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FAILURE MODE ANALYSIS OF ALUMINIUM METAL MATRIX COMPOSITE

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ABSTRACT-*In recent years Aluminum Metal Matrix Composites are extensively used in wide application like Aerospace, Automobile and defense sectors. The main objective of this project deals with aluminum Metal Matrix casting are economically competitive and alternative use with iron and steel casting. The project also carried out various testing like tensile test, impact test and compression test. In present decades, recognizes that weight reduction and improved efficiency will make the greatest contribution. Aluminum Metal Matrix Composites one of the most interesting material alternatives for the manufacture of light weight parts with wear resistance and strength equals to cast iron 67% lower density and 3 times that thermal conductivity aluminum metal ,matrix composite alloys or ideal materials for the manufacture of light weight and other commercial panels with the combination of fly ash and titanium carbide at various percentage levels by using stir process*

.***Key words:*** *Aluminum metal matrix composite, stir casting.*

I. INTRODUCTION

Aluminum metal matrix composites are attractive of structural materials used in industrial factors, Automotive, Defense, Aerospace application because of their light weight, high specific ratio, and stiffness excellent wear resistance high service temperature .The main purpose is to increase the strength of the metal matrix composites since it is widely used in a automobile sectors. To investigate the mechanical behavior of Aluminum Metal Matrix Composite. To evaluate the tensile strength, compression strength, impact strength of the laminate.

Classification of composite material:

- Metal matrix composites
- Ceramic matrix composites
- Polymer matrix composites

Metal matrix composite: Metal matrix composite is composite material with at least two constituent parts, one being a metal necessarily the other materials may be a different metal or another material such as a ceramic or organic component. when a least three materials are present , it is called a hybrid composite. These includes

- Good strength at higher temperature
- Higher transverse strength
- Excellent electrical conductivity

However the major disadvantage of MMC is their higher densities and consequently lower specific mechanical properties compared to polymer matrix composites another notable difficulty is the high energy requirement for fabrication of such composites.

II .PROJECT BACKGROUND

In the 21st century high strength, light weight and energy efficient material have received extensive attention ,since the problems of environment and energy are major threshold areas. In order to fulfill this requirement , Engineers and researchers are striving to develop new and better engineering materials .The modern engineering materials find wide applications aerospace, defense field , Engineering industry , Automobile and Leisure industry . The performance and efficiency for this applications can be increased largely by the application of modern engineering materials : metal matrix composite is one such material developed for several applications. Hence, it is clear that technical developments in various field depend on the advance made in the field of materials

IV . JUSTIFICATION

To investigate the mechanical behavior of Aluminum Metal Matrix Composite and discuss them as an alternative to the use of cast iron.To evaluate the tensile strength , flexural strength, Impact strength and hardness of the laminate.

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III . OBJECTIVE

In recent years , recognizes that weight reduction and improved engine efficiency will make the greatest contribution with wear resistance and strength equals to cast iron , 67% lower density and 3 times the thermal conductivity .

V. LITERATURE SURVEY

- **Preparation of Hybrid Aluminum Metal Matrix Composite by using stir process**

By V.Chandramohan* ,R.Arjunraj from International journals of engineering science and research technology on November 2014 the project is to fabricate the aluminium A1356/Fly ash , Graphite and Boron Carbide metal matrix resistance compare to unreinforced alloys.

- **Corrosion characterization of Aluminium 6061/Red mud metal Matrix Composite in sea water**

By Dr.P.V.Krupakara, H.r.Ravikumar from International journals of engineering science and research technology on June 2015 .The present investigation aims to evaluate the corrosion properties of red mud participate reinforced aluminium 6061 metal matrix composites red mud particulates reinforced varying from two or sic percent by weight in step of two percent under dry condition composites are prepared by liquid melt metallurgy techniques using vortex method .

- **Investigation of mechanical properties of aluminium metal matrix composite**

By P.Subramanya Reddy ,R.Kesavan from International journals of Advanced Research in science Engineering and Technology on October 2015, To investigate the tensile and impact properties of hybrid metal matrix composite consists of aluminium-alumina (Al203)-silicon carbide (Sic) fabricated by stir casting process.

- **Development of Aluminium Based silicon Carbide particulate metal matrix composite**

By Manoj Singla , D.Deepak Dwivedi ,Lakhvir Singh,Vikas Chawla from Journals of Materials Characterization & Engineering on 2009,Achieving of uniform distribution of reinforced within the matrix is one challenge which affects directly on the properties and quality of composite materials by using stir casting .

- **Silicon Carbide Reinforced Aluminium Metal Matrix Composite of Aerospace**

By K.Suryanarayanan ,R.Praveen, S.Raghuraman. from International Journal of Innovative Research in Science on November 2014 , Compound work pieces are developed to combine favourable properties of favourable properties of different materials .The materials mixed with non metal and analysed in this mechanical properties and fabrication techniques

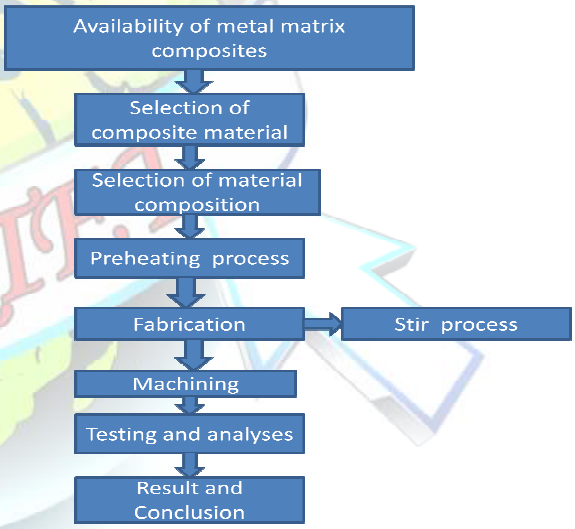
- **Aluminium Metal Matrix Composite,**

By B.Vijaya Ramnath, C.Elanchezhian, v.vignesh from Revised Edition Material and Science on October 2013 , This paper presents the overview of the effect of addition on different reinforcements in aluminium alloy highlighting their merits and demerits major issues like agglomerating phenomenon ,fibre matrix bonding and the problems related to distribution of particles .

- **Development of new aluminium matrix composite reinforced with iron oxide**

By E.Bayraktar ,D.Katundi from Journals of Achievement in material and manufacturing engineering on Jan 2010 , To develop new aluminium matrix composites reinforced with iron oxide that will be used in aeronautical engineering or electronic industry. Different parameters such sintering time and temperature , reinforcement compact pressure were evaluated .this project is mainly used to improve conductivity and permeability of this new composite.

VI. METHODOLOGY



VII.FABRICATION

STIR PROCESS: The term stir casting is the process of stirring molten metal's are used for continues stirring particles in to the metal alloy to melt and immediately pour into the sand mould then cooled and allowed to solidify , in stir the particles are often tends to form agglomerates , which can be only dissolved by vigorous stirring with high temperature . First the raw material aluminum in the solid form were weighted according to requirement for are kept under furnace with a temperature of 800C about 30 to 45 minutes. In mean time the dyes were made ready by the process of green sand molding After the molding is got over it is kept under drying by using compressed gas By then

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with the melted aluminum the materials like titanium carbide and fly ash were added according to the percentage by stirring continuously with the stirrer in figure

Fig 1:*stir casting process*

And then the mixture is poured in to the molds made by the green sand The poured mixture is kept for aside for 15 to 20 minutes and thus the casting is doneCasting is a liquid state method of composite material fabrication, in which dispersed phase (TiC and Fly Ash) is mixed with molten matrix metal by means of mechanical stirring. The liquid composite material is then. Cast by conventional casting method and may also be processed by convectional metal forming technologies.

VIII.SPECIFICATION:

TENSILE TEST : ASTM E8-82 standards

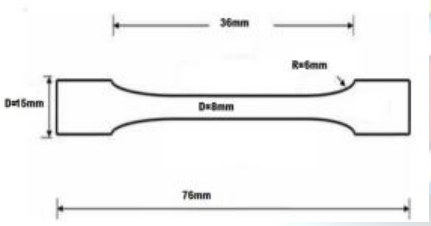


Fig 2: *Tensile test dimensions*

COMPRESSION TEST: ASTM C469 standards

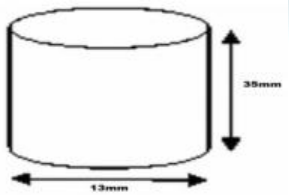
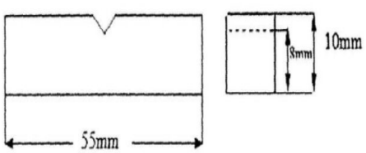


Fig 3: *compression test dimensions*

IMPACT TEST:



HARDNESS TEST:

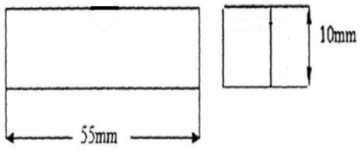


Fig 5: *Hardness test dimensions*

VII. TESTING

TENSILE TEST :

Test specimen were repaired according to ASTM E8-82 standards, each specimen having dimensions as shown in The specimen was loaded in Hounsfield universal test machine until the failure of the specimen occurs. Test were conducted on composite of different combination of reinforcing material and ultimate tensile strength and elongation of the material

Fig 6: *Tensile test specimen*

COMPRESSION TEST:

Test specimen were repaired according to ASTM C469 standards, each specimen having dimensions as shown in figure. Test were conducted on different composition of material and the compression strength as shown in the figure

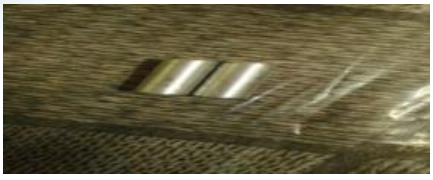


Fig 7:*Compressin test specimen*

IMPACT TEST:

The charpy impact test, also known as the charpy v-notch test, is a standardised high strain-rate test which determines the amount of energy absorbed by a material

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HARDNESS TEST:

In the brinell test, a hardened steel ball indenter is forced into the surface of the metal to be tested. The diameter of the hardened steel indenter is 13mm. the standard loads are maintained as a for 10-15seconds.Bulk hardness measurements were carried out on the base metal and composite samples by using standard brinell hardness test. Brinell hardness measurements were carried out in order to investigate the influence of particulate weight fraction on the matrix hardness

. **Fig 8:** *Impact test specimens*

IX .SAMPLE DISCRIPTION

SI.NO	AL %	FLY ASH %	TiC %
SAMPLE 1	90	10	-
SAMPLE 2	90	-	10
SAMPLE 3	90	5	5
SAMPLE 4	80	10	10

Table 1: *composition of materials*

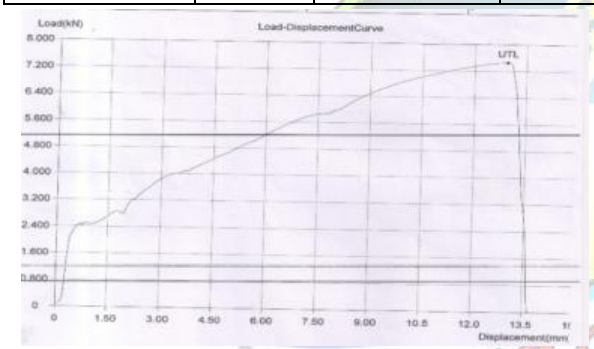

Fig 9: *Elongation of sample 1 (Al (90%)+ Fly ash (10%)*

Fig 10:*Elongation of sample 2 (Al (90%)+TiC)*

X .RESULT

The various tests used for testing the specimen and their results are as follows.

Tensile test:

SAMPLE	SAMPLE DISCRIPTION	TENSILE STRENGTH (KN)
1	Al(90%)+flyash (10%)	7.295
2	Al(90%)+TiC (10%)	7.45
3	Al(90%)+TiC(5%)+ fly ash (5%)	8.075
4	Al(80%)+TiC (10%)+ fly ash (10%)	6.0

Table 2: Results for tensile strength

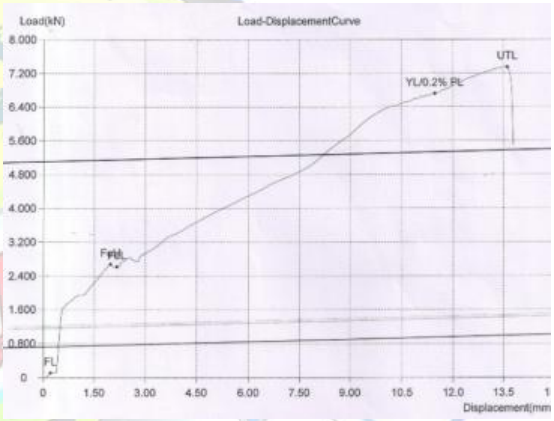

Fig 11*: Elongation of sample 4 Al(80%) + TiC (10%) + fly ash (10%).*

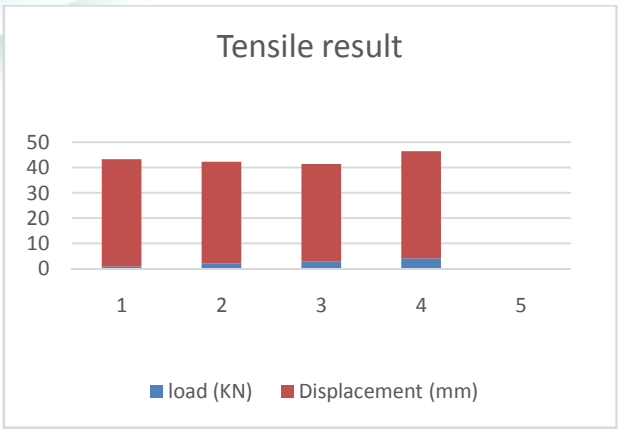

Fig 12: *Comparison chart for Tensile Test.*

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COMPRESSION TEST:

SAMPLE	SAMPLE DISCRIPTION	COMPRESSION STRENGTH (KN)
1	Al(90%)+flyash (10%)	99
2	Al(90%)+TiC (10%)	79
3	Al(90%)+TiC(5%)+ fly ash (5%)	110
4	Al(80%)+TiC (10%)+ fly ash (10%)	76

Table 3: *Compression test results.*

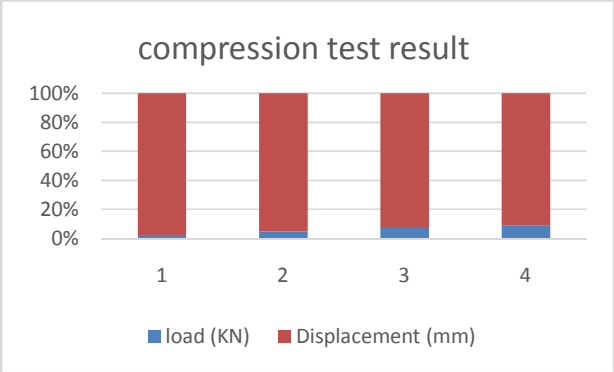

Fig 13: *comparison test results for Compression Test.*

IMPACT TEST:

SAMPLE	SAMPLE DISCRIPTION	ENERGY ABSORBED (J)
1	Al(90%)+fly ash (10%)	6
2	Al(90%)+TiC (10%)	4.67
3	Al(90%)+TiC(5%)+ fly ash (5%)	4.67
4	Al(80%)+TiC (10%)+ fly ash (10%)	6

Table 4: *Impact test results.*

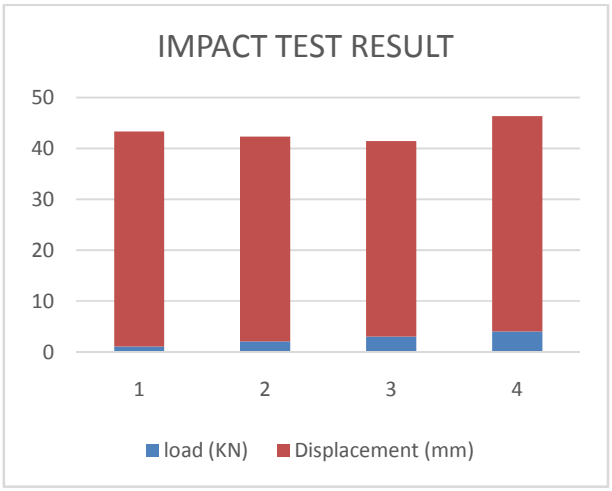

Fig 14: *Comparison test for Impact test.*

HARDNESS TEST:.

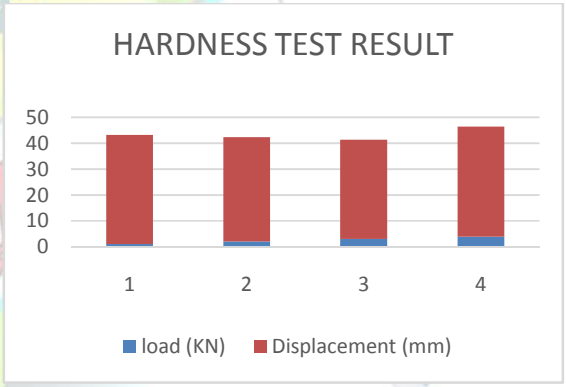

Fig 16: *comparison chart for Hardness Test.*

X. CONCLUSION

Research have been done for the proper MMC fabrication technique and selected as stir process. Material selection for matrix material composite has done based on the availability and the required properties. The mechanical behaviour of fly ash and titanium carbide has done. Based on the study conducted on the fly ash and titanium carbide containing Aluminium composite material, the following conclusions were made, using sand casting method, fly ash and titanium carbide can be successfully introduced in the Aluminium alloy matrix to fabricate Aluminium metal matrix composite material. From the failure mode analysis, the tensile

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strength of composite material compared to the cast iron alloy, increases significantly by 60%-70% ; the improved in compression strength is also observed but it was marginal. Further improvement in compressive behaviour of composite can be achieved by incorporating fabrication method other than sand casting method. The impact strength of the composite material also increases with increase in wt% of fly ash and titanium carbide content in the composite material. The hardness of the composite material also increases with increase in wt% of fly ash and titanium carbide content in the composite. This is due to the strengthening of Al alloy matrix by the fly ash and titanium carbide.

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