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EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF EGLASS SHORT FIBRES & FLY ASH REINFORCED AL 7075 HYBRID METAL MATRIX COMPOSITES

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"EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF E-GLASS SHORT FIBRES & FLY ASH REINFORCED AL 7075 HYBRID METAL MATRIX COMPOSITES"

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Abstract- conventional monolithic materials have limitations in achieving good combination of strength, stiffness, toughness and density. To overcome these shortcomings and to meet the ever increasing demand of modern day technology, composites are most promising materials of recent interest. Metal matrix composites (mmcs) possess significantly improved properties including high specific strength, specific modulus, damping capacity and good wear resistance compared to unreinforced alloys. Among the mmc's aluminum composites are predominant in use due to their low weight and high strength. The key features of mmc's are specific strength and stiffness, excellent wear resistance, high electrical and thermal conductivity. The present investigation aims at the development of aluminium based e-glass and flyash particulate reinforced hybrid metal matrix composites. The test specimens are prepared as per astm standard size by turning and facing operations to conduct tensile and compression test.

***Keywords-** hybrid mmc, al-7075, e-glass fibre, flyash, tensile strength, compression strength.*

I. INTRODUCTION

Composite materials are new generation materials developed to meet the demands of rapid growth of technological changes of the industry. Composite materials or composites are engineering materials made from two or more constituents' materials that remain separate and distinct on macroscopic level while forming a single component. It consists of short and soft collagen fibers embedded in a mineral matrix called apatite. a composite material is defined as a structural materials created synthetically or artificially by combining two or more materials having dissimilar characteristic. One constituent is called matrix phase and other is called reinforcing phase. Reinforcing phase is embedded in the matrix to give desired characteristic.

A composite material consists of two or more physically and /or chemically distinct, suitably arranged or distributed phase, with an interface separating them. Most commonly composite materials have a bulk phase, which is continuous called the matrix and one dispersed. Non-continuous phase called the reinforcement, which is usually harder and stronger.

Mmcs are made by dispersing a reinforcing material into a metal matrix. As the name implies, for metal-matrix composites (*mmc*s), the matrix is a ductile metal. These materials may be utilized at higher service temperatures than their base metal counterparts; furthermore, the reinforcement may improve specific stiffness, specific strength, abrasion resistance, creep resistance, thermal conductivity, and dimensional stability. Some of the advantages of these materials over the polymer matrix composites include:

- Higher operating temperatures
- No flammability
- Do not absorb moisture
- Have better electrical and thermal conductivity
- Are resistant to radiation damage
- Greater resistance to degradation by organic fluids

Low cost, therefore, their (mmc) use is somewhat restricted. In polymeric composites, matrix materials play important but secondary role of holding the fibers in place and providing proper load dispersion in the fibers, while material strength and stiffness are controlled by the reinforcements. By contrast, mechanical properties of metal matrix composites are controlled by the matrix to a considerably larger extent, though fibers still provide the main contribution to strength and stiffness of the material. The super alloys, as well as alloys of aluminum, magnesium, titanium, and copper, are employed as matrix materials. The reinforcement may be in the form of particulates, both continuous and discontinuous fibers, and whiskers; concentrations normally range between 10 and 60 vol%.

II. LITERATURE SURVEY

Shyong j.h [1] reported, the deformation characteristics of aluminium alloy 6061 reinforced with particulate sic particulate 3, 10 and 30 micro meter size by varying the sic vol percentage(0.5, 10 and 20 %) using experimental numerical methods. They measured tensile strength and stiffness of the composite subjecting the matrix to dispersoid content. They observed that the tensile strength and stiffness of the composites were found to increase with the increasing particle content (volume fraction) for heat treatment provided that it was over a limiting value. The highest tensile strength, but the na specimens had the greatest elongation to failure and largest ratio of tension to yield strength. Good arrangement was observed between experimental results and predictions of mechanical properties.

Cui y geng [2] investigated that, an aluminium matrix composite was successfully obtained using the self propagating high temperature sic particulates as reinforcement material. The composite was found to be superior in mechanical performances to those of the composite reinforce with the conventional abrasive grade sic particulates. High interfacial bond strength was observed between sic and aluminium matrix. The interfacial bond strength was attributed the effective mechanical keying role and the atom match bonding with an crystallographic orientation relationship.

Choon weng wong, manoj gupta, lilu[3], studied aluminium based metallic matrices having varying weight fractions of copper(1 wt% cu and 4.5 wt% cu) were reinforced with sic particulates using a partial liquid phase casting casting technique. The results of their investigation showed smaller sized and higher weight percent of copper in the matrix.

III. METHODOLOGY

A. Procurement of materials:

Al 7075 alloy:11 kgs of aluminium 7075 was collected at fenfe metallurgicals located at uttarahalli, bangalore

E-glass fiber:1 kg e-glass fiber was being collected at suntech fiber pvt. Ltd, vasanth nagar, bangalore.

Fly ash: 1 kg fly ash was collected at kpcl, kudithini located near to bellary.

B. Fabrication of test specimens*:*

The alloy ingots are placed in the crucible, and then the crucible is heated to the required temperature. The heating of the crucible may be done by means of electric furnace, coal furnace etc. The temperature inside the furnace was recorded using a temperature recorded.

The crucible was taken out when the temperature was 660 degree celsius. Here we have made use of a induction furnace. Degasifier is added to molten metal to remove soluble gases present in liquid state metal, in the amount of 2 to 3 percent of molten metal weight.

Molten metal at about 660^0c is taken in a crucible from the furnace. The temperature is recorded using a thermo couple. Then the reinforcements namely e-glass, and fly ash are added to the molten metal and with the help of a mechanical stirrer the reinforcements are easily mixed with the matrix. Then after few minutes of stirring, the liquid metal with reinforcements are poured into the dies to get the required castings.

Fig 1: aluminium 7075 ingot

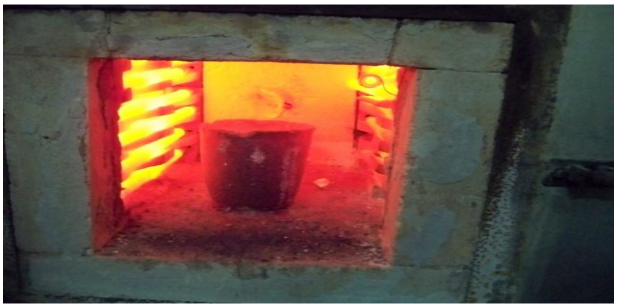


Fig 2: loading al 7075 in to furnaces with crucible

Fig 3: degasifier (exo-chloro ethane)

Fig 4: stirring after adding reinforcements

Fig 5: pouring molten metal into mould box

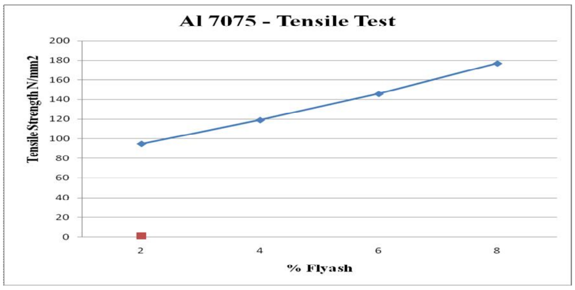
fig 6: final casting al 7075 metal matrix composites

IV. RESULTS AND DICUSSIONS

C. Tensile strength of al 7075 + 1% e-glass+ varying % of fly ash:

Tensile strength (n/mm^2)	% of e-glass	% of flyash
94.67	1	2
118.87	1	4
145.8	1	6
176.76	1	8

Table: 1: tensile results for 1% e-glass



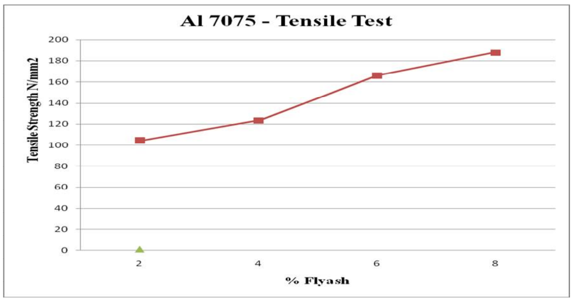
Graph 1: tensile strength v/s 1% e-glass with varying % of flyash

It is observed that with varying percentage of flyash tensile strength increases from 94.67 n/mm^2 to 176.76 n/mm^2.

D. Tensile strength of al 7075 + 3% e-glass+ varying % of fly ash:

Tensile strength (n/mm^2)	% of e-glass	%flyash
104.25	3	2
123.45	3	4
165.87	3	6
187.89	3	8

Table 2: tensile results for 3% e-glass



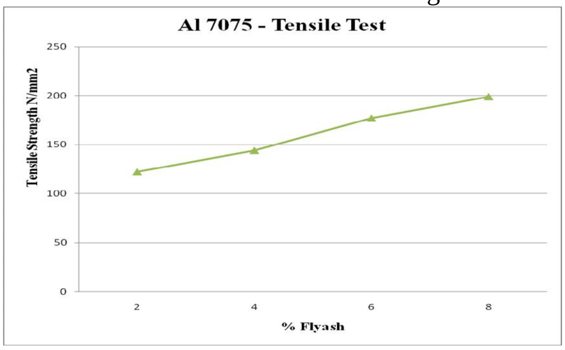
Graph 2: tensile strength v/s 3% e-glass with varying % of flyash

It is observed that with varying percentage of flyash tensile strength increases from 107.25 n/mm^2 to 187.89 n/mm^2.

E. Tensile strength of al 7075 + 5% e-glass+ varying % of fly ash:

Tensile strength (n/mm^2)	% of e-glass	%flyash
121.98	5	2
143.65	5	4
176.77	5	6
198.98	5	8

Table 3: tensile results for 5% e-glass



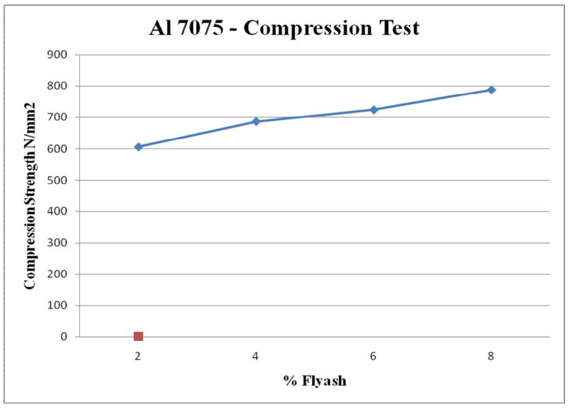
Graph 3: tensile strength v/s 5% e-glass with varying % of flyash

It is observed that with varying percentage of flyash tensile strength increases from 121.98 n/mm^2 to 198.98 n/mm^2.

F. Compressive strength of al 7075 + 1% e-glass+ varying % of fly ash:

Compressive strength(n/mm^2)	% of e-glass	%flyash
605.56	1	2
686.26	1	4
723.76	1	6
787.87	1	8

Table 4: compression strength results for 1% e-glass



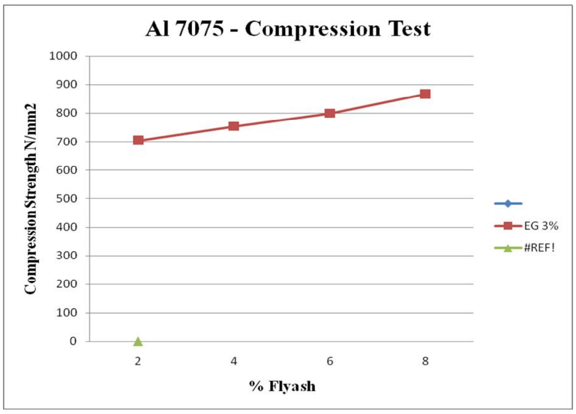
Graph 4: compression strength v/s 1% e-glass with varying % of flyash

It is observed that with varying percentage of flyash compressive strength increases from 605.56 n/mm^2 to 787.87 n/mm^2.

G. Compressive strength of al 7075 + 3% e-glass+ varying % of fly ash:

Compressive strength(n/mm^2)	% of e-glass	%flyash
703.86	3	2
753.86	3	4
798.97	3	6
867.76	3	8

Table 5: compression strength results for 3% e-glass



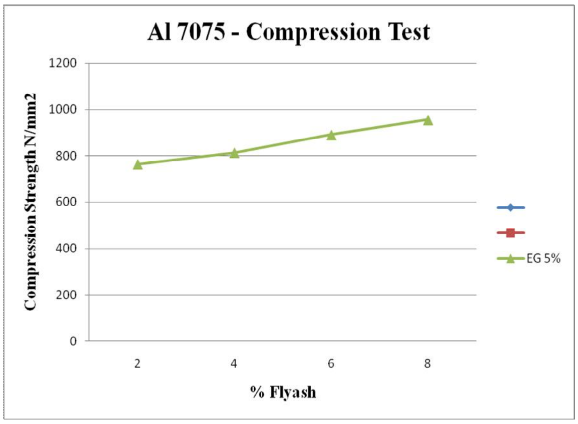
Graph 5: compression strength v/s 3% e-glass with varying % of flyash

It is observed that with varying percentage of flyash compressive strength increases from 703.86 n/mm^2 to 867.76 n/mm^2.

H. Compressive strength of al 7075 + 5% e-glass+ varying % of fly ash:

Compressive strength(n/mm^2)	% of e-glass	%flyash
763.61	5	2
813.65	5	4
889.98	5	6
954.65	5	8

Table 6: compression strength results for 5% e-glass



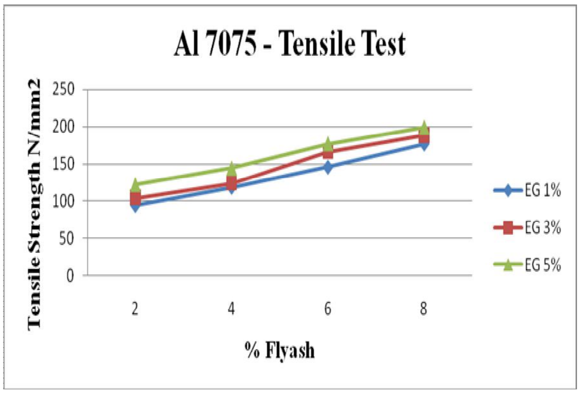
Graph 6: compression strength v/s 5% e-glass with varying % of flyash

It is observed that with varying percentage of flyash compression strength increases from 763.61 n/mm^2 to 954.65 n/mm^2.

I. Comparision of tensile strength:

Eg 1%	Eg 3%	Eg 5%	%flyash
94.67	104.25	121.98	2
118.87	123.45	143.98	4
145.8	165.87	176.98	6
176.76	187.89	198.98	8

Table 7: comparative results of tensile strength mpa



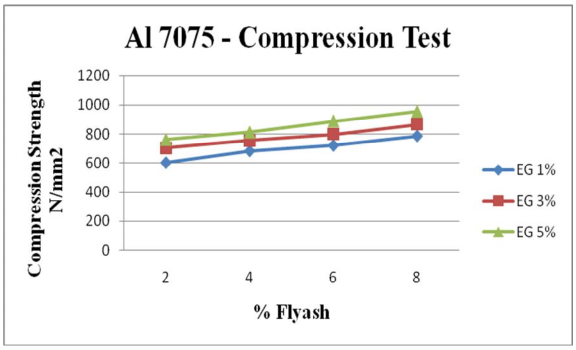
Graph 7: comparative line chart of tensile strength

From the above results we can conclude that tensile strength of the al7075 hybrid composites produced in this work is increased when percentage of e-glass and flyash is increased.

J. Comparision of compression strength:

Eg 1%	Eg 3%	Eg 5%	%flyash
605.56	703.86	763.61	2
686.26	753.86	813.65	4
723.76	798.97	889.98	6
787.87	867.76	954.65	8

Table 8: comparative results of compression strength in mpa



Graph 8: comparative line chart of compression strength

From the above results we can conclude that compression strength of the al7075 hybrid composites produced in this work is increased when percentage of e-glass and flyash is increased.

V. CONCLUSIONS

From the experiments conducted to study the effect of adding various volumes fractions of e-glass and fly ash on the tensile and compression of the following conclusions can be drawn.

- Composite material of al 7075 reinforced with e-glass fibre and fly ash was successfully casted.
- Tests conducted to determine ultimate tensile strength indicated no exact trends; however there has been an increase in uts due to presence of e-glass fibre and fly ash as compared to base metal.
- Tests conducted to determine the compressive strength revealed very encouraging results as the reinforced composite was able to take more compressive load due to presence of e-glass fibre and fly ash the compressive strength increased.
- Metal matrix composites of al 7075 reinforced with e-glass and fly ash particulates is found to have improved tensile strength and compression strength when compared to al 7075 alloy alone.

REFERENCES

[1] Shyong j.h et al, materials science & engineering a: structural materials; properties, microstructure and processing, vol.a197, n 1, jun 30 1995, pp 11-18.

[2] Cui y geng, journal of materials science letters vol. 16, n10, may 15 1997, pp.788-790.

[3] Choon weng wong, manoj guptha, lilu, j of matl. Sc. & tech vol. 20, feb 2004.pp.34-42.

[4] K.h.w. Seah., s.c sharma, j of alloys and compounds vol.306, 2000, pp. 270-276.

[5] F.t. Wallenberger, structural silicate and silica glass fibers, in advanced inorganic fibers processes, structures, properties, applications, f.t. Wallenberger, ed., kluwer academic publishers, 1999, p 129–168

[6] D.m. Miller, glass fibers, composites, vol 1, engineered materials handbook, asm international, 1987.