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***Short Communication***

# Microstructural Studies of Cast Zinc - Aluminum-Sic-Graphite Hybrid Composites

**Prakash C.H.[1] and Pruthviraj R.D.[2]**
[1]Department of Mechanical Engineering, College of Marine Science and Technology, Massawa, ERITREA, North – East AFRICA
[2]Department of Chemistry, Amruta Institute of Engg and Management Sciences, Bidadi, Bangalore, Karnataka, INDIA

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## Abstract

*Since ages, Zn-Al and its alloys have found extensive applications in manufacture of bushes and bearings, heat transfer conductors, high conductivity electrical contractors and so on. However, currently, in all these applications, there is a significant enhancement in the service loads, wear resistance; conductivity thus forcing the material researchers to develop a newer class of Zn-Al based advanced materials. In this direction, researchers have focused their attention on improving the strength and the tribological properties by reinforcing Zn-Al with hard ceramic reinforcements such as silicon carbide and titanium carbide. The major drawbacks of these Zn-Al based composites are reduced conductivity and poor machinability. To overcome this, efforts are on to make use of a soft phase such as graphite as a additional reinforcement to the conventional Zn-Al based hard reinforced composites. Graphite being a solid lubricant can improve the machinability of the composites. Furthermore, graphite possess excellent thermal and electrical conductivity thereby, can improve the conducting capability of Zn-Al composites. In the light of the above facts, this paper aims at discussing the tribological characteristics of cast Zn-Al -SiC-graphite hybrid composites.*

**Keywords:** Hybrid composites, Zn-Al, silicon carbide, graphite.

## Introduction

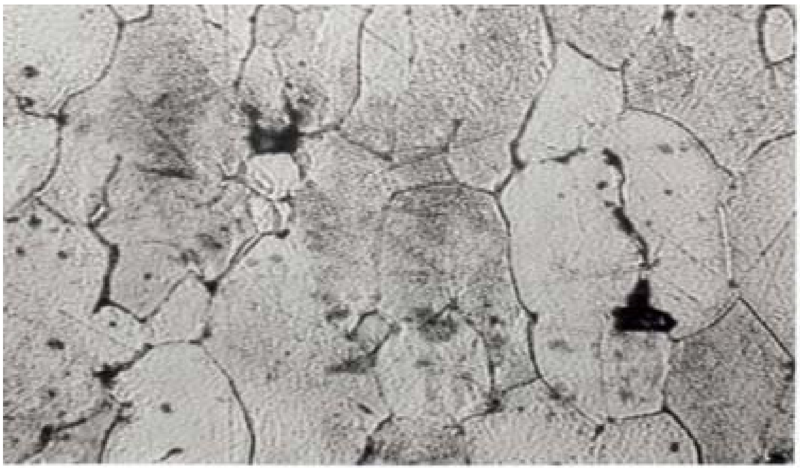
In recent years, Zn-Al based composites are gaining wide spread importance in several high tech applications. The mechanical properties of Zn-Al based conventional composites involving a single reinforcement have been studied. Use of single reinforcement in Zn-Al may sometimes lead to the deterioration in the values of its physical properties. To overcome this, the concept of use of two different types of reinforcement is being tried out in Zn-Al matrix. Hard reinforcements such as SiC will enhance the hardness and abrasive wear resistance of Zn-Al while it has a negative effect on the machinability and conductivity of Zn-Al. To offset these effects, graphite being a solid lubricant and possessing good conductivity can be dispersed in Zn-Al along with SiC. However, meager information is available as regards the processing and characterization of these novel hybrid Zn-Al composites. In the light of the above, the present investigation is aimed at producing Zn-Al hybrid composites using pure Zn-Al as matrix and SiC and graphite powders as reinforcements.

## Material and Methods

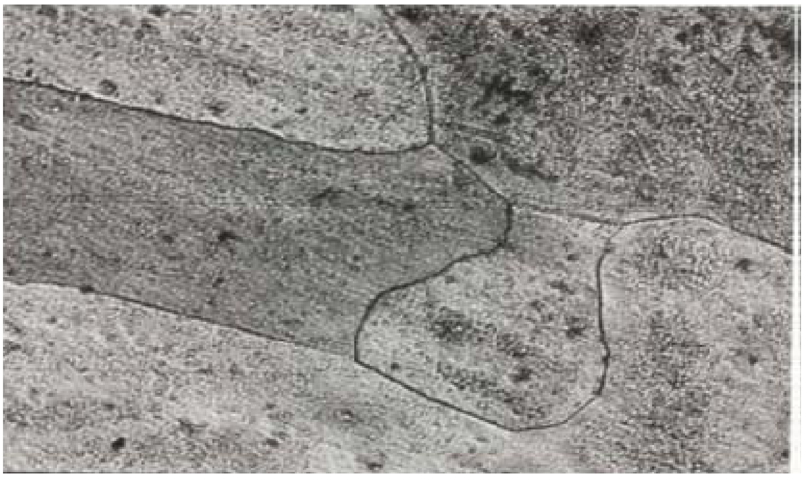
Pure Zn-Al was melted using coke fired furnace and preheated silicon carbide and graphite powders in the weight ratios of 3:1, 5:1, 10:1 were added to the vortex of the molten metal. Stirring time adopted was 10 minutes. Degassing was achieved by use of commercially available degassing tablets. The composite melts were poured into preheated cast iron cylindrical moulds. Cast hybrid composites were then machined and subjected to metallographic studies, hardness, and friction and wear tests. Friction and wear tests were conducted using a pin on disc machine. The specimen diameter was 10mm. Counter disc used was high carbon high chromium steel of hardness RC 60. Sliding speed was varied between 100 and 500 rpm (Sliding velocity of 0.3-1.5m/sec) while load was varied between 10-50N. The frictional force was recorded using a force transducer while the wear loss was measured in terms of height loss of the specimens using an LVDT.

## Results and Discussion

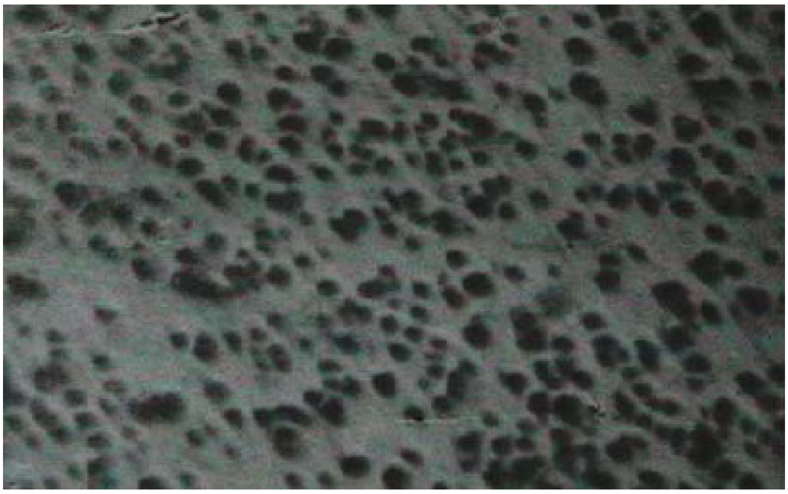
Figure 1 shows the microphotographs of cast Zn-Al and its hybrid composites. It is observed that there is a fairly uniform distribution of reinforcements in the matrix metal. The silicon carbide particles can be clearly identified when compared with graphite. Figure 2 shows the variation of hardness of all the composites studied. It is observed that on addition of SiC to Zn-Al, there is an enhancement of hardness of Zn-Al composites. Use of graphite as an additional reinforcement to Zn-Al –SiC composites has lowered the hardness. The reduction in the hardness is not drastic. The hardness of the hybrid composites are lower than Zn-Al-SiC while it is much higher when compared to Zn-Al and Zn-Al-graphite composite. Figure 3 shows the wear loss with time for all the composites studied. Increased time has resulted in higher weight loss for all the materials studied. However, increased content of SiC in the hybrid composites has resulted in lower wear loss. The increased wear resistance of the hybrid composites when compared with pure Zn-Al can be attributed to the following reasons. Increased content of SiC a hard ceramic will result in enhancement in the hardness of the composites. Increased hardness leads to lowering of wear loss and seizing. Further, the presence of graphite in hybrid composites has further influenced the wear behavior of it. Graphite, a solid lubricant will tend to get smeared out between the rubbing surfaces thereby minimizing the chances of three body abrasive wear that is normally encountered in conventional hard ceramic reinforced metal matrix composites. This phenomenon will drastically reduce the wear loss of the hybrid composites. Figure 4 shows the variation of coefficient of friction of Zn-Al and its hybrid composites with time. It is observed that increased time results in higher coefficient of friction for all the materials studied



**Zn-Al**



**Zn-Al – 3wt% SiC – 1wt% Gr**



**Zn-Al – 10wt% SiC – 1wt% Gr**
**Figure-1**
**Microphotograph of Cu and its Hybrid composites**

## Conclusion

Hybrid Zn-Al-SiC-Graphite composites have been successfully prepared by liquid metallurgy route. The hybrid composites possess values of hardness, coefficient of friction in between that of Zn-Al-SiC and Zn-Al-graphite composites but possess excellent wear resistance when compared with the monolithic composites.

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