



Al/B₄C Metal Matrix Compounds with 8 and 10 mass Percentage of B₄C reinforcement content produced through Stir Casting method

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Abstract

In this investigation an endeavor is made to determine the effect of fortification on mechanical of Al6061-B₄C composite. Two composites are manufactured by varying 8 and 10 mass percentage of fortification through stir casting method. Prepared composites are tested to determine influence of fortification on tensile power and stiffness of the Metal matrix compounds. From the investigation we found that by varying supporting material in the composites properties like tensile strength and hardness was optimized. Optical and SEM images confirms that there is a homogenous dispersion of the reinforcement with the matrix hence there is increase in mechanical properties

Keywords : Stir casting process, optical, SEM, Tensile power, Stiffness

Introduction

With the extension pursued for less thicker and remarkable stiffer part, Al cross section composite track down its situation in the space of aeronautics & non-flying classes. The replacement of the nickel cast iron in customary diesel engine chamber crown by aluminum cross section composite has achieved a lighter, genuinely squashing and more sensible thing[1]. In presentations, for example, auto energy channels, chamber linings, interfacing posts and on account of low warm development then conductivity Al based composites are utilized as hotness

sinks in chip transporter multi-facet sheets, fast worked with circuit bunches for PCs and in base plates for electronic supplies. Aluminum structure being lighter can be reinforced via growing less thick hard ended particles, for example, SiC, Al₂O₃, TiB₂, B₄C,[2] [3] and so on which expressions enhancements in stuffs. Amount of gathering strategy are presence utilized for manufacture of MMC seems to be strong state techniques, fluid state framework, announcement and in situ procedure[4] [5] ready of which fluid phase strategies unequivocally mix projecting has an enchanting cash related perspective got along with varied

confirmation of constituents and dealing with situations[6][7]. In standard mix projecting association, support substantial is being put to liquid association and poured in to exceptionally strong patterns following mixing system [8]. Mix projecting collaboration deals with better holding among association and sponsorship as a result of the blending development. The critical worry in making MMC's is bother in accomplishing similar designation of elements, wettability, compound responses at the sign of association and permeability [9][10][11].

An enormous piece of evaluation carried out around development of Aluminium based Metal matrix composites, by and large, Al₂O₃, TiB₂ as help substantial; yet utilization of B₄C partials is staggeringly restricted considering gigantic expense and unprotected soaking with Aluminium framework under 1100°C [12]. Boron carbide is having hardness of 3800Hv measured as third toughest material close to pearl and Carbon-boron nitride with mind blowing effect and wear impediment, short express thickness ,small warm conductivity and extraordinary robustness and it can be used in applications like flying covering, as unsavory, meanders aimlessly, and so forth . Soaking of soil atoms may be further developed through various methods which intertwine pre-treatment, utilization of exterior special specialists [13] which reduces exterior strain and inter connected powers[14]. Covering of boron carbide elements with Ti dust accomplishes headway of staggering exterior coatings of TiB and TiC [15] and these inter connected things have more significant metal person to their holding developing improved wire of boron carbide atoms through consolidate. Utilization of Potassium Fluortitanate through projecting an alternative technique used to cleaning which has accomplished furthermore developed holding among Aluminium and boron carbide atoms working with improved mechanical possessions in

MMC`s. Additional, throughout dissolve blending, attainment certifiable dispersal of creating subdivisions through grid is attempting. Since just subsequent to soaking the atoms bowl because of thickness contrasts thus, the disseminating becomes non homogeneous which might incite social occasion and separation of particles at a specific spot in the soften. Such impact could incite a couple microstructural leaves corresponding permeability, oxide examinations and inter connected responses.

In Present research an attempt have been made to manage 6061aluminium-boron carbide combinations at hotness of 750°C via crumble mixing process. During composite accessibility, pre-warmed B₄C particles were integrated strides of dual hooked on gather to update soaking besides blend of boron carbide atoms hooked on fluid Aluminium. Additional, the combinations coordinated stayed introduced to calculation of mechanical belongings to announcement degree of progress accomplished in this way.

Test subtleties

B₄C particle developed 6061Al compound composites containing 8 and 10wt% of B₄C were made by condense blending using two phase extensions. The manufactured design of the 6061Al mixture organization and B₄C is as shown in table 1 and 2. The system for fluid phase formation was utilized. The combinations were fabricated by implementing the mixture broadening series, as proposed underneath. An obstruction extra scorching became used to withdraw a celebration of 2 kg of 6061-Aluminium to 750°C in a graphite crucible. A agitator became implemented to disturb the clean and to create a excellent twister. Slag became sure from the liquid metallic then the 3g of degassing pill became carried out to the vortex. Warmed boron carbide debris of eight and ten weight percentage have been carried out to the twister at 800°C with mechanical mixing at three hundred rpm

for five minutes. The liquid metallic became then crammed a preheated plan and permitted to harden at a hotness of 850°C. This method became employed to create Aluminum Metal Composites with

unequivocal boron carbide mass amounts. Images 1 display the cast iron plan and image 2 displays the blend projecting chart employed to produce composites.

Composition	Al	Mg	Si	Fe	Cu	Cr	Zn	Ti	Mn
% age Weight	Min95.85	0.8	0.40	0.0	0.1	0.04	0.0	0.0	0.0
	Max98.56	1.2	0.8	0.7	0.40	0.35	0.25	0.25	0.15

Table 1. Chemical composition of Aluminum 6061

Property	Value
Density (g.cm ⁻³)	2.52
Melting Point (°C)	2445
Hardness (Knoop 100 g) (kg.mm ⁻²)	2900 - 3580
Fracture Toughness (MPa.m ^{-1/2})	2.9 - 3.7
Young's Modulus (GPa)	450 - 470
Electrical Conductivity (at 25 °C) (S)	140
Thermal Conductivity (at 25 °C) (W/m.K)	30 - 42
Thermal Expansion Co-eff. x10 ⁻⁶ (°C)	5
Thermal neutron capture cross section (barn)	600

Table 2 Chemical Composition of B₄C



Image.1 cast iron form



image 2 mix projecting arrangement

Nano structure Representation and Mechanical examination

The pre-arranged compounds existed exposed to Nano structure portrayal utilizing optical microscopy and Scanning Electron Microscopy outfitted with EDX investigation to distinguish morphology and transmission of boron carbide elements in 6061Al lattice. Miniature hardness estimations were directed on pre-arranged composite at various areas on a similar example utilizing miniature Vickers hardness analyzer . The mechanical possessions of the pre-arranged compounds were estimated underneath strain utilizing a Computerized UTM according to ASTM E08- norms. Malleable examinations conducted on three examples of every synthesis and normal worth was accounted for.

RESULTS AND DISCUSSIONS

Portrayal Utilizing SEM and Optical Microscopy

Microstructural portrayal of the 6061Al combination and 6061Al built up with 8 and 10wt% reinforcement is completed by the assistance of Scanning Electron Microscope and optical magnifying

instrument and are introduced in image 3 (a-c) and image 4 (a-c). Image 3 (a) and Image 4 (a) shows SEM microphotograph and optical microphotograph of 6061Al without expansion of boron carbide particles. Image 3b, 3c and image 4b, 4c Microphotographs obviously uncover the existence of boron carbide elements in Al lattice. From the images it clears that two stage increases has brought about genuinely homogeneous dissemination of supporting elements in the Al network. Likewise no grouping or accumulations of the elements were perceived all through sample which might be because of recovering mixing activity accomplished by means of two stage expansion. The ounce mass of composite was expressively more humble than that of the combination later atoms go about as nucleation objections. Images moreover uncovers that extraordinary dissemination of strongholds and there is no agglomeration in the composite and there is a respectable breakdown unrestricted property was formed at discrete regions amongst the assistance and cross section mixture

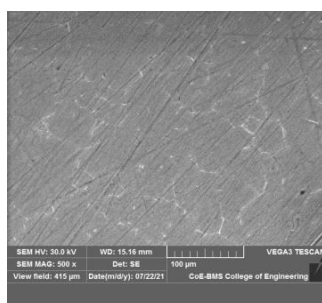


Image 3a scanning electron microscope pictures of as cast Aluminum 6061,

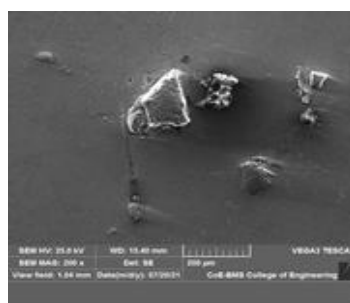


Image 3b scanning electron microscope pictures of composite with 8% reinforcement

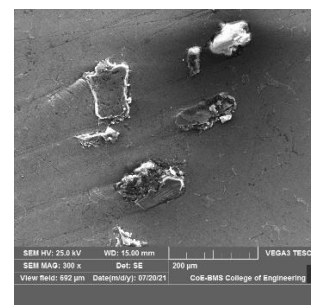


Image 3c scanning electron microscope pictures of composite with 10% reinforcement

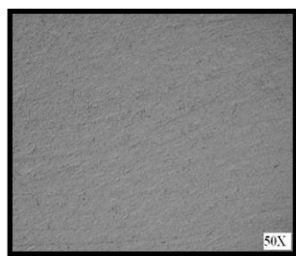


Image 4a optical microscopy image of As cast AL6061

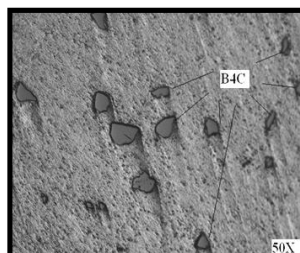


Image 4b optical microscopy picture of composites with 8 % reinforcement

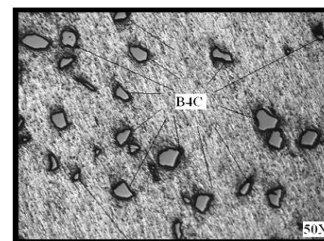


Image 4c optical microscopy picture of composites with 10 % reinforcement

Assessment of Mechanical Properties

The mechanical properties, for example, ludicrous flexibility, yield strain, Hardness and % broadening were reviewed both on 6061Al and 6061Al created with 8 and 10 wt. % reinforced compounds. Outcomes of the identical are accessible in Fig.5 (a-d). It is unblemished from image. 5(a-c) that mechanical stuffs of the as cast organization are enhanced with the development of boron carbide elements after appeared differently in relation to that of immoral cross section only. The level of progress got in the as cast blend next inclusion of 8 and 10 wt. % of B₄C elements were 55% and 29% (outrageous versatility) and 54% and 35%, (yield pressure) and 44% and 36% (Hardness) independently. Of course the adaptability of the combinations lessens with development of boron carbide atoms which might be a result of the way that existence of boron carbide elements reasons tension setting through soft disfigurement, therefore reducing the flexibility. Additionally, the occurrence of

permeability and interfacial things outlined at the place of communication could be various purposes behind minor pliability in the compound models. The enhancements in mechanical stuffs saw with compounds over as cast network might be a result of binary components. As a matter of first importance, presence of minimal second stage particles reliably dispersed in a moldable system are considered to be the typical wellspring of composite bracing. Likewise, the development of reinforcement to the Al network has achieved decrease in particle size of the framework blend

In the ongoing effort, it is imagined that boron carbide elements, when supplementary to Aluminium liquefy go likely as diverse nucleating protests through lying out and accordingly main to reduction in particle mass and thusly updates in mechanical stuffs. The outcomes and models got in the flow effort are in mind boggling synchronization with persons of prior scientists

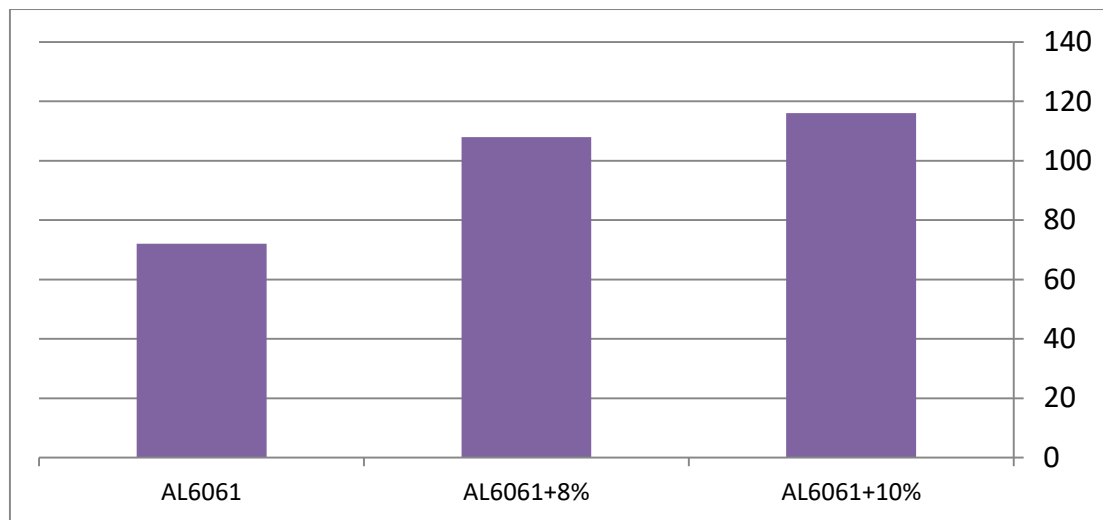


Fig 5 a Showing the Hardness Results of Cast Al 6061 with Addition of 8, 10 wt. % of B₄C Particulates

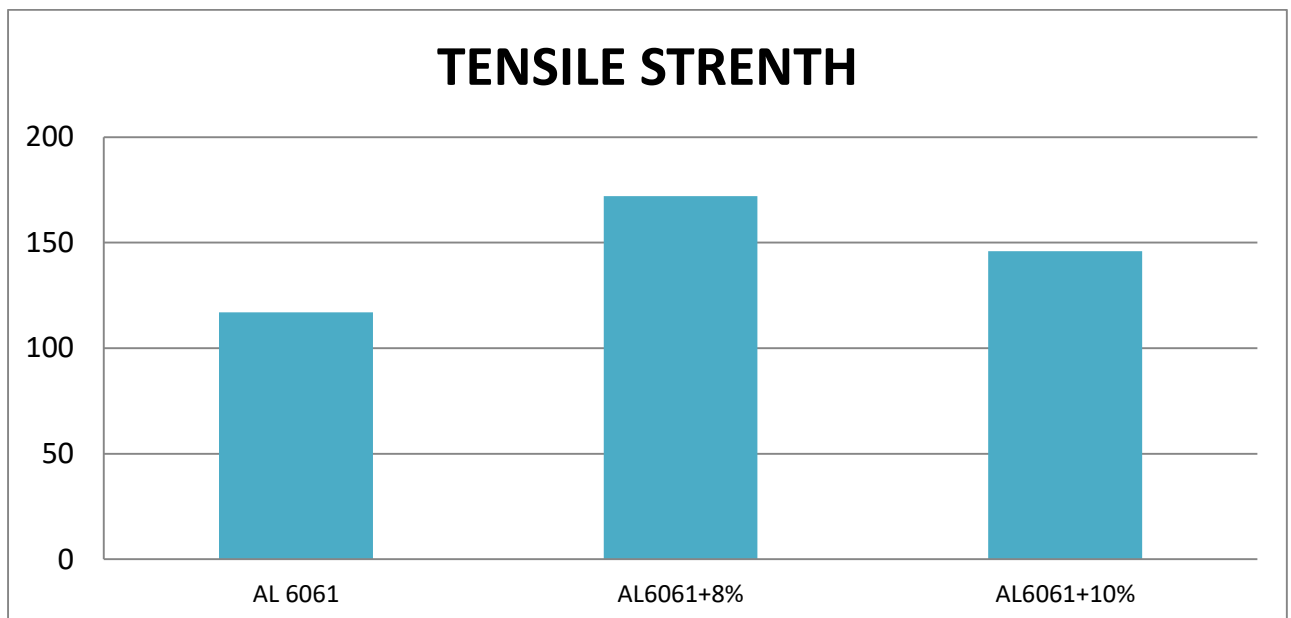


Fig 5 b: Showing the Tensile Test Results of Cast Al 6061, with Addition of 8,10 wt. % of B₄C Particulates

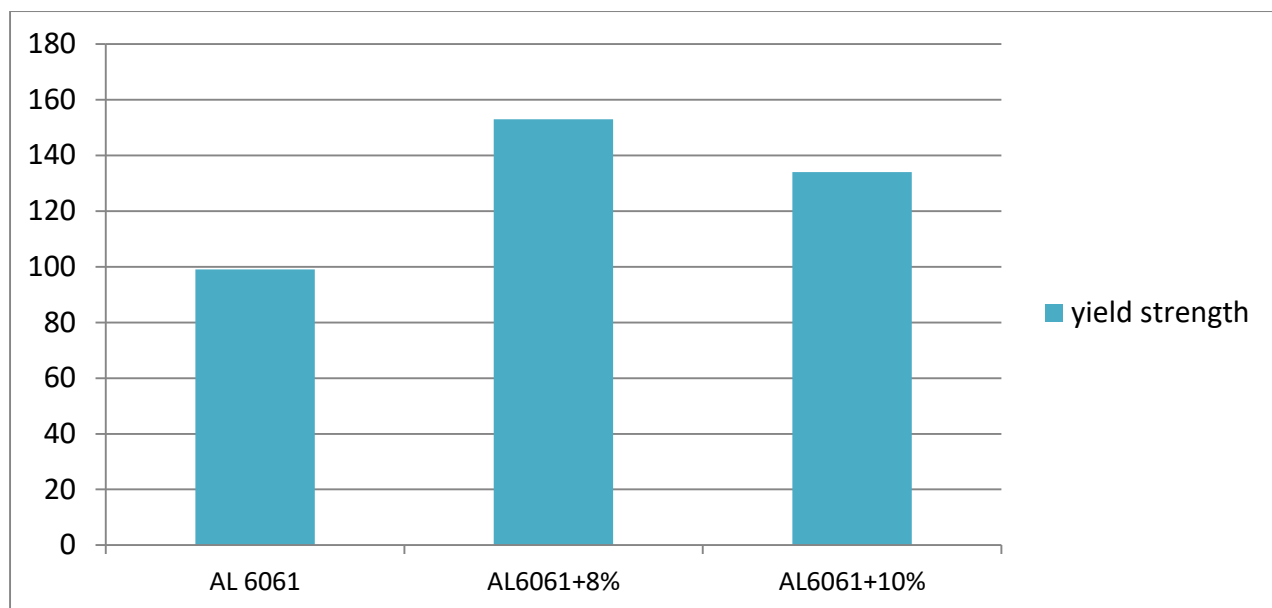


Fig 5 c Showing the Yield strength Results of Cast Al 6061, with Addition of 8, 10 wt.% of B₄C Particulates

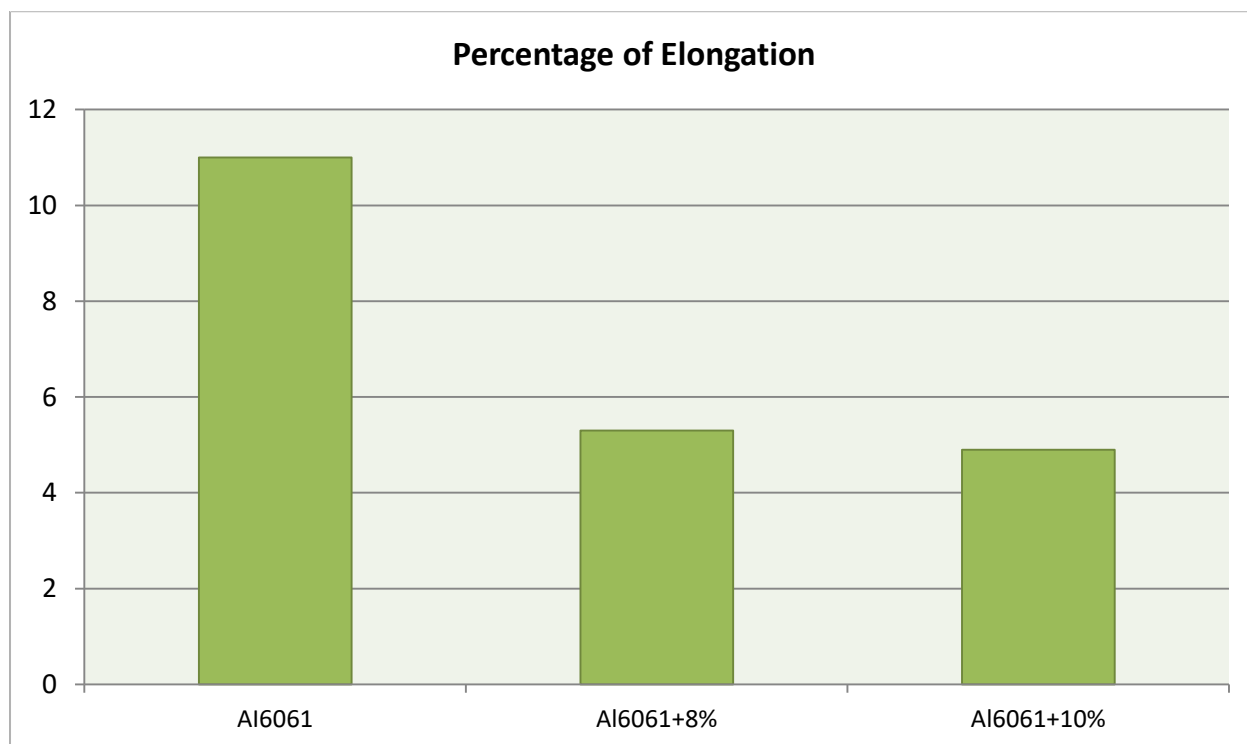


Fig 5 d showing the Percentage elongation of Cast Al 6061, with Addition of 8, 10 wt.% of B₄C Particulates

Fractography of fractured specimen

Fractography assessment was ambitious on overdrawn reasonable physical for recognize the method of interruption that happened during the flexible examination. Image 6 broke flexible ideal Scanning Electron Microscope copy of unreinforced composite obviously demonstrations

versatile disruption, at this juncture Dents were tracked down in the image. image 7 and 8 ruined adaptable typical Scanning Electron Microscope copy of composites reinforced with 8% and 10% boron carbide displays the gentle interruption due to nature of boron carbide . In images visibly wrecked exterior displays sensationally far new turn of proceedings and cleavages.

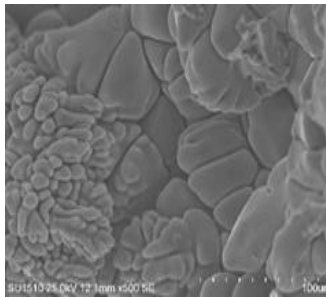


Image 6 broke ductile example SEM picture of as cast 6061

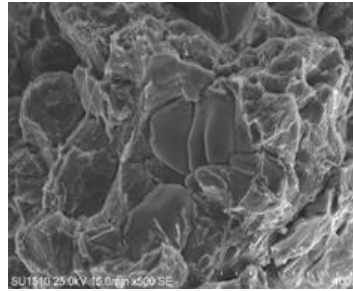


Image 7 broke ductile example SEM picture of composite with 8% reinforcement

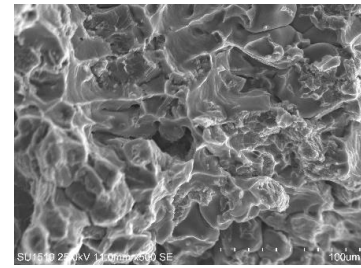


Image 8 broke ductile example SEM picture of composite with 10% reinforcement

Conclusions

The accompanying results are drawn from the examination

- 6061Al blend remained aware of eight and ten weight percentage of boron carbide particulate compounds have been enough long past earlier than via combo projecting system
- The existence of boron carbide particles was discovered by Scanning Electron Machine pictures and optical micrographic analysis, indicating that boron carbide is scattered homogenously with metal connection compound.
- When isolated from the lattice alone, the advancement of the boron carbide atoms to the 6061Al arrangement has the effect of increasing the mechanical qualities (hardness, yield strength, UTS), while the flexibility decreases..
- The adaptive mode break in unreinforced material is demonstrated by versatile broken surfaces. Furthermore, a delicate mode break is tracked down in the composites as the help delighted with rising to eight and ten weight percentage.

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