International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

Sintering Characteristics of Al-2.3%Cu-1.6%Mg-Fly ash Metal Matrix Composite

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Abstract: ***In this paper, Aluminium (Al)-2.3% Copper (Cu), 1.6% Magnesium (Mg) with 0,5,10,15 and 20 weight percent fly ash metal matrix composites are fabricated at 300MPa compaction pressure using powder metallurgy technique. The composites are sintered at 560^{o}C for 45 minutes. The density and compressive strength of both the green and sintered compacts are determined. The density of the composites decreases with the increase in weight percent fly ash. No change in density is observed in the composites before and after sintering. The strength of the composites increases with the increase in fly ash upto 5 weight percent and there after decreases. The sintered strength of all the composite specimens is greater than their corresponding green strength.***

Keywords: Aluminium, Copper, Magnesium, Fly ash, Powder Metallurgy, Sintering

I. INTRODUCTION

In the present scenario, aluminium metal matrix composites (AMMCs) are promising and widely used materials due to their typical properties like high strength, elastic modules, high specific strength, wear rate, enhance stiffness, low thermal coefficient, etc. These AMMCs have brought in various fields such as aerospace, automobiles, defence, entertainment and sports [1]. The properties of AMMCs can be tailored by selecting and controlling the alloying and reinforcing materials. Further, the properties of AMMCs depend on the fabrications technique employed. The fabrication techniques employed for AMMC include squeeze casting, die casting, stir casting, extrusion, powder metallurgy (PM) etc. PM technique is simple, easy to process and has capability to fabricate near net shape components [2]. Rohatgi et al. reported a nominal improvement in hardness, tensile and wear properties of fly ash reinforced AZ91D composite [3]. Anil Kumar et al. concluded an increased tensile strength, compressive strength and hardness with enhancing wt% of flyash reinforcement particle in Al 6061MMC [4]. Bodukuri et al. studied the Al/SiC/B4C MMC characteristics by using PM process. In their investigation considered a ball milling machine, to reduce the SiC and B4C powder particles sizes. Finally, concluded that increase in B4C reinforcement enhance the micro hardness of the MMC [5]. Seelam et al. successfully prepared Al/Pb/Fly ash composites fabricated by powder metallurgy technique and studied their compacting and sintering characteristics. It is reported that the hardness of the composites increased with the increase addition of flyash [6-9].

In the present study, Al-2.3%Cu-1.6%Mg with 0, 5, 10, 15 and 20 weight percent of fly ash metal matrix composites are fabricated by powder technique. The compaction pressure of 300MPa, sintering temperature 560^{o}C and sintering time 45 minutes is employed. The density and the strength of the composites are studied and the comparison of green and sintered compacts is made.

II. EXPERIMENTAL DETAILS

The powders of Aluminium (Al), Copper (Cu), Magnesium (Mg) are purchased from the local suppliers. Fly ash is collected from Dr NTTPS, Ibrahimpatnam, Vijayawada. These powders are weighed in the required proportions and blended using an eccentric blender. The blended powders are compacted at 300MPa using single action die compaction processes. The prepared composites are sintered at 560^{o}C for 45 minutes in the sintering furnace shown in Fig.1. The dimensions of the specimens before sintering and after sintering are measured and the densities are calculated. The compressive strength of the specimens is determined using electronic tensometer model PC2000.

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Fig.1 Sintering Furnace

III.RESULTS AND DISCUSSIONS

The results of the composites before sintering and after sintering are as below.

A. Density

The comparison of green density and sintered density of the composites measured from the dimensions of the composites is shown in Fig.2. There is no change in the density of the composites due to sintering.

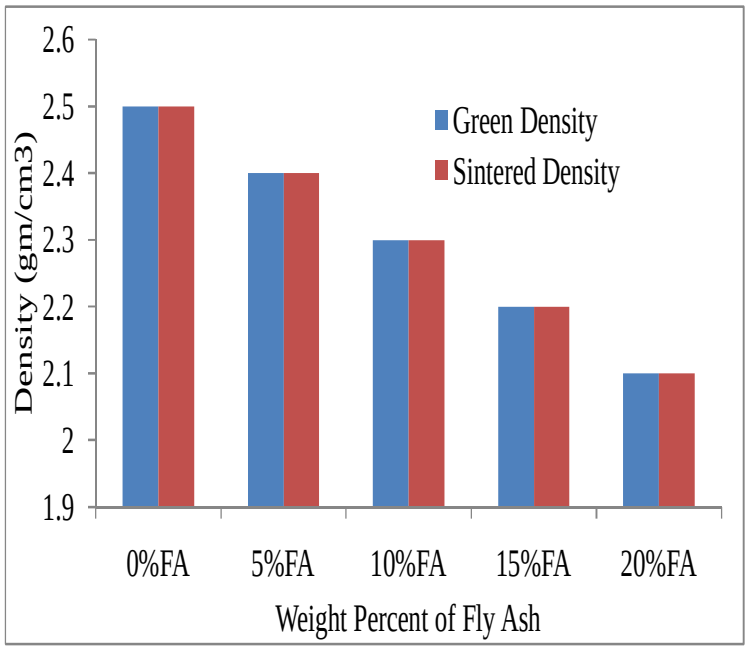

Fig. 2 Comparison of Green Density and Sintered Density of Composites

B. Green Compressive Strength

The effect of weight percent of fly ash on the green compressive strength of the composites is shown in Fig. 3 and the sintered compressive strength is shown in Fig.4. It is observed that both the green and sintered strength increases with increase in fly ash upto 5weight percent and there after decreases. Further comparison of green and sintered strength of the composites is shown in Fig.5. It is observed that for all the composites, the sintered strength is higher than the green strength. This is due to increase in inter-particle bonding of the sintered composites compared to that of green composites as shown by the microstructures in Fig. 6 and Fig.7.

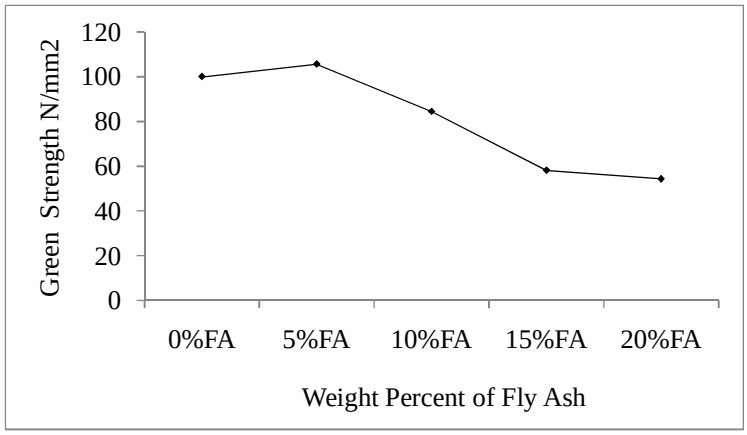

Fig.3 Effect of Weight Percent of Fly ash on Green Strength

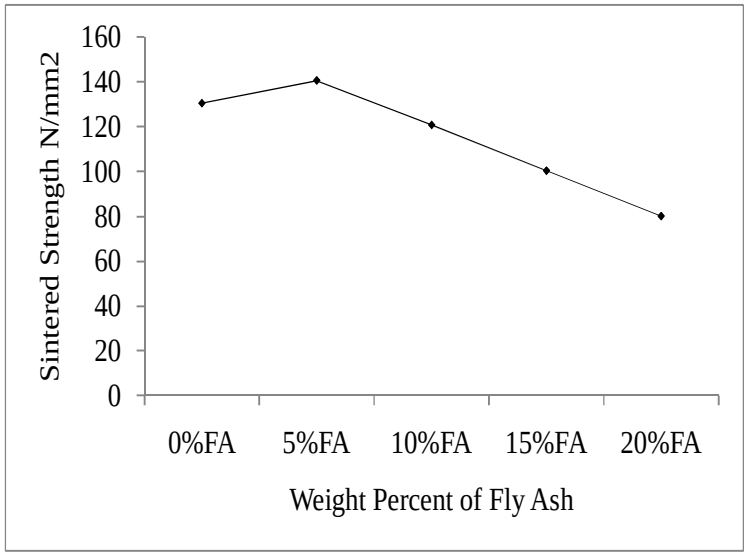

Fig.4 Effect of Weight Percent Fly ash on Sintered Strength

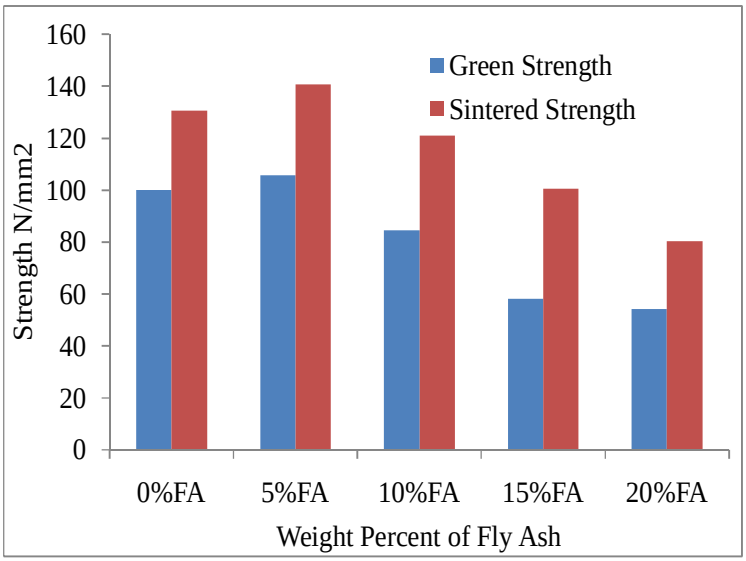

Fig.5 Comparison of Green Strength and Sintered Strength of Composites

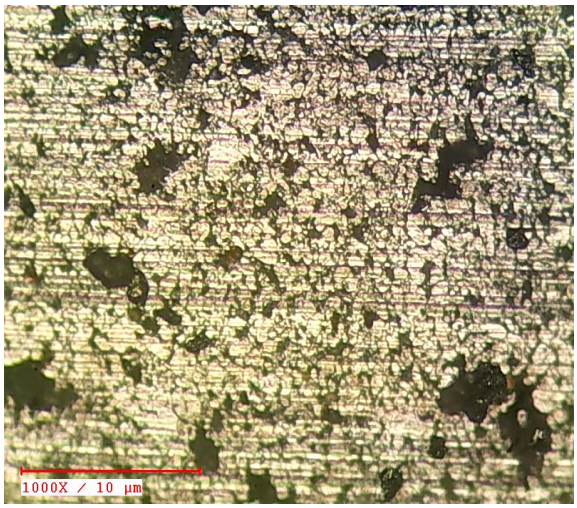

Fig. 6 Microstructure of 10wt% Fly Ash Green Composite

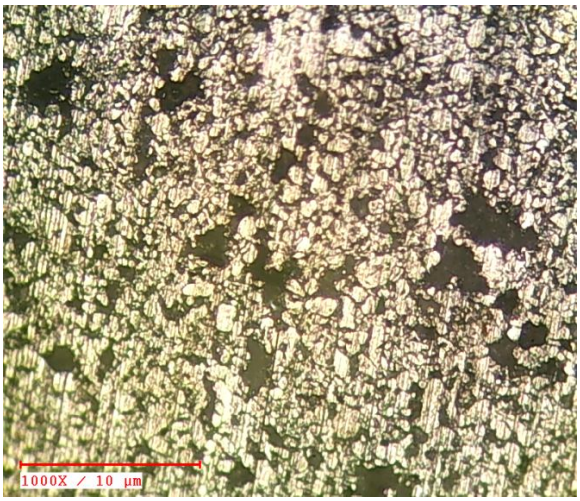

Fig.7 Microstructure of 10wt% Fly Ash Sintered Composite

IV. CONCLUSIONS

The conclusions drawn from the present work are:

A. The Al-2.3%Cu-1.6%Mg-Fly ash metal matrix composites are successfully prepared by powder metallurgy technique.
B. The sintering of the composites did not show any change in the dimensions of the composites.
C. The strength of the composites increased with the increase in fly ash upto 5weight percent and subsequently decreased.
D. The strength of the composites increased with the sintering of the composites.
E. The sintering of the composites results in diffusion of particles.

V. ACKNOWLEDGMENT

The author would like to extend their acknowledgements to University Grants Commission (UGC)-India for financial support received under UGC minor project No. F MRP-6180/15 (SERO/UGC).

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