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RESEARCH ARTICLE

STUDIES OF AL 7005 REINFORCED S-GLASS AND FLY ASH HYBRID MMC

[1]Praveen Kumar, S., [2]Dr. Shantharaja, M., *[,3]Ketan Patil and [4]Avinash, L.

[1]PhD. Scholar, University Visvesvaraya College of Engineering, Bengaluru, Karnataka, India
[2]Professor, Department of Mechanical Engineering, University Visvesvaraya College of Engineering, Bengaluru, Karnataka, India
[3]Mtech. Machine Design, Department of Mechanical Engineering, NMIT, Bengaluru, Karnataka, India
[4]Assistant professor, Department of Mechanical Engineering, NMIT, Bengaluru, Karnataka

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ABSTRACT

This paper mainly deals with study of mechanical properties of Al 7005 alloy based hybrid MMC's. Two types of reinforcement materials were used to obtain hybrid composite. Reinforcements were in the form of fibers and particulate. Stir casting method is followed to obtain the required composite material with proper mixing of reinforcements. By different combination of composition three castings were obtained with same base material of Al 7005 alloy. Further mechanical properties and microstructure were analyzed for all three castings by preparing specimens with required dimensional accuracy. Mechanical properties include tensile strength, compression strength, and hardness. Obtained results were then compared to the values of unreinforced alloy. Also graphical representation of all properties when compared with unreinforced alloy is shown. Properties mentioned like tensile strength, compressive strength, and hardness were found to be improved with increasing the composition percentage of reinforcements.

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INTRODUCTION

Composites have been a need for tremendous growth in this early era of development. As an alternative material over conventional materials this composite materials have been used to modify the material properties like strength of material, stiffness of material, also toughness of material. Some materials in use at current situations are not as level as composites because they have fewer measures when treated with reinforcing materials, thus they form a same property data as that of base materials. Thus improved material which is obtained by blending two or more materials are termed to be as "Composite materials". This study highlights the idea of using best manufacturing method to form composite. The research outcomes with forming a hybrid composite where S-glass and Fly ash is used as reinforcing material while aluminum alloy is used as matrix material. Further this study deals with preparing the test specimens from the obtained composite billets. Testing the specimens on different experimental setup and obtaining the results for physical and mechanical behavior of the composite. Further an appropriate conclusion is also obtained to deliver the objective of this research. Following subsection gives the idea about hybrid material and composite formed from those materials.

Corresponding author: **Ketan Patil,**
Mtech. Machine Design, Department of Mechanical Engineering, NMIT, Bengaluru, Karnataka, India.

Hybrid composites

Blending two or more materials in to single material forms hybrid composite. As name as hybrid it is not a single or pure material and is a mixture of other appropriate materials. Basically these materials are categorized in to two types i.e. organic and inorganic. S-glass falls under inorganic while fly ash under organic type. More than two materials can be reinforced in the base material but when deal with only two materials it provides added benefits in comparison. Hybrid composites with their balanced mechanical properties have gained demand in recent development of engineering field.

MATERIALS AND METHODS

Material selection

From number of series of aluminum Al-7005 series alloy is chosen as matrix material for this research while S-glass and fly ash are reinforcing materials. S-glass is used due to their ability to work at extreme conditions, while fly ash is easily available from rice husk.

Table 1. Chemical configuration of Al-7005

Element	Cr	Cu	Mg	Zn	Aluminum
% Weight	0.20	0.10	1.8	4.5	Balance

Experimental procedure

- Selected materials are weighed properly and placed separately.
- Stir casting method is followed to obtain the castings.
- All required arrangements for stir casting technique are made ready, viz; graphite crucible, plug, mold and stirrer.
- Aluminum alloy is then placed in crucible inside induction chamber to melt.
- (PID) temperature controller is provided on equipment to adjust the melting temperature.
- Al is allowed to melt and reach the preset temperature i.e. 850ºC.
- Later reinforcements are added in molten matrix and allowed to stir at about 300RPM for about 20 mins.
- Reinforcing material is preheated before adding to the molten base material.
- Proper stirring is carried out to obtain better distribution of materials.
- After being stirring the metal mixture is then poured in to the mold placed at bottom.

Table 2. Material composition for casting

Material matrix	S-glass	Fly ash
Al-7005 alloy	_	_
		2%
Al-7005 alloy	1%	4%
		6%
		2%
Al-7005 alloy		4%
	3%	6%

- Care should be taken while pouring the molten mixture.
- After pouring the metal it is allowed to solidify at room temperature and later composites are taken out for further study.
- Required specimens are for respective tests are prepared as per there dimensions and tested.
- Specimens are obtained as per the ASMT E8 and E9 standards.

Fig.2.1 Casted composite material

Testing specimens and methods

Figure below shows specimens prepared for testing various tests which includes SEM & EDAX, hardness test, compression test and tensile test.

a)SEM & EDAX specimens

b) Hardness test specimen

c) Compression test specimen

d) Tensile test specimen

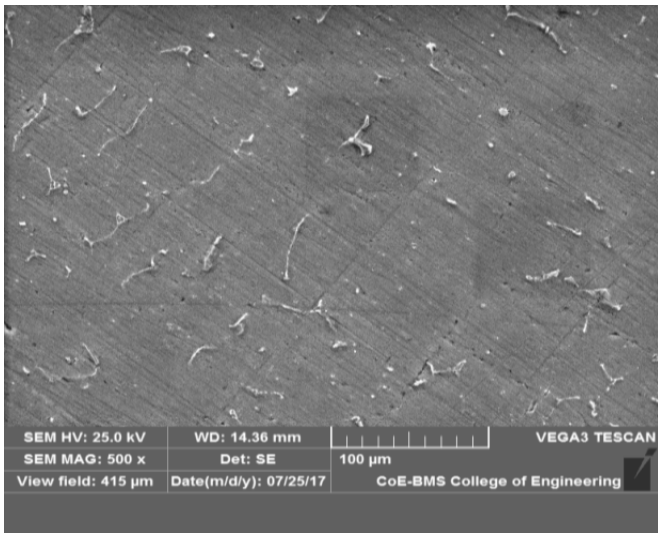
Fig.2.2 Test specimens

RESULTS AND DISCUSSION

This chapter encloses the results obtained for above mentioned experimental testing's. Results for higher composition of casting composite are mentioned below and there comparison is discussed to obtain appropriate conclusion.

1) SEM and EDAX results

Microstructure and elemental composition of casted composite is obtained by this method. Figure below shows the microstructure for higher composition composite. "Scanning electron microscope" gives the better results for microstructure than the simple microscopy view.



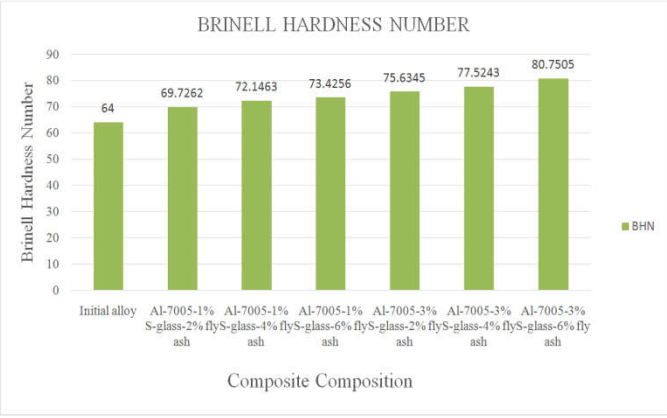
a)

Element	Weight %	Atomic %	Net Int.	Error %	Kratio
C K	5.26	10.84	0.65	89.74	0.0052
O K	3.85	5.95	2.80	45.51	0.0082
AlK	90.00	82.52	654.39	2.06	0.8451
SiK	0.54	0.48	1.10	80.83	0.0014
CaK	0.34	0.21	1.24	65.15	0.0027

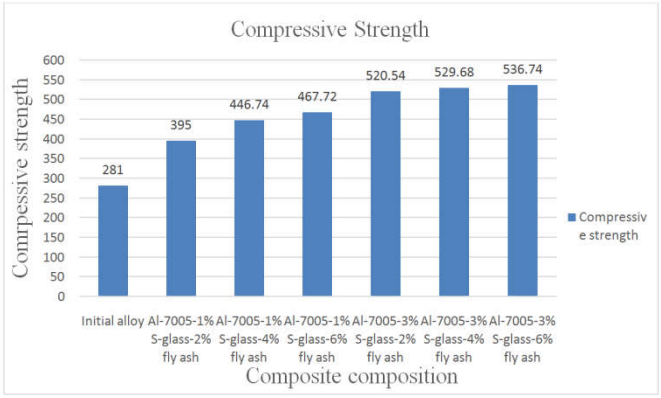
b)

Fig. SEM and EDAX results a)microstructure b) Elemental configuration

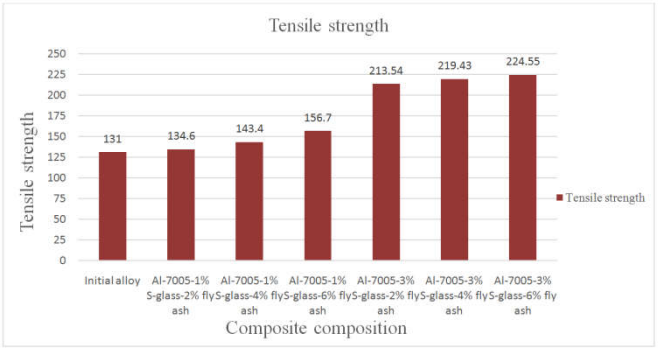
2) Hardness test results



3) Compression test results



4) Tensile test results



Above results plotted on graph shows the variation of properties for various composite compositions used in this research. It is seen that with increasing the percentage of reinforcing materials the values of hardness, compressive strength, and tensile strength varies, this is because reinforcing material molecules gains the space in between and avoid dislocation thereby improving the properties. Thus these properties increase with increase in reinforcing material.

Conclusion

- Referring to above obtained results it is concluded that stir casting method offers better processing of composite materials.
- Hybrid composites delivers better material properties than conventional one
- With increase in percentage of reinforcements, hardness, compressive strength, and tensile strength of composite materials is also increased.
- Thus obtained composite material can be utilized in several engineering fields like; aerospace, defense, etc.

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