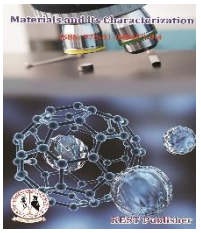
Materials and its Characterization
Vol: 2(3), 2023
REST Publisher; ISBN: 978-81-948459-0-4
Website: https://restpublisher.com/book-series/mc/



Production And Mechanical Properties of Al 6063/B4c Composites

*** Ajay Karan**
PSN Institute of Technology and Science, Tirunelveli, India.
*Corresponding Author Email:

Abstract: *The present research work has focused on the production and evaluation of mechanical properties by introducing Boron carbide (B4C) into Al6063 alloy matrix. Reinforced B4C particles with aluminium alloy matrix composites were prepared by stir casting method. Al6063 alloy has been taken as the base material to which B4C particulates were added as reinforcements. 2, 3.5, 5, and 6.5 wt. % of B4c particulates were added to the base matrix. The microstructure study was done by using optical microscope and also mechanical properties were evaluated. The result revealed that addition/increases of Boron carbide (B4C) reinforced particles in Al6063 improves the mechanical properties.*
Keywords: *Al6063 alloy, B4C reinforcements, Stir casting, Mechanical behaviour.*

1. INTRODUCTION

AMMCs are very important in different areas of research of medicine and engineering. In engineering fields AMMCs are majorly used in aerospace, defence and automobile [1-3]. Nowadays industrial need is a good material having light weight, good properties and cost less, which gives the scientists to do research on the composite materials. AMMCs widely used than other conventional materials, due to they are possesses good strength to weight ratio, adequate wear resistance and economic [4,5]. The main advantages of particulates reinforced aluminium composites over the other materials are their low cost, easily formability, and improved the corrosion and seizure resistance [6,7]. The main properties of AMMCs are mainly depending on micro structural parameters of the reinforcing materials like size, shape, volume fraction and orientation. Most of the researchers during the last three decades have been generated tremendous interested to use aluminium and its alloys due to their properties such as light weight, excellent mechanical properties, low cost, and good tribological properties compared to conventional metals. In the recent years, discontinuous MMCs have investigated. Recent interests in discontinuous MMCs have been rekindled. The MMCs are shaped by melting process, this melting process (stir casting) has rare benefits such as good bonding among the matrix and particles, low cost of processing, and structure of MMC is easily control. The current work is concentrated on new examination on learning microstructural and mechanical behaviour of Al6063/B4C composites (AMMCs), on which little work has been done.

2. EXPERIMENTAL SETUP AND PREPARATION OF AMMCS

The Aluminium alloy (Al6063) is used as matrix metal to fabricate composites that have been reinforced by weighing percentages of 2, 3.5, 5, and 6.5 of B4C. Composition of Al6063 is as given in the Table 1. The composite has been made-up by the stir casting procedure to confirm the circulation of uniformity of the B4C strengthening in Al6063. Base metal was taken and cut as small parts to place in the container. The melting has been taken in the range of 750 ± 20^0C. An illustrated representation of the stir casting setup and mould is as shown in the Fig.1. Liquefy has been automatically stirred [8-10]. Stirring method was done at a hotness of 750^0C along using stirrer speed of 600 revolutions per minute and period of 600 sec.

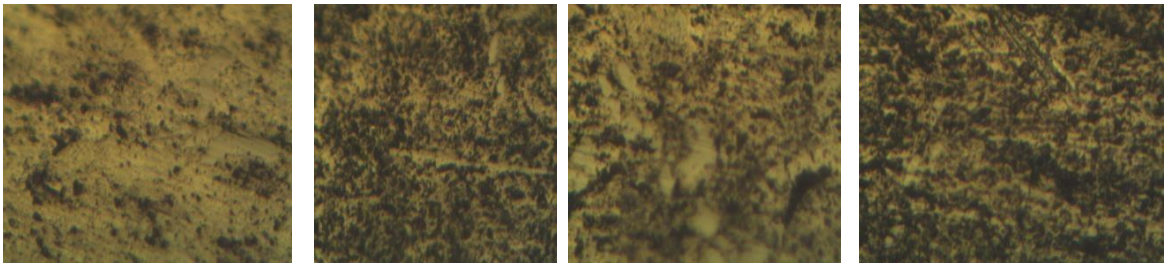
Copyright@ REST Publisher

TABLE 1. Composition of Al6063 by weight percentage

Element	Weight percentage of Al6063
Si	0.2
Fe	0.3
Cu	0.1
Mn	0.1
Cr	0.1
Zn	0.1
Ti	0.1
Aluminium	99.2

FIGURE 1. Stir casting setup and mould with AMMCs

3. MICROSTRUCTURAL STUDIES OF AMMCS



(a) (b) (c) (d)

FIGURE 2. (a), (b), (c), (d) Optical micrographs of Al6063/B4C composites with 2 wt. %, 3.5 wt. %, 5 wt. % and 6.5 wt. % respectively

4. EXPLORATION OF MECHANICAL PROPERTIES

The composite specimens have been evaluated for tensile strength, impact strength, hardness, and density.

Tensile Strength

FIGURE 3. Tensile tested specimen of Al6063/ B4C composites

Copyright@ REST Publisher

By means of conducting tests with the computer universal testing machine, the experiment values were obtained. The tensile strength is increased up to addition of reinforcements 2%, 3.5%, 5%, and decreased at 6.5% and this is due to the base material is not comfortably accommodating the reinforcements [14-17]. The tensile strength has been increased because of strong interface bonding between base metal and reinforcements. The deviation in tensile strength is as shown in Fig.4.

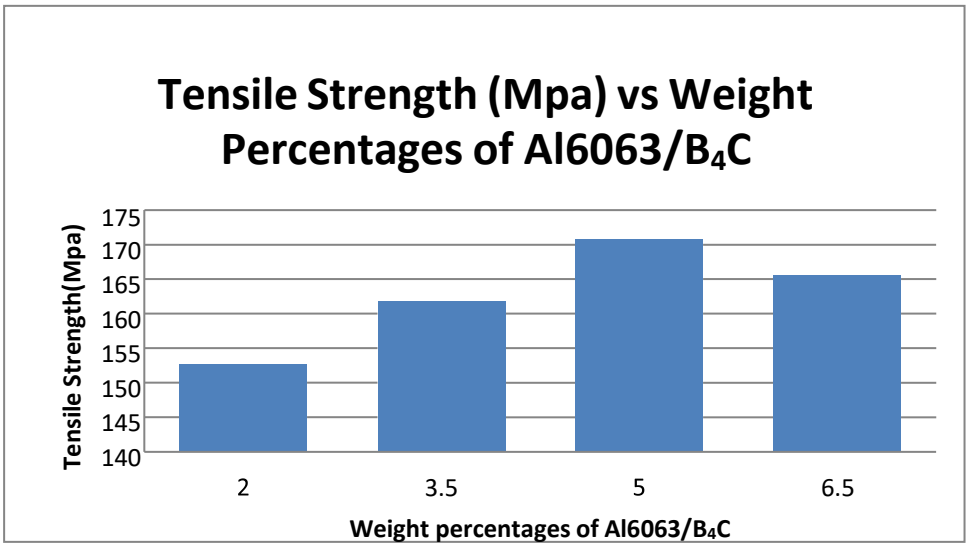


FIGURE 4. The deviation in Tensile strength of Al6063/ B4C composites

Impact Strength

By conducting experiments with the help of the Izod impact testing machine, the experimental values were obtained. The impact strength is increased up to addition of reinforcements 2%, 3.5%, 5%, and decreased at 6.5% and this is due to the base material is not comfortably accommodating the reinforcements. The variation of impact strength is as shown in Figure 6.

FIGURE 5. Impact strength tested specimen of Al6063/ B4C composites

Copyright@ REST Publisher

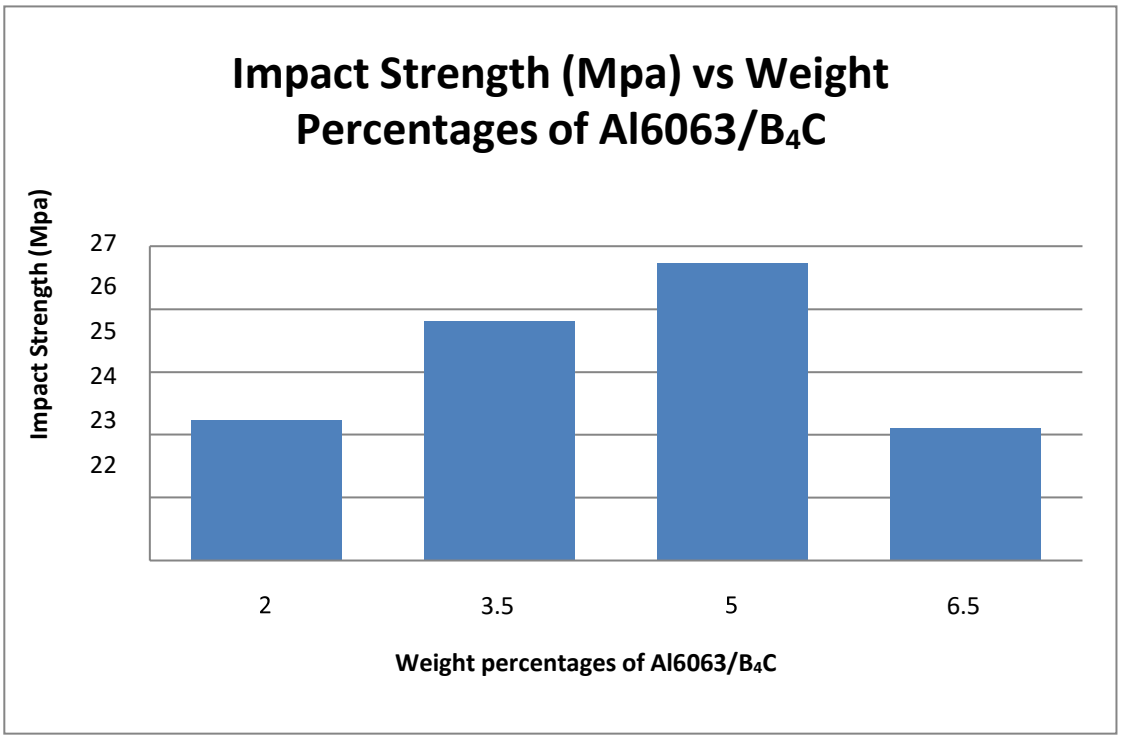


FIGURE 6. Impact strength tested specimen of Al6063/ B4C composites

Hardness

The hardness is notable mechanical property in composite material, suppose if hardness of matrix material has precise low, and it is having limited applications. Hardness of base material enhanced because of reinforcement of B4C particles are added in base material.

The values of hardness of the Al6063 and Al6063/ B4C composites were

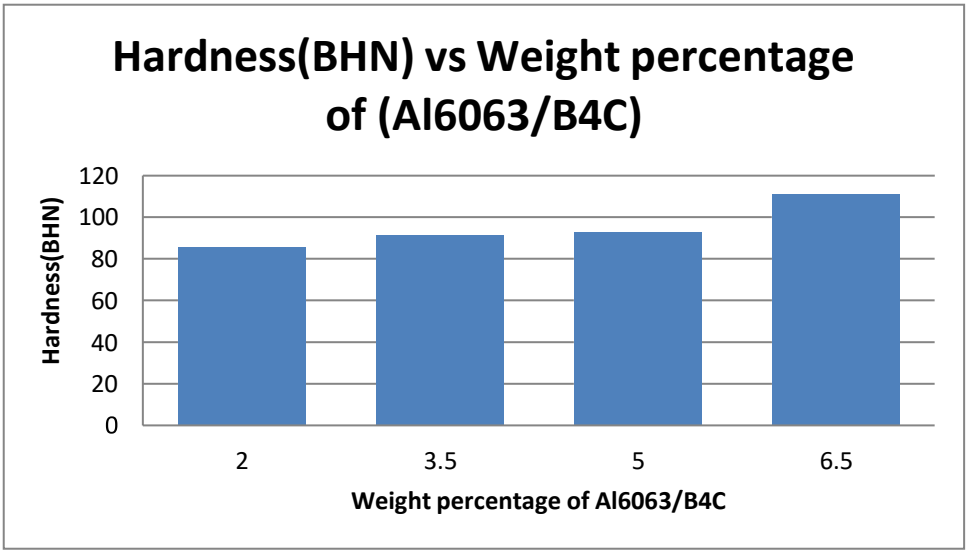


FIGURE 7. Hardness (BHN) of Al6063/ B4C composites

Copyright@ REST Publisher

Density

Density is considerable factor in selection of material for several obtained by Brinell hardness tester. The variation in hardness of Al6063/ B4C is as shown in the Fig.7.

Hardness of Al6063/ B4C composite is noticed that is 85.62, 91.57, 93.02, and 111.25 of weight percentages 2, 3.5, 5, 6.5 of B4C respectively. So, Brinell hardness number in composites is more than the Al6063. A good rise in the hardness of the Al6063 have been observed with addition of B4C particles. engineering application to improve their efficiency. Determining the experimental values of density, the AMMCs samples of measured volumes are weighed using digital balance. The density of Al6063/ B4C composites. are decreased by means of increasing the weight percentage of reinforcements 2, 3.5, 5, and 6.5 and obtained density of Al6063/ B4C are
2.65 gm/cc, 2.64 gm/cc, 2.63 gm/cc, and 2.62 gm/cc respectively.

TABLE 2. Densities of Al6063/ B4C composites

S. NO	**Weight Percentages of Al6063/ B4C composites**	**Density (gm/cc)**
1	2	2.65
2	3.5	2.64
3	5	2.63
4	6.5	2.62

5. CONCLUSION

The conclusions have been made based on the experimental investigation on B4C reinforced Al6063 at different weight fractions, which are following bellow:

1. Al6063/ B4C composites were successfully produced by liquid stir casting technique by adding 2 wt. %, 3.5 wt. %, 5 wt. %, and 6.5 wt.
   % of B4C reinforcement in Al6063 metal matrix.
2. Microstructural observations show that B4C particles with weight percentages 2, 3.5 and 5 are good distributed in the matrix material (Al6063) and good bonding between them.
3. Tensile strength has been increased with weight percentages 2, 3.5, and 5 of B4C in base metal.
4. Enlargements in impact strength of Al6063 matrix alloy were acquired by addition of weight percentages 2, 3.5 and 5 of B4C particles.
5. Hardness of the Al6063/ B4C greater than the base metal, this is due to addition of the weight percentages of B4C.
6. Density of Al6063/B4C has dwindled in cumulative the weight percentage of the B4C. It is determined that, an Al6063/B4C composite have lower density than the pure Al6063.

REFERENCES

[1] Sukumar, M.S., Anand Babu, K., Venkataramaiah P. 2014. Exploration of mechanical behaviour of Al2O3 reinforced aluminium metal matrix composites Elixir Mechanical Engineering, 72, 25462-25465.

[2] Shorowordi, K.M., Laoui, T., Haseeb, A.S.M.A., Celis, J.P., Croyen, L. 2003. Microstructure and interface characteristics of B4C, Sic and Al2O3 reinforced Al matrix composites: a comparative study, Journal of Processing Technology, 142, 738-743.

[3] Kumar, T., Ramana, K.V., Choudary. R.B. 2018. Spectroscopic characterization of mechanically synthesised MoO3/Tio2 Composite Nano Powders, ISSN: 0976-6340.

[4] Wahab, M.N., Daud, A.R., Ghazali, M.J. 2009. Preparation and characterization of stir cast- Aluminium Metal Matrix Composites, International Journal of Mechanical and Materials Engineering (IJMME), 4(2),115-117.

[5] Reddy, C., Essa Zitoun A. 2010. Tensile behaviour of Al6063/ Al2O3 particulate Metal Matrix Composites fabricated by Investment Casting Process, International journal of applied engineering research, dindigul, 1(3), 542-552.

[6] Nagaral, M., Dayanand, S., Basavaraj, V.K., Auradi V. 2015. Production and mechanical Properties of Al2618-Tic Composites, Indian Journal of Scientific Research, 12(1), 055-059.

[7] Chawla, N., Shen, Y.L. 2001. Mechanical Behaviour of particule reinforced Metal Matrix Composites, Advanced Engineering Materials, 3(6), 357-370.

[8] Singh, V., Prasad, R.C. 2004. Tensile and Facture behaviour of 6061 Al- Sicp Metal Matrix composites, International Symposium of research students on materials and engineering, Chennai, India, department of metallurgy and materials engineering, Indian institute of Technology Madras.

Copyright@ REST Publisher

[9] Rohatgi, P. 1991. Cast aluminium matrix composites for automotive applications, Journal of Organometallic Chemistry, 10-15.
[10] Baradeswarn A., Perumal, E. 2013. Influence of B4C on tribological and mechanical properties of Al7075-B4C Composites, Composites part B, 54, 146-152.
[11] Rai, R.N., Rao, A.K.P., Dutta, G.L., Chakraborty, M. 2013. Forming behaviour of Al-TiC in-situ composites. Material Science Forum, ISSN: 1662-9752.
[12] Besterci, M. 2006. preparation, microstructure and properties of Al- Al4c3 system produced by mechanical alloying, materials and design 27, 416- 421.
[13] Chadwich, G.A., Health, P.J. 1990. Machining of metal matrix composites, Metals and Materials International, 2-6, 73-76.
[14] Sahin, Y., 2003. Preparation and some properties of SiC particle reinforced aluminium alloy composites. Materials and Design, 24, 671- 679.
[15] Dinwoodie, J. 1987. Automotive applications for MMCs based on short staple alumina fibres, SAE Technical Paper series, Int. Con. Exp., Detroit, Michigan, 23-27.
[16] Rosso, M. 2006. Ceramic and metal matrix composite: Routes and Properties, Journal of Materials processing Technology 175, 364-375.
[17] Umananth, K., Palanikumar, K., Selvamani. 2013. Analysis of dry sliding wear behaviour of Al6061-Sic – Al2O3 hybrid metal matrix composites, Composites part B, 53, 159-168.

Copyright@ REST Publisher