Preparation and Microstructure Characteristics of Aluminium 6061 Alloy Based Metal Matrix Composite

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Abstract*: *The role of engineering substances within the improvement of cutting-edge era like metallic Matrix Composites (MMCs) have evoked a eager hobby nowadays for capacity programs in aerospace and car industries as a result of their advanced power. Aluminium (6061) and Boron Carbide (Powder) is chosen for reinforcement material and matrix respectively. Al–B4C composites containing special weight probabilities 3.5 %, 7.0% and 10.5% of B4C have been fabricated by way of stir casting Technique. Experiments are conducted with the aid of various weight fraction of B4C (3.5%, 7.0% and 10.5%), at the same time as maintaining all other parameters regular. The compositions of their small structural options are determined through scientific discipline magnifier..

Keywords* : *About Boron Carbide, Stir casting, Aluminium and metal Matrix Composite .

I. INTRODUCTION

The chemically awesome level which is fabric inclusive is known as composite fabric[1]. The matrix or non-stop element has the reinforcing aspect which is present inside. The matrix which is metallic is known as the Metal Matrix Composite (MMC)[2]. The reinforcement takes place in MMC by means of non-stop, quick fibers, whiskers and particles.Now days with the fashionable development, superior manufacturing materials innovations for varied manufacturing packages are continuing to grow [3].Steel matrix composite is one in every effective delivery to meet these desires. Composite fabric is one of the most robust alternatives[4]. Compounds in composites are mixed in this way so we can make better use of their figure fabric while minimizing the outcomes of their deficiencies to a certain extent[5]-[6].

II. OBJECTIVES OF THE PROJECT

The targets of the challenge are:

- ☐ The primary objective of this paper is to manufacture Al-B4C metal matrix composite with varying composition (three.5 %, 7.0 %, and 10 %) of Boron Carbide reinforcement debris that used the stir casting approach
- ☐ The compositions of their micro structural capabilities have been determined by using Metallurgical Microscope.

III. CHOICE OF MATRIX

A. Aluminium 6061

Define The Al 6061 commercial grade has 2.7g/cm3 theoretical density and used for the metal matrix such as, marine, aerospace and transport applications and with the welding strength, efficiency and high corrosion resistance. Aluminium 6061 matrix is shown in figure 1. The constitu¬ents of Al 6061 have been given in Table I.

Table- I: Name of the Table that justify the values

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
0.4 - 0.8	0- 0.7	0.15 -0.4	0.0 - 0.15	0.8- 1.2	0.04- 0.35	0.0 - 0.25	0.0 - 0.15	Bal

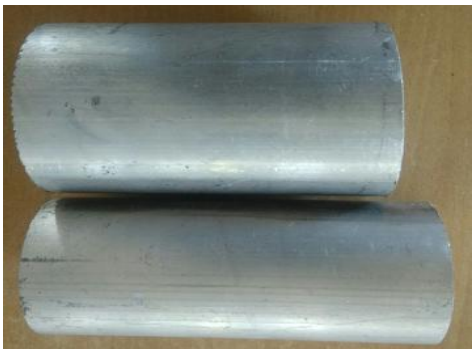

Fig. 1. Aluminium 6061 Matrix .

B. Boron Carbide

The hardest ceramic material known as boron carbide is taken as reinforcing

Revised Manuscript Received on December 16, 2019.
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material. The B4Cis 2.52 g/cm3 density and its melting point is 2450°C. B4C as shown in figure 2. The constitu¬ents of B4C have been given in Table II.

Fig. 2.Boron Carbide Powder .

Table- II: Constituents of Boron Carbide

Elements	B+C	B Min	C max	B_2O_3	Fe	Si
Percentage	94-98.5	74-79	17-24	0.1-1.0	0.2-0.5	0.1-0.3

IV. METHODS AND MATERIALS

Because For the manufacturer of Al MMC, stir casting method was identified as well as the marking were given in Table III.Using coupling motor with gearbox and a mild steel stirrer, the preliminary stirring device were superior. All the melting was accomplished in an oil-fired furnace in a graphite crucible. Bars of aluminum 6061 were preheated at one thousand for three to 4 hours in advance than melting and mixing the Silicon Carbide debris had been preheated at 500°.

The semi-strong kingdom is preserved by the melted alloys and cooled down as liquid. The composite slurry is exactly become reheated after the completion of manual blending. The mechanical mixing is changed for 10 minutes at regular string at 700 rpm. The modified temperature controlled inside is 760°C in the final blending system. The die mould is prepared with the scale for (100mm x 100mm x 14mm) for composite slurry pouring. The squeeze and stir casting is used as the experimental setup. The low charge liquid has to provide the MMC for stir casting approach, so the stir preprocessing is discussed in this paper. Figure 3 and 4 desk shows the stir casting setup to examine the flexible, attractive and simple.

It produces a undamaged reinforced materials over the stir casting direction guarantees. Additionally fabricates Al-B4C MMCs specimen as shown in determine in figure 5.

Table- III: Compositions of samples

Sample of weight=1250 Grams

Sample No	Aluminium (Grams)	Boron Carbide(Grams)	Remarks
1	1206.25	43.75	Al-3.5%B4C
2	1162.50	87.50	Al-7.0%B4C
3	1118.75	131.25	Al-10.5%B4C

Fig. 3.Stir Casting Apparatus .

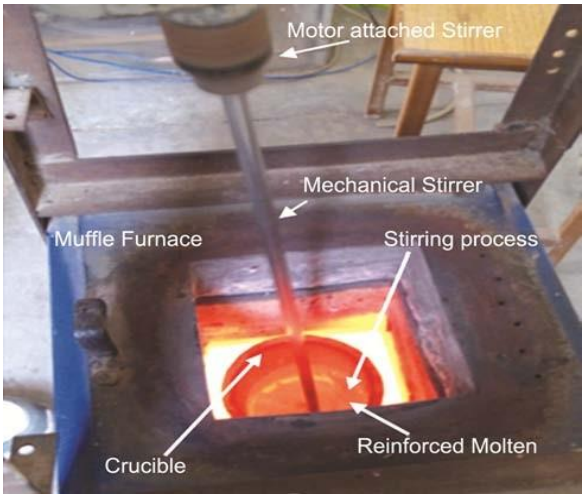

Fig. 4.Stir Casting process .

Fig. 5.Al-B4C MMCs Specimen .

V. RESULT AND DISCUSSION

Boron Carbide with aluminium is fabricated by using stir casting process for particulate composites. Al-B4C MMCs are proven in determine in figure 7,8 and 9. Metallurgical Microscope Dewinter Tech equipment as proven figure 6.

Fig. 6. Metallurgical Microscope Dewinter Tech Equipment.

Fig. 7. Microstructure of Al-3.5% B4C MMCs.

Fig. 8. Microstructure of Al-7.0% B4C MMCs.

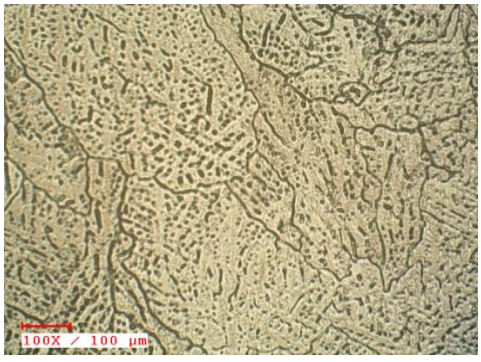

Fig. 9. Microstructure of Al-10.5 % B4C MMCs.

Chemical composition of the composite of 3.5 %wt, 7.0 %wt and10.5 %wt Al-B4C is discussed in Table IV.

Table- IV: Chemical composition

Composition	Al-3.5%B4C	Al-7.0%B4C	Al-10.5%B4C
Silicon	0.789	0.790	0.523
Iron	0.300	0.688	0.339
Copper	0.269	0.187	0.095
Manganse	0.126	0.099	0.094
Mangesium	0.828	0.817	0.526
Chromium	0.128	0.246	0.092
Zinc	0.024	0.009	0.021
Titanium	0.027	0.027	0.005
Boron	0.001	0.002	0.006
Aluminium	Balance	Balance	Balance

VI. CONCLUSION

B4C MMCs were produced through stir casting route with extraordinary wt%(viz.,3.5,7.0& 10.5wt%) of the microstructure and reinforcement properties are performed and evaluated. The following conclusions are made from this study.

☐ The Al-Boron carbide has the production and it is changed efficiently.

☐ The microstructure of Al-B4C MMCs was discovered to be Boron are uniformly dispersed particles with a aluminium matrix wt% of reinforcement.

REFERENCES

1. N. Khan ,M. Wahid ,S. Singh, A. Siddiquee, Z. Khan ," A study on micro hardness in wire electrical discharge machining based on taguchi method", *Int. J. Mech. Produc. Eng.* Vol.1,No.1,2013,pp.10-5.
2. R. G. Bhandare ,P. M. Sonawane ," Preparation of aluminium matrix composite by using stir casting method", *International Journal of Engineering and Advanced Technology*,*Vol.3.No.3,Dec.*2013 Dec,pp.61-5.
3. R. Dasgupta ,H. Meenai," SiC particulate dispersed composites of an Al–Zn–Mg–Cu alloy: Property comparison with parent alloy", *Materials characterization*,*Vol.54,No.4-5,* May.2005,pp.438-45.
4. J. Jeykrishnan ,B. V. Ramnath ,X. H. Savariraj ,R. D. Prakash,V. D. Rajan, D. D. Kumar," Investigation on tensile and impact behavior of aluminum base silicon carbide metal matrix composites", *Indian journal of science and technology*,*Vol.37,No.9*, oct.2016.
5. B. Ravi ," Fabrication and mechanical properties of Al7075-SiC-TiC hybrid metal matrix composites", *International Journal of Engineering Science Invention*, Vol.6,2017,pp.12-9.
6. A.Aravindkumar," CFD ANALYSIS OF GAS FLOW BEHAVIOR IN VARIOUS ECONOMIZER DUCT", *International Journal of MC Square Scientific Research* ,Vol.6, No.1 Nov 2014,pp.61-65

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