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Experimental investigation on mechanical properties of aluminium based composites

G. Ramesh

gramesh_me@yahoo.co.in

MEA Engineering College,

Perinthalmanna, Malappuram, Kerala

C. Poovendran

cpoovendran@gmail.com

Sri Krishna Polytechnic College,

Coimbatore, Tamil Nadu

N. Vasudevan

vasudevan.npa@gmail.com

NPA Centenary Politechnic College,

Kotagiri, Tamil Nadu

B. Gopinath

gopi_npatkg@yahoo.co.in

NPA Centenary Polytechnic College, Kotagiri,

Tamil Nadu

V. C. Uvaraja

c_uva@rediffmail.com

Bannari Amman Institute of Technology, Erode,

Tamil Nadu

ABSTRACT

Hybrid metal matrix composites are used in many industries due to its strength. Composites can be prepared using stir casting method. In this paper, an Al 7075 alloy is used as the matrix with varying weight percentage of Silicon carbide and Boron Carbide particles as the reinforcement material. In this study tensile strength, compression strength and hardness of the composite specimen were discussed. Results showed that there is a considerable increase in hardness and tensile strength of the fabricated composites than the base metal

Keywords: Reinforcement, hardness, metal matrix composites, weight percentage, casting.

1. INTRODUCTION

The reinforcement material is varied with a matrix to present desired characteristics [1]. MMCs are extensively used in aerospace applications because of enough strength. [2-3]. Owing to less weight aluminum and its alloys are used in many industries [4]. The various reinforcements like SiC, Al₂O₃, Zircon, Graphite, Boron carbide, Mica were also taken for many applications [5]. Boron carbide particles are worn as reinforcement in engineering applications. [6]. Exploration of mechanical properties of aluminum alloys reinforced with Boron carbide and silicon carbides is an inspiring field of research. [7] In recent years, composite materials are well thought-out due to its slighter cost and their capability for dispensation. [8,9]. Stir casting is a successful giving out method since it is very less pricey and provides a spacious variety of materials. [10,11]. Accordingly, the intent of this study is to scrutinize the consequence of Boron Carbide content and silicon carbide content on the hardness, tensile strength Al7075- varying wt. % of B₄C (5%) and SiC (5%) composites. [12]

2. EXPERIMENTAL INVESTIGATION

2.1 Material details

Aluminum 7075 is used in automobile industries due to good strength, low density, and enhanced thermal properties. Aluminum alloy has good wear resistance with reinforced particles. Boron carbide is an enhanced reinforcement material due to its superior quality chemical steadiness. All the mechanical tests were done on B₄C and SiC particulates reinforced composites. Table 1 shows the composition of weight percentage of matrix materials Al7075. The size of reinforcement materials B₄C and SiC 20-25µm. The evaluation of density for matrix and reinforcement materials are tiny and hence results in identical mixing.

2.2 Processing Methodology

In Stir casting method the stirrer was rotated uniformly to stir the reinforcements. Aluminum was heated above its melting temperature. Silicon carbide about 25% and Boron carbide about 15 % were added in the molten metal. Using stirrer uniform stirring was done and Stirrer was rotated at 600rpm. After some time the bottom of the furnace was opened. A die with the dimension 50X50X50mm was kept under the furnace. The lid at the bottom was opened and the molten metal was forced to settle in the die. After cooling the die was removed and the composite was taken out. Then the second specimen with silicon carbide 20% and Boron carbide 10% was fabricated with the same setup. Tensile strength, Compressive strength, and hardness were tested. Tensile strength was tested in UTM and hardness were tested using Brinell hardness testing machine. Four set of readings were taken as an average value was taken as the hardness value.

Table 1: The composition of Al 7075 by weight percentage

Elements	Si	Fe	Cu	Mn	Ni	Zn	Ti	Mg	Cr	Al
Wt%	0.06	0.18	1.63	0.074	0.05	5.62	0.049	2.52	0.22	Balance

3. RESULTS AND DISCUSSION

3.1 Tensile Test

It is noticeable that tensile strength of composites containing 15 wt% B₄C and 25%SiC reinforcement particles was high when compared to other composites. This was outstanding to a thermal variant in the matrix. The presence of B₄C and silicon carbide particles in the matrix does the matrix a large amount harder and avoid crack through deformation. Fig 1 illustrates the Tensile strength. The ductility of the Al alloy-based composites, quantified in rudiments of tensile elongation, decreased with an increase in B₄C and SiC particle size. The accumulation of B₄C and SiC particles into composites enhanced the tensile strength.

3.2 Compression Test

Figure 2 shows the dissimilarity of compressive strength. During compression test, the specimen is compressed and the warp takes place. Elastic limit, proportional limit, yield point, yield strength, compressive strength can be resolute by compression strength. When the bend comes to the intermolecular forces rise and overcomes the force functional. A bigger applied force may direct to an eternal deformation of the object.

3.3 Hardness Evaluation

A remarkable increase in hardness of the alloy matrix was observed totaling together of SiC and B₄C particles. This indicated that the persistence of particulates in the matrix improved the on the entire hardness of the composites. This is billed to the fact that aluminum is a spongy material and the reinforced particles individual hard, contribute certainly to the hardness of the composites. The existence of stiffer and harder B₄C and SiC reinforcement leads to magnify in resistance to plastic deformation of the matrix. Figure 3 shows the hardness assessment.

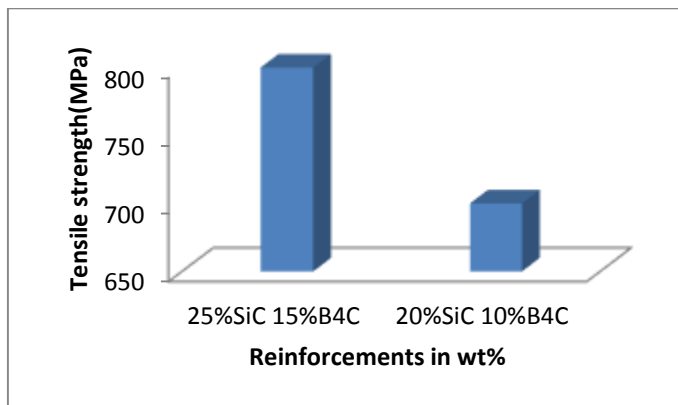


Fig. 1: The ultimate Tensile strength of the Al7075 composite alloy

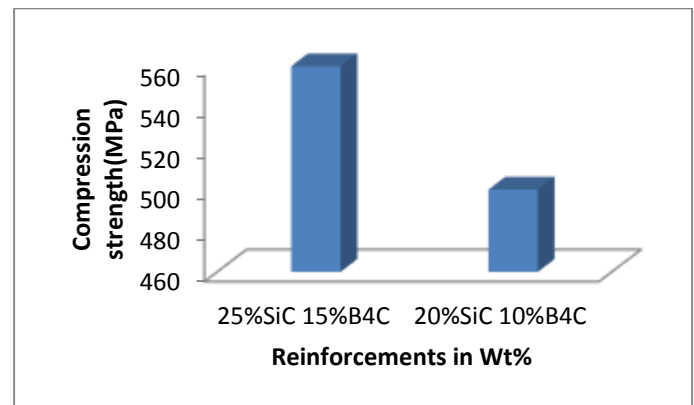


Fig. 2: The ultimate Compressive strength of the Al7075 composite alloy

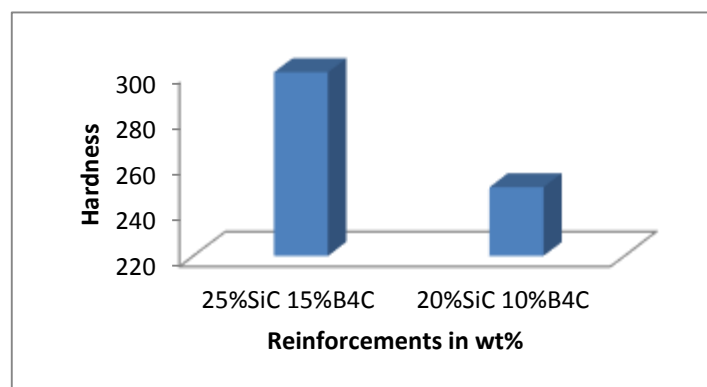


Fig. 3: Hardness Evaluation of Al7075 Composite alloy

4. CONCLUSION

The incidence of the advanced reinforcing particles causes a crucial increase in tensile strength. The pervasiveness of stiffer and harder B₄C and SiC reinforcement escort to the heave in resistance to plastic deformation of the matrix. It was investigational that in the Al7075 matrix alloy B₄C and SiC reinforcements act as a better-quality attachment. A compression test consequences the decisive concert of materials.

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