IJETST- Vol.||03||Issue||12||Pages 4855-4857||December||ISSN 2348-9480 2016

Open access Journal International Journal of Emerging Trends in Science and Technology

IC Value: 76.89 (Index Copernicus) Impact Factor: 2.838 **DOI:** https://dx.doi.org/10.18535/ijetst/v3i12.09

Mechanical Behaviour of AZ31 Mg/Ti Composites

Authors

M.Appoothiadigal[1], B.K.Raghunath[2]

[1]Assistant Professor in Manufacturing Engg, FEAT, Annamalai, University, Annamalai Nagar, Tamilnadu, India

Email: *appoothii_adigal@yahoo.co.in*

[2]Assistant Professor in Manufacturing Engg, FEAT, Annamalai, University, Annamalai Nagar, Tamilnadu, India

Email: *bkrau@rediffmail.com*

ABSTRACT

Metal matrix composites have emerged as a new class of advanced materials in aerospace and automotive applications. Magnesium matrix composite reinforced with titanium (Mg-Ti). The most important property of magnesium-titanium composite with reference to the aerospace and automobile industry is its strength to weight ratio, which is three times more than aluminum. The Mechanical response of AZ31 Mg/Ti composite was investigated by means of hot compression test. The flow curves were obtained in the temperature and strain rate range of 300 to 500oc and strain rate 0.01 to 0.1 S-1 for AZ31 Mg matrix with different volume fraction of Ti (4%, 8%, and 12%). Izod impact test is used to measure the impact energy of the AZ31Mg/Ti metal matrix composite

Keywords- *Metal Matrix composite, AZ31 Mg/Ti composites, Impact test, compression test, Mechanical Behaviour.*

INTRODUCTION

A composite material is a material consisting of two or more physically and chemically distinct parts, suitably arranged, having different properties respect to those of the each constituent parts. Metal matrix composites have emerged as a new class of advanced materials in aerospace and automotive applications [1]. The performance advantage of MMCs lies in their tailored physical, mechanical and thermal properties, which include low density, high specific modulus, high specific strength, high thermal conductivity, control of thermal expansion, good fatigue response and high abrasion and wear resistance [2]. The two most widely used reinforcements are silicon carbide and Ti, as they are the hardest and strongest among the available reinforcements. These include piston, brake drum, cylinder liners etc. in automobile components [3]. Magnesium matrix composite reinforced with titanium (Mg-Ti). The most important property of magnesium-titanium composite with reference to the aerospace and automobile industry is its strength to weight ratio, which is three times more than aluminium [4]. A compression test is a method for determining the behaviour of materials under a compressive load. Compression tests are conducted by loading the test specimen between two plates and then applying a force to the specimen by moving the crossheads together [5-6]. Impact tests are used not also to measure the energy absorbing capacity of the material subjected to sudden loading; but also to determine the transition temperature from ductile to brittle behaviour.

EXPERIMENTAL PROCEDURE

Based on the exhaustive literature survey, it is concluded that powder metallurgy method of the solid phase processing methods serves better than other process. Powder metallurgy (P/M) is one of the processing techniques adopted for Titanium reinforced magnesium composites because relatively lower temperatures (below melting point) are involved in P/M processing. Homogenous, high strength and net shape components of Magnesium-Titanium composites can be produced through powder metallurgy (PM) route.

The undesirable interfacial reactions and development of detrimental intermetallic phases are negligible in AZ31Mg/Ti composites as compared to the cast composites. Compared to fibrous composites, particulate composites offer improved ductility and reduced anisotropy in mechanical properties. On a cost-benefit scale, the particulate composites are generally farsuperior. However, homogeneity, machinability, and interfacial reaction of the constituents represent the large problems pertaining to these composites.

The MMC test specimens are fabricated by powder metallurgy route using ball mill mixing, solid state sintering and heat treatment. In P/M techniques the following steps are involved. (i) Blending and mixing of powders, (ii) Compacting, (iii) Sintering and (iv) Finishing operations.

Universal Testing Machine.

Hot compression test specimens of 10 mm height and 10 mm diameter are machined for testing. A 0.2 mm 45° chamfer was provided on the specimen edges to avoid fold over of the material during the initial stage of compression.

Izod Impact Test

IZOD impact test is performed as per ASTM standard for determining the impact resistance of materials using an Izod impact testing machine.

RESULTS AND DISCUSSION

Compression Test

Table 1 Strain Rate of Compression Test for AZ31Mg/Ti (4%) Composite

Temperature °C	Strain	Strain Rate S^{-1}		
		0.01	0.05	0.1
300	0.1	36.8	90.4	106.8
	0.2	38.2	89.2	108.8
	0.3	36.3	90.5	112.1
	0.4	36.1	92.8	111.5
	0.5	35.6	94.8	114
350	0.1	29.2	69.5	99.5
	0.2	29.8	75.2	108
	0.3	31.0	78.5	107
	0.4	32.5	80.0	106.5
	0.5	32.0	80.8	106.2
400	0.1	20.1	60.2	90.3
	0.2	16.5	62.2	90.2
	0.3	18.2	62.2	87.5
	0.4	18.5	68.5	85.8
	0.5	19.1	65.5	84.2
450	0.1	14.1	48.5	69.2
	0.2	12.8	53.2	67.2
	0.3	10.9	53	66.5
	0.4	11.2	51.8	66.2
	0.5	15.8	56.3	65.5
500	0.1	6.8	49.3	68.3
	0.2	6.4	47.2	63.1
	0.3	6.7	46.1	59.2
	0.4	5.9	46.1	59.1
	0.5	6.1	44.6	58.5

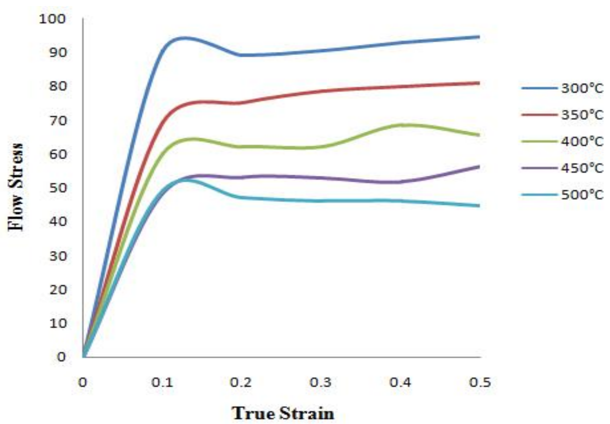

Fig 1 Strain Rate Vs Flow Stress for Various Temp of AZ31 Mg/Ti (4%)

The shape of stress strain curve is considered to contain some information related to the mechanism of hot compression [Ganesan et al, 2003]. The flow softening type of stress strain behaviour with an initial peak stress oscillation is taken to suggest dynamic recrystallization (DRX). However similar behaviour can also be due to flow instability. Likewise, DRX can occur in cases where the behaviour is steady state. At lower strain rate, the deformation is isothermal, but at high strain rate it is adiabatic [sankar et al, 1993].

Impact Test

Table 2 Impact Strength of AZ31 Mg/Ti Composites

Composite	Impact Strength (J)			
	A	B	C	Avg
AZ31 Mg/ Ti	13	12	14	13
AZ31 Mg/ Ti	15	15	16	15.3
AZ31 Mg/ Ti	16	15	13	14.6

Impact strength of ion AZ31Mg/Ti composite with volume fraction of Ti composites conducted in the IZOD impact test. Three selected location test were conducted namely A, B and C and average value is tabulated as in the table 3. Composite with 4% Titanium, shows impact strength as 13J further increase of titanium with 8% impact strength also increases as 14.6J which is 20% more than composite with 4% titanium. When Titanium increase upto 12% in AZ31 Mg Composite increase the impact strength by 10% (15.3J).

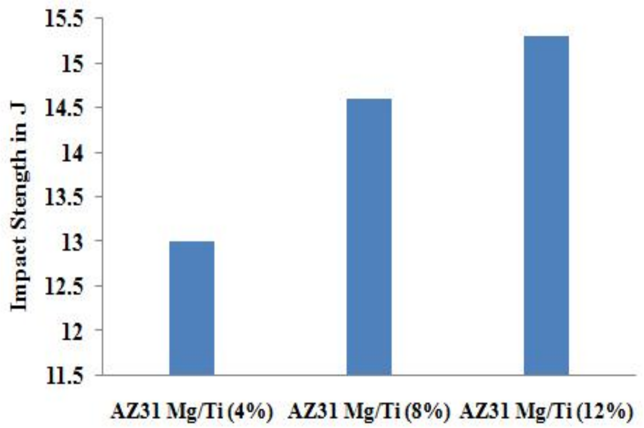

Fig 2 Impact Strength for Various % of Ti With AZ31 Mg Matrix

CONCLUSIONS

The research work highlights the preparation of AZ31 Mg/Ti metal matrix composite (MMC) following the powder metallurgy route

Flow curve at 400oC and 450oC exhibits multi peaks in the curve, which represents DRX mechanism. At higher temperature flow curve is almost flat, which reveals work hardening takes place.

The impact strength is measured for AZ31Mg/Ti (4%) composite is 13J, and for the composite of AZ31Mg/Ti (8%) the impact strength is measured as 14.6J and the impact strength of 15.3J is measured for AZ31Mg/Ti (12%) composite

REFERENCES

1. D. Magers, J. Brussels, B.L. Mordike, K. U. Kainer (Eds.)," Magnesium alloys and their applications", Werkstoff-informationsge-sellschaft, Wolfsburg, germany, ,pp 105-108, 1998.
2. Rohatgi, P.K., S. Ray, R. Asthana and C. S. Narendranath, "Interfaces in Cast Metal-Matrix Composites ", International Journal Material Science and Engineering, Vol A162, Issue 163, 1993.
3. Bharat Bhusan, "Introduction to Tribology", New York, John Wiley, 2002
4. A.T. Alpas and J.Zhang, " Effect of SiC Particulate Reinforcement on the Dry Sliding Wear of Aluminium-Silicon Alloys" Journal of wear , Volume (A356) , Issue 155 pp 83-104, 1992.
5. A.T. Alpas and J. Zhang, "Wear transitions in case aluminium silicon alloys reinforced with SiC particles", Scripta Metallurgy., Volume 26, pp 505-509,1992.
6. Lim, S. C., Liu, Y. and Tong. M. F.," The effects of sliding condition and particle volume fraction on the unlubricated wear of aluminum alloy-SiC particle composites". Proc. Conf on Processing Properties and Applications of Metallic and Ceramic Materials, Birmingham, Volume 7, Issue 10, p485-490 , 1992.