EXPERIMENTAL INVESTIGATION OF HEAT TREATED ALUMINIUM 7075 ALLOY REINFORCED WITH GRAPHITE AND BAGASSE-ASH UNDER COMPRESSIVE LOAD

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***Abstract*:** In this present investigation efforts are made to study the compression strength of as cast and heat treated AA7075 alloy reinforced with graphite and bagasse-ash composites. The vortex method of stir casting was employed, in which the reinforcements were introduced into the vortex created by the molten metal by means of mechanical stirrer. Samples have been prepared as per the ASTM E8 standards. Results give out that there will be greater effect of reinforcing different bagasse-ash and heat treatment condition in aluminium alloy matrix composites. An improved mechanical properties occurs on reinforced compared to Unreinforced MMCs alloys.

Keywords: Al matrix composites, Bagasse-ash, Graphite, compression strength, Heat treatment

I. INTRODUCTION

Aluminium hybrid composites are a new generation of metal matrix composites that have the potentials of satisfying the recent demands of advanced engineering applications. These demands are met due to improved mechanical properties and possibility of reducing production cost of aluminium hybrid composites. The performance of these materials is mostly dependent on selecting the right combination of reinforcing materials since some of the processing parameters are associated with the reinforcing particulates. [1] Nowadays, Aluminium based composites (AMCs) are widely used due to their properties like low weight, excellent strength, toughness, better thermal stability, ease of casting, good corrosion resistance and accessibility. These composites are used in manufacturing of components in aerospace, marine, automotive and nuclear manufactures. But due to the high cost of fabrication and limited techniques of fabrication, their potential is not yet fully harvested.[2] Stir casting Technique has remained the most investigated technique for fabricating AMCs owing to its simplicity, flexibility and commercial viability, Heat treatment is an operation in the fabrication of an engineering materials system. The main objective of heat treatment is to make the material system structurally and physically fit for engineering application[1] These thermal treatments are similar to those ordinarily used for hardening aluminum alloys .Widely used treatments like T4 and T6 treatments involve solution heat treatment ,quenching and subsequent natural and artificial aging respectively and is the common method to increase the strength of the composite[2].. Compared to polymer and ceramic matrix composites, metal matrix composites (MMCs) have been the subject of significant research and development over the past three decades.This is because of its attractive and superior mechanical properties. Nowadays all fields of engineering utilize the metal matrix composite which are extremely efficient in terms of design and weight applications [3-4].strength increment due to ageing is necessary in aluminium alloys because it helps to develop acceptable mechanical properties [5]

II. OBJECTIVES OF PRESENT WORK

The main objective of this project is to develop Al (7075)/ graphite and bagasse-ash particulate metal matrix composites. Where the graphite and bagasse-ash are used as reinforcement material & Al 7075 is used as matrix material. Different weight percentages of Specimens are prepared by using liquid route metallurgy technique. Test specimens are prepared to evaluate compression strength

III. EXPERIMENTAL DETAILS

Following steps are carried out in our experimental work:
1. Material selection
2. Composite preparation
3. Testing

3.1 Material selection

The Al 7075 alloy (matrix material), graphite and bagasse-ash 30-40 μm size particles (reinforcement) were used for fabrication of MMCs. The chemical composition of Al7075 is given in the Table 1.the reinforcement percentages is given in Table 2.

Table 1: Chemical Composition of Al 7075

Composition	Al	Zn	Fe	Mg	Mn	Cu	Si	Cr	Ti
% Composition	88.6	5.6	0.5	2.5	0.3	1.6	0.4	0.23	0.2

Table 2: Percentages of reinforcements

Models	Reinforcements	
	Bagasse ash	Graphite
1	1%	2%
2	3%	2%
3	5%	2%
4	1%	4%
5	3%	4%
6	5%	4%
7	1%	6%
8	3%	6%
9	5%	6%

3.2 Composite preparation

The graphite of 30-40 μm size and bagasse-ash were used as the reinforcement and the graphite content in the composites was varied from 1% to 5% in steps of 2% by weight and bagasse-ash are varied from 2% to 6% in steps of 2% by weight. Liquid metallurgy technique was used to prepare the composite materials in which the graphite and bagasse-ash particles were introduced into the molten metal pool through a vortex created in the melt by the use of an alumina-coated stainless steel stirrer. Zirconium coated stirrer used to stir the molten metal. The stirrer was rotated at 200–300 rpm for duration of 15 minutes and the depth of immersion of the stirrer was about two-thirds the depth of the molten metal. The resulting mixture was tilt poured into preheated permanent moulds.

3.3 Heat Treatment

The composite melt was cast in a permanent mould. Cast Al7075 alloy and all synthesized composites are subjected to heat treatment process. The sequence of heat treatment process involved were solutionizing, quenching, aging and furnace cooling. Solutionizing was done at a temperature of 520˚C over a time period of one hour and then quenched in a water bath.

3.4. Compression test

Compression test were conducted at room temperature using universal testing machine (UTM) in accordance with ASTM E9-9. The compression specimens prepared are of diameter 20 mm and length 20mm

IV. RESULTS AND DISCUSSION

4.1 compression properties

The results of the *compression* tests such as ultimate compression strength and percentage reduction of as cast and heat treated Al7075 MMCs are given in the Figure 4.1, Figure 4.2 ,Figure 4.3 and Figure 4.4 respectively.

4.1 Effect of reinforcements and heat treatment on compression strength

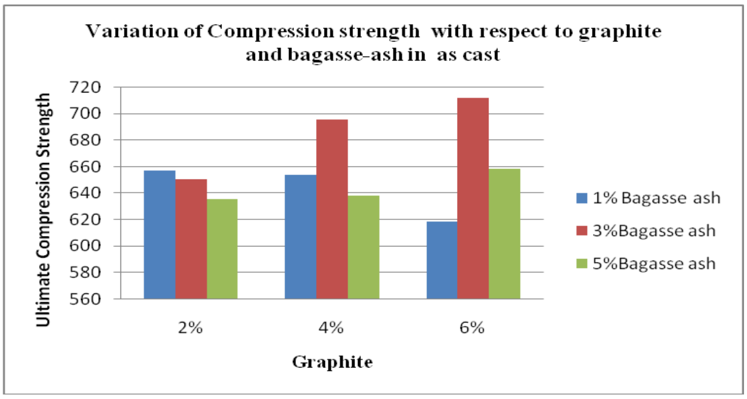

Fig 4.1 Variation of Compression strength with respect to graphite and bagasse-ash in as cast

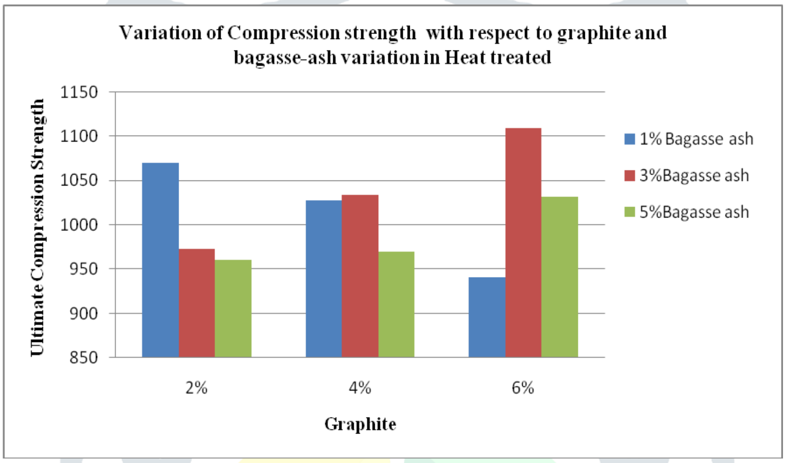

Fig 4.2 Variation of Compression strength with respect to graphite and bagasse-ash after Heat treatment

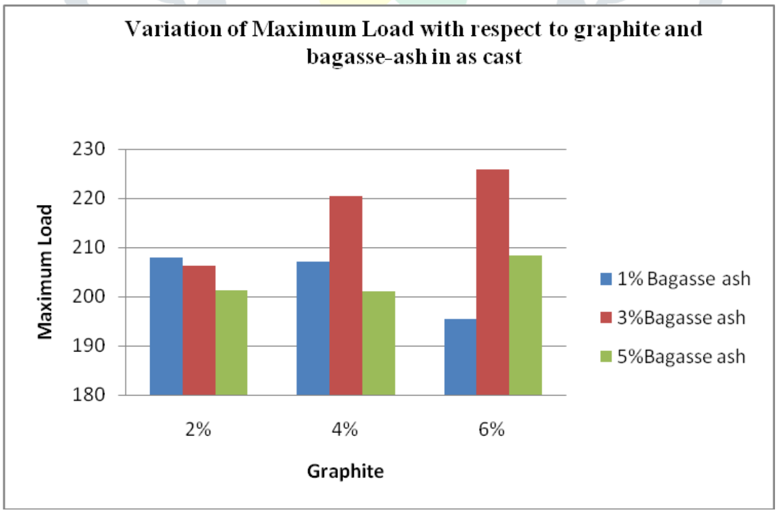

Fig 4.3 Variation of Maximum Load with respect to graphite and bagasse-ash in as cast

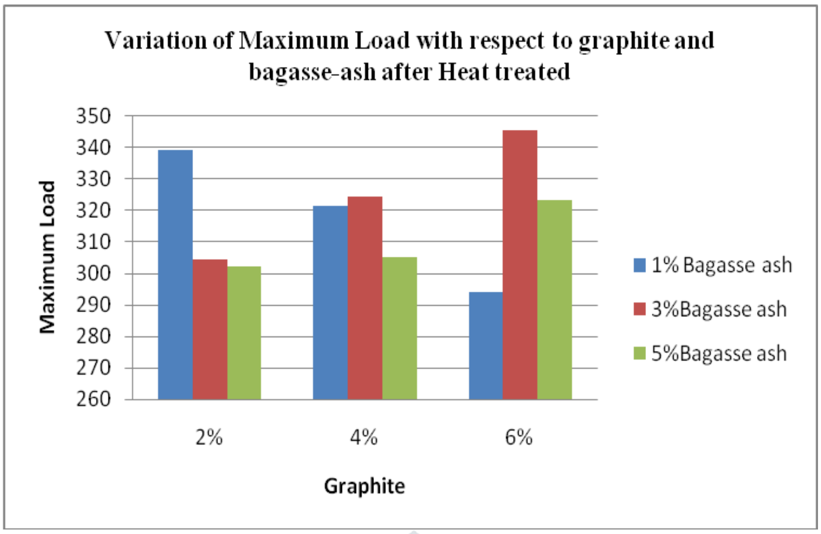

Fig 4.4 Variation of Maximum Load with respect to graphite and bagasse-ash after Heat treated

Figure.4.1 to 4.4 shows effect of reinforcements and heat treatment on Al7075 alloy MMCs, during the heat treatment, intermetallic particles are precipitated which resist the movement of dislocations in a crystal lattice, Bagasse ash and graphite particles and precipitation of intermetallic increase tensile strength. As the amount of Bagasse ash and graphite particles and intermetallics put together increase, the compression strength increases This marked improvement in compression strength of both Al7075 alloy and its composites studied on heat treatment can be attributed to larger extent of formation of fine intermetallic precipitates after heat treatment.

V. CONCLUSIONS

1. The compression strength increases with increasing wt. % of reinforcement for the MMCs.
2. Important micro-structural changes occur during initial addition of reinforcement.
3. The mechanical properties such as compression strength, Maximum load increase with increasing wt. % of reinforcement for the MMCs.
4. Heat treatment has a significant effect on compression strength, Maximum load of matrix alloy and its composites

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