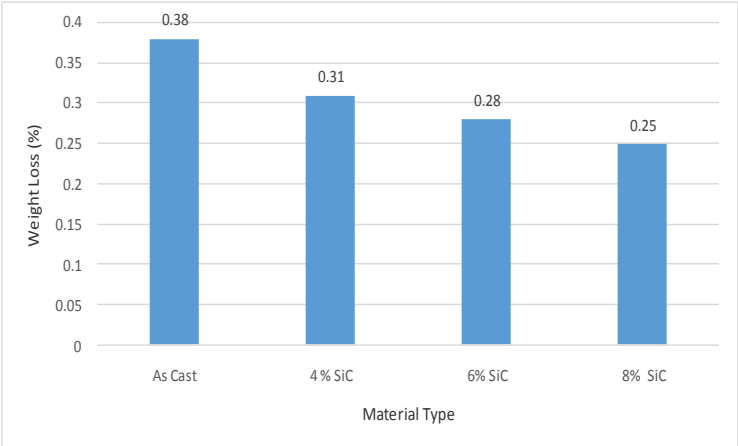

Figure 16 : Variation of weight loss (at the end of 30 min testing for 6% Al_2O_3) with SiC content test speed 800 rpm, test load 1.5 kg

- The results follow similar trend as with those obtained at a test speed of 600 rpm

IV. CONCLUSIONS

- Compared to as cast Al-Cu specimens composites containing varying amounts of AL_2O_3 as well as Sic exhibit better wear resistance at all the test speeds and loads studied in the present investigation

- Hence Al-Cu alloy composites can be suggested for applications requiring good wear resistance in industrial components. Depending on the extent of wear resistance required, the composition of the composite can be suitably selected

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