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# Effect of Flyash and Alumina Reinforcement on Mechanical Properties of AL7075 based Metal Matrix Composite

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***Abstract:***

***Aluminium based composite are getting a vast scope nowadays because of its properties and availability. In the present work, fly ash and AL2O3 reinforced composite are prepared using stir casting technique for varying wt.% (fly ash 3% and AL2O3 3%, 6% & 9%). Hardness and tensile properties were determined, with the addition of reinforcement the properties are improved compared to the parent metal alone. Based on the evaluation 6% AL2O3 and 3%fly ash gives a better result as compared to other composition.***

***Keywords: flyash, AL2O3, Composite , Aluminium, Reinforcement, stir casting***

## I. INTRODUCTION

Composite, as the name itself indicates it is a combination of two or more material, which are non reactive and of different phase, that don't makes a homogeneous mixture that is where it stands different than alloying. The research on composites are not from few days it is from few decades, but still the process parameters are not optimised and a huge numbers of reinforcement are available which still keeps this field in higher altitude. And composites provide a better alternative to conventional material as it constitutes different material, it has its own contribution over the properties. There are so many methods to prepare metal matrix composite like powder metallurgy, stir casting, extrusion etc. Among which stir casting will be easier and economical way to produce composites.

Cu coating on particles like SiC contributes better bonding between the reinforcements and matrix [Mohan Vanarotti et al., (2014)]. Using halide salts wettability can be increased and cover flux results in decreased contact angle and surface tension forces [G.L Rajesh et al., (2014)]. Inert gasses can also be used to prevent the formation of oxides [J. Jebeen Moses et al., (2014)]. Addition of some materials like fly ash to aluminium matrix improves the hardness, wear resistance, stiffness etc., when the reinforcement is more than 15% the tensile strength is reportedly decreasing [ Rohatgi et al., (1997)]. The grain also has its own impact on material properties, lower grain size results in higher mechanical properties [K.R. Ravi et al., (2008)]

## II. COMPOSITE PREPARATION

In our work, stir casting technique is used to prepare the composites. The procedure used is the required amount of aluminium is weighed and placed in crucible, temperature was preset to $710^0$c, and once the temperature is attained, same temperature is maintained for 10minutes to confirm complete molten state of the metal, hexacholoroethane tablets are used for degassing. The corresponding wt.% of reinforcement is weighed and preheated to $400^0$c to remove moisture. And the mould is also preheated to minimize casting defects. Now after achieving complete liquid state the melt is stirred at 300-400 RPM to create vortex and preheated reinforcement along with magnesium and coverall is introduced while stirring, coverall helps in preventing oxidation and magnesium to improve wettability. After stirring for 10 minutes the slag is removed and the melt is poured in to the permanent moulds. Further, solidified preforms are machined to required ASTM standards and tested for different parameters.

 

Fig. 1 Alumina Particle

Fig. 2 fly ash

## III. MECHANICAL PROPERTIES

### *A. Tensile Strength*

The tensile tests were carried out at a constant speed in Universal testing machine of 100KN capacity. The specimen prepared as per ASTM standard E8 and having dimensions of gauge length of 50mm and diameter 8mm, with a grip distance of 10mm and diameter 12mm.

Table I Results of Tensile Test

| Sl NO | NOMENCLATURE | TENSILE STRENGTH (MPa) |
|---|---|---|
| 1 | Al7075 | 391 |
| 2 | Al7075 + 3% fly ash+ 3% AL2O3 | 403 |
| 3 | Al7075 + 3% fly ash+ 6% AL2O3 | 407 |
| 4 | Al7075 + 3% fly ash+ 9% AL2O3 | 371 |

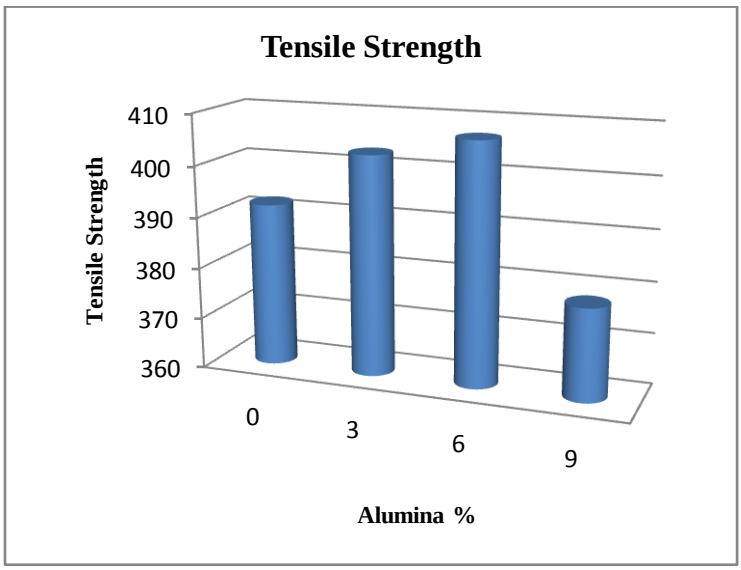


Fig. 3 Variation of Tensile Strength with reinforcement %

### *B. Hardness*

Hardness is the resistance to plastic deformation (e.g., a local dent or scratch). Thus, it is a measure of plastic deformation. The Hardness of the composites samples were measured using a Leitz, Brinnel hardness measuring machine with a load of 100 N. The specimen prepared as per ASTM standard and the dimension of the specimen is 19X19 mm.

Table II Results of Hardness Test

| Sl NO | NOMENCLATURE | LOAD (N) | BHN |
|---|---|---|---|
| 1 | Al7075 | 250 | 53 |

 

| | | | |
|---|---|---|---|
| 2 | Al7075 + 3% fly ash + 3% AL2O3 | 250 | 58 |
| 3 | Al7075 + 3% fly ash+ 6% AL2O3 | 250 | 64 |
| 4 | Al7075 + 3% fly ash + 9% AL2O3 | 250 | 69 |

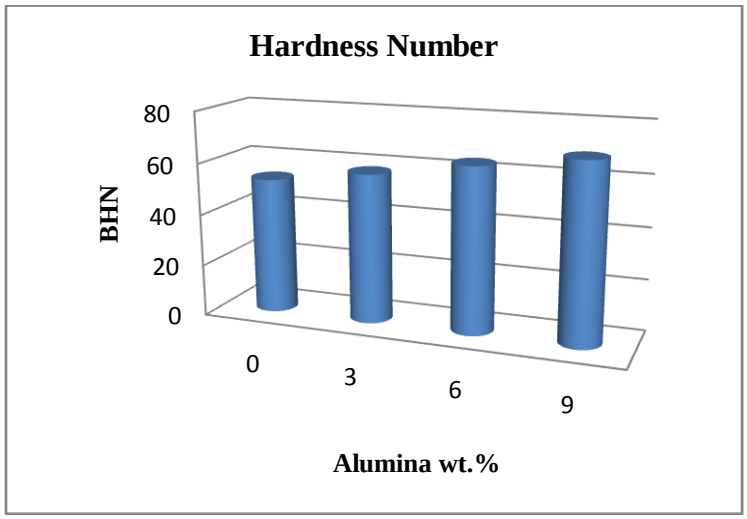


Fig. 4 Variation of BHN with reinforcement %

The hardness of the composite material increases monotonically by significant amounts as the reinforcement's particles content increases. As the AL2O3 reinforcement contents increased from 3% to 9% by weight with 3% fly ash constant, the hardness is increased by 30%. The percentage of increase in hardness as a variation of different reinforcement is shown in the table 1.

## IV. CONCLUSIONS

- Addition of reinforcement particles with the aluminium increases the mechanical property and gives a better result.
- Addition of 6% alumina with 3% fly ash in aluminium improves the hardness by 30 % and tensile strength is also increased.
- For 9% alumina with 3% fly ash reinforcement there is a drop in tensile strength which may be due to the clustring of reinforcements.

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