



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 11, November 2020

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.512**

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# Influence of Silicon Carbide and Alumina Particles on Compressive Strength of Magnesium Metal Matrix Composites

Satish J<sup>1</sup>, K G Satish<sup>2</sup>

Assistant Professor, Department of Mechanical Engineering, SJMIT, Chitradurga, Karnataka, India<sup>1</sup>

Assistant Professor, Department of Mechanical Engineering, UBBDTCE, Davanagere, Karnataka, India<sup>2</sup>

**ABSTRACT:** Compressive tests have been carried out on magnesium metal composites matrix (Mg-5%SiC-5%Al<sub>2</sub>O<sub>3</sub>, Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub>, Mg-15%SiC-15%Al<sub>2</sub>O<sub>3</sub>) and on pure magnesium. The Composites reinforced with equal weight percentage of silicon carbide and alumina were fabricated through powder metallurgy process. The compressive strength of composites increases as compared with that of pure magnesium due to the presence of silicon carbide and alumina particles. Also results shows that compressive strength was higher for composite Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub> when compared with other compositions.

**KEYWORDS:** Compressive strength, Magnesium MMCs, Powder metallurgy.

## I. INTRODUCTION

Due to their high specific tensile strength and modulus, as well as their high wear resistance, particulate reinforced magnesium metal matrix composites (MMCs) have great potential to be applied in the automotive and aerospace industries. There are Several techniques are used to fabricate the particulate reinforced Magnesium Metal Matrix Composites, such as stir casting, powder metallurgy, squeeze casting and so on. The magnesium MMCs are made from powders in the P/M process without going through a fully melting state. In addition, without or with less excessive reactions between the matrix and reinforcement, the P/M approach can achieve a more uniform distribution of particulates in the metal matrix [1].

Magnesium and its alloys are promising materials because of their low density, high specific strength, high specific stiffness, good dimensional stability and high damping capacity. Comparative to magnesium alloys, magnesium matrix composites is an excellent candidate because of its higher specific stiffness, higher specific strength and good elevated temperature creep properties [2]. The primary aim of this study is to evaluate the compressive strength of silicon carbide and alumina particles reinforced with magnesium metal matrix composites for various equal weight percentage of reinforcement.

## II. METHODOLOGY

The magnesium is used as a matrix material for the preparation of composite material. The silicon carbide and alumina particles were used as a reinforcement. The silicon carbide and alumina powders were blended thoroughly with magnesium powder through the ball mill apparatus to achieve a uniform mixing of powders. Compaction of powders was performed after blending with the aid of die and punch having close tolerances. The blended powder are poured into die cavity and compacted by punch using Universal Testing Machine to obtain the green compacts. The green compacts are then sintered in a vacuum furnace at a temperature of 550<sup>0</sup>C to obtain the composite specimen as shown in Figure 1.

Compression test was carried out for pure magnesium, Mg-5%SiC-5%Al<sub>2</sub>O<sub>3</sub>, Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub>, Mg-15%SiC-15%Al<sub>2</sub>O<sub>3</sub> composites using Universal Testing Machine (UTM). The composite specimen was placed between two flat hardened plates and a standardised load was applied across the two opposite ends of the specimen. The plates are then pressed together in a UTM, allowing the specimen to flatten as shown in Figure 2.



Figure 1 : Vacuum furnace used for sintering

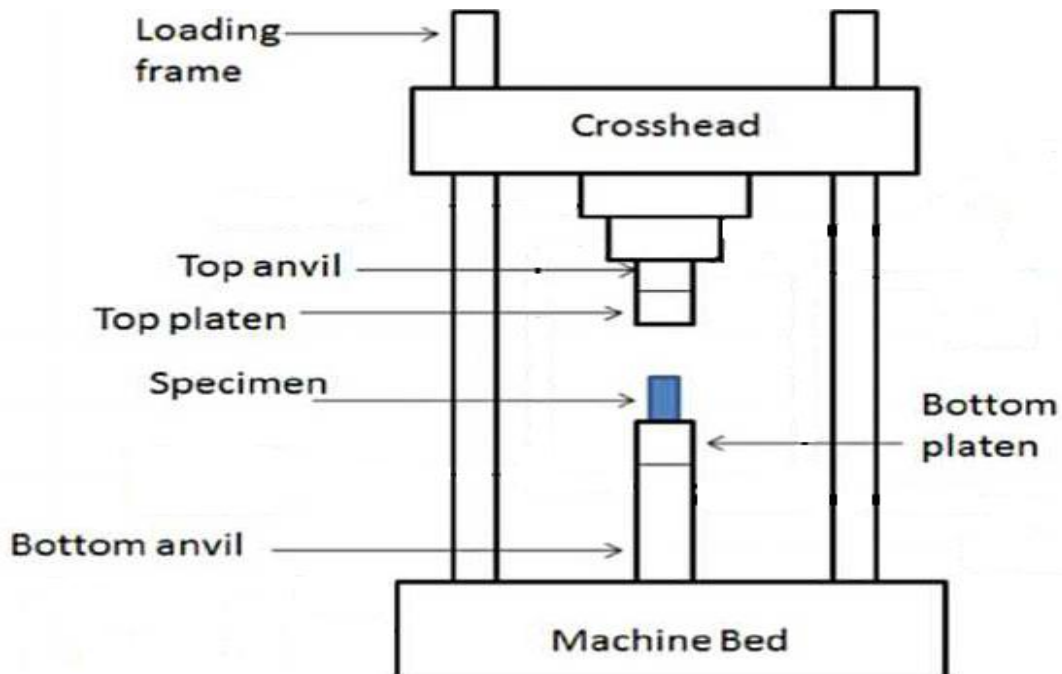


Figure 2 : Compression Test set up

### III. RESULTS AND DISCUSSIONS

The test sample is generally placed in between two plates that distribute the applied load across the entire surface area of two opposite faces of the test sample and then the plates are pushed together by a universal test machine causing the sample to flatten. A compressed sample is usually shortened in the direction of the applied forces and expands in the direction perpendicular to the force [3].

Compression test were performed on test ready specimen by using Universal Testing Machine as shown in Figure 3(a). Compression test determines the characteristics of materials under compressive loads. The composite specimen was compressed and deformation was noted for different loads. Compressive stress and strain was determined and plotted as a stress-strain diagram as shown in Figure 3(b). Compressive strength for different composition of specimen were shown in Figure 4. Results showed that compressive strength of magnesium metal matrix composites was enhanced as compared with pure magnesium due to the presence of silicon carbide and alumina reinforcement particles. Under all studied composition, Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub> composites exhibits higher compressive strength. For Mg-15%SiC-15%Al<sub>2</sub>O<sub>3</sub> possess lesser compressive strength as compared to Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub> due to porosity increases with increase in SiC and Al<sub>2</sub>O<sub>3</sub> particles reinforcement content.

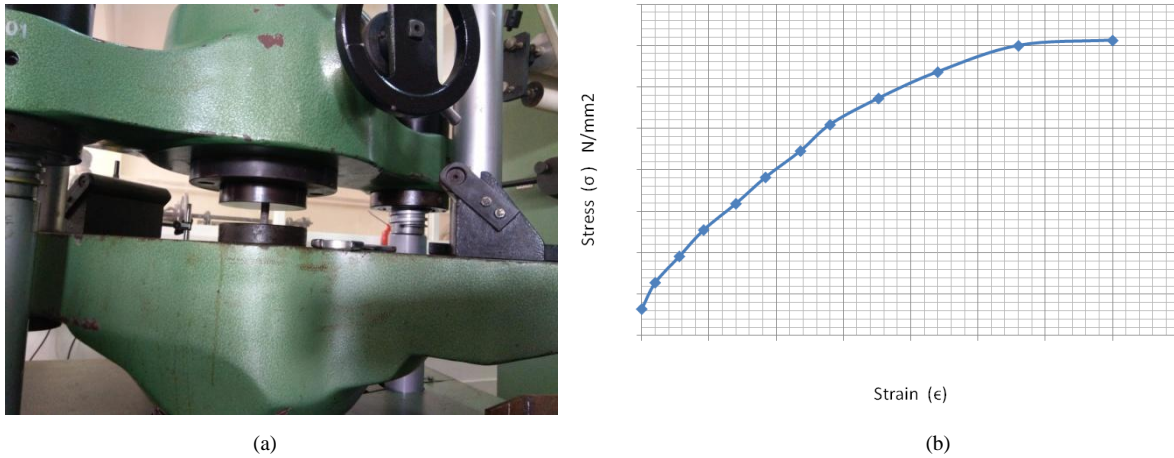


Figure 3 : (a) Compression Test, (b) Stress-strain diagram for Mg-5%SiC-5%Al<sub>2</sub>O<sub>3</sub>

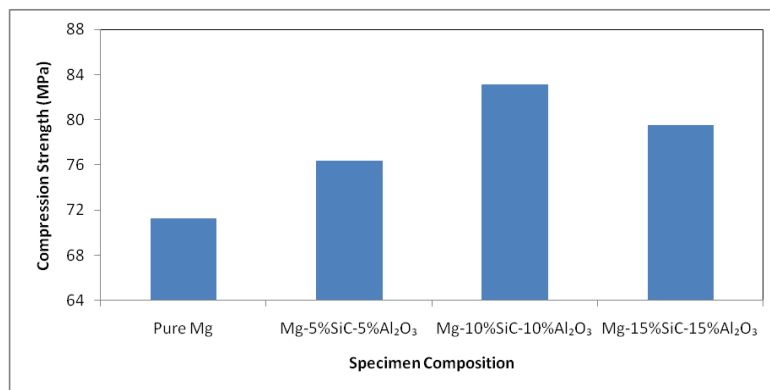


Figure 4 : Compressive Strength for magnesium MMCs

#### IV. CONCLUSION

Using the Powder metallurgy technique, silicon carbide and alumina particles can be successfully reinforced in the magnesium metal matrix to fabricate hybrid metal matrix composite material. Compression test was successfully performed on test ready specimens. The results reveals that, the compressive strength of magnesium metal matrix composites were increased as compared with pure magnesium due to the presence of reinforcement particles. Under all studied composition, Mg-10%SiC-10%Al<sub>2</sub>O<sub>3</sub> composites exhibits higher compressive strength.

#### REFERENCES

- [1] H.Y. Wang, Q.C. Jiang, Y. Wang , B.X. Ma, F. Zhao, " Fabrication of TiB<sub>2</sub> particulate reinforced magnesium matrix composites by powder metallurgy", Materials Letters 58 (2004) 3509–3513.
- [2] Zhang Xiuqing, Liao Lihua, Ma Naiheng, Wang Haowei, " New In-situ Synthesis Method of Magnesium Matrix Composites Reinforced with TiC Particulates", Materials Research, Vol. 9, No. 4, 357-360, 2006.
- [3] Gubbala Eswara Kumar, G.S.V.Seshu Kumar, " Fabrication and Testing of Aluminium Metal Matrix Composites Through Stir Casting Technique", International Research Journal of Engineering and Technology, Volume 05, Issue: 06, June-2018.
- [4] Zaklina Gnjidic, Dusan Bozic, Mirjana Mitkov, " The influence of SiC particles on the compressive properties of metal matrix composites", Materials Characterization 47 (2001) 129– 138.
- [5] S Muniaraj, P Senthil kumar, "Experimental Analysis of Compressive Stress-strain rates and Mechanical Properties of Al-6061 and Al 6061-Sic", International Journal of Latest Trends in Engineering and Technology, Volume 6, March 2016.
- [6] Lakshmanan Pillai.A, Jinu.G.R and Elansezhian.R, "Evaluation of Mechanical Properties of Magnesium Reinforced with Titanium Oxide Composites", International Journal of Engineering Trends and Technology (IJETT) – Volume-42 Number-8 - December 2016.



- [7] Muhammad Rashad, Fusheng Pan, Wei Guo, Han Lin, Muhammad Asif and Muhammad Irfan, " Effect of alumina and silicon carbide hybrid reinforcements on tensile, compressive and microhardness behavior of Mg–3Al–1Zn alloy", *Materials Characterization* 106 (2015) 382–389.
- [8] B.W. Chua, L. Lu and M.O. Lai, "Influence of SiC particles on mechanical properties of Mg based composite", *Composite Structures* 47 (1999) 595-601.
- [9] L. Falcon-Franco, I. Rosales, S. García-Villarreal, F.F. Curiel, and A. Arizmendi-Morquecho, " Synthesis of magnesium metallic matrix composites and the evaluation of aluminum nitride addition effect ", *Journal of Alloys and Compounds*, vol. 663, 2016, pp. 407-412.
- [10] Q.C.Jiang, X.L.Li and H.Y.Wang, "Fabrication of TiC particulate reinforced magnesium matrix comp[osites]", *Scripta Materialia*, Volume 48, Issue 6, 2003, Pages 713-717.
- [11] M. Meignanamoorthy and M. Ravichandran, "Synthesis of Metal Matrix Composites via Powder Metallurgy Route: a Review", *Mechanics and Mechanical Engineering*, Vol. 22, No. 1 (2018) 65–75.
- [12] Manickam Ravichandrana , Abdullah Naveen Saita and Veeramani Anandakrishnanb, "Workability Studies on Al+2.5%TiO<sub>2</sub> +Gr Powder Metallurgy Composites During Cold Upsetting", *Materials Research*. 2014; 17(6): 1489-1496.
- [13] Angelo, P. C., Subramanian, R., "Powder metallurgy science, Technology and Applications", PHI Learning Private Limited, 1-126, 2009.
- [14] HAI ZHI YE, XING YANG LIU, " Review of recent studies in magnesium matrix composites", *Journal of Materials Science* 39 (2004) 6153 – 6171.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor

**Impact Factor:  
7.512**

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details