INVESTIGATION OF EFFECT OF MECHANICAL PROPERTIES ON ALUMINIUM HYBRID MATERIAL

[1]Mr. Kharade R.S., [2]Prof. Shitole J.S., [3]Prof.Sodal J.A.

[1]PG Student, [2, 3]Assistant Professor

Dattakala Group of Institutions Faculty of Engineering, Maharashtra, India

ABSTRACT

Wonderful research is going on Aluminium Metal Matrix Hybrid composite material due to extensive applications in Aerospace, Automobile, Ship etc. In current industrial situation hybrid composite material has too much scope due to its improved mechanical properties like toughness, hardness, compressive & tensile strength. Predictable monolithic materials have restrictions with respect to hybrid composite material in terms tribological properties. The hybrid composite contents two characteristic phases as matrix and reinforcement. The aluminium alloy Al356 has good probable to work as matrix material because of its good weldability, low melting point, castability, and corrosion resistance. In the present examination, it is found that intribological properties, when the reinforcement % increases wear of hybrid composite material decreases.

Keyword :- *Al356,Metal Matrix composite, Matrix , Reinforcement*

I.INTRODUCTION

Aluminium (Al) is the second-most plentiful element on earth and it became an economic competitor in the engineering applications at the end of the 19^{th} century. The emergence of three important industrial revolutions would, by demanding material characteristics consistent with the unique qualities of Aluminium and its alloys, greatly benefit growth in the production hybrid composite materials. Among the most striking characteristics is its versatility. Aluminium alloys and its composite materials are extensively used as the materials in transportation (aerospace and automobiles), engine components and structural applications [1]. Thus it becomes all the more vital to study the tribological characteristics of Aluminium alloys and its composite materials. Addition of Silicon to Aluminium gives high strength to weight ratio, low thermal expansion coefficient, and high wear resistance. Hybrid Composite Materials show improved strength and wear properties as the silicon content is increased beyond eutectic composition. Such properties warrant the use of these materials as structural components in automotive industries

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. The composites industry has begun to recognize that the commercial applications of hybrid composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. The detailed review of the Metal matrix composite is given as follow.

Definition of composite material:

The composite material can be defined as the system of material consisting of a mixture of combination of two or more micro constituents insoluble in each other and differing in form and or in material composition. These materials can be prepared by putting two or more dissimilar material in such way that they function mechanically as a single unit. The properties of such materials contrast from those of their constituents Normally in the composite material have a hard stage in the delicate pliable network where the hard stage go about as a supporting specialist increment the strength and modulus, and delicate stage go about as framework material.

1.2 Classification of Composites

1.2.1 Matrix material can be classified in the following groups:

a) Polymer-matrix composites (PMC)

The most common matrix materials for composites are polymeric. Polyester and vinyl esters are the most widely used and least expensive polymer resins. These matrix materials are basically used for fiber glass reinforced composites. For mutations of a large number resin provide a wide range of properties for these materials .The epoxies are more expensive and in addition to wide range of ranging commercials applications ,also find use in PMCs for aerospace applications.

b) Metal-matrix composites (MMC)

The matrix in these composites is a ductile metal. These composites can be used at higher service temperature than their base metal counterparts. These may improve specific stuffiness specific strength, abrasion resistance, creep resistance and dimensional stability. The MMCs are light in weight and oppose wear and warm contortion, so it is chiefly utilized in vehicle industry. Metal grid composites are substantially more costly than PMCs and, thusly, their utilization is fairly limited.

c) Ceramic-matrix composites (CMC)

One of the primary destinations in creating CMCs is to build the strength. Earthenware production materials are intrinsic impervious to oxidation and decay at raised temperatures; a portion of these materials would be ideal possibility for use in higher temperature and serious pressure applications, specifically for components at automobile an air craft gas turbine engines.

1.3 Hybrid Composite

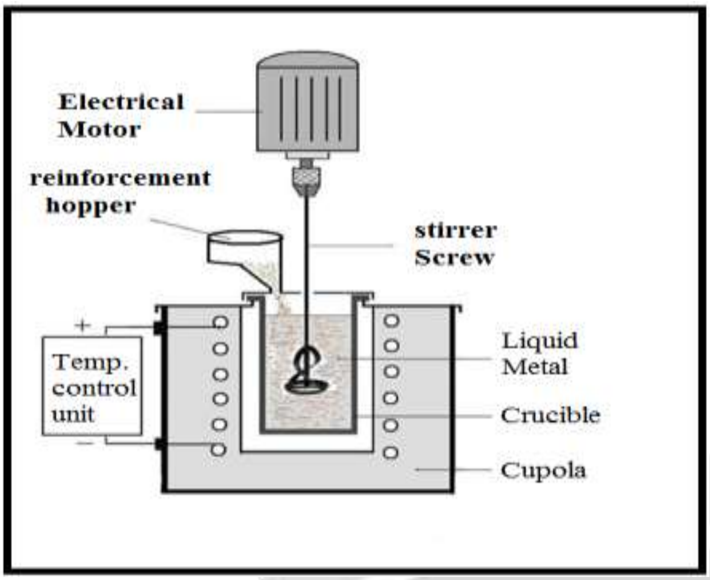
Hybrid composites are more advanced composites as compared to conventional simple composites.

In general, the major advantages of Hybrid Matrix Composites (HMMCs) over composite materials are as follows:

- High specific strength
- High specific stiffness
- Higher elevated temperature strength
- Improved wear resistance
- Low density
- High strength to weight ratio.
- Improved damping capabilities
- High thermal expansion coefficients
- Good corrosion resistance etc.

a)Stir casting:

Stir-casting techniques shown in Fig.1.3 are currently the simplest and most commercial method of production of MMCs. This methodology includes mechanical blending of the support particulate into a liquid metal shower and moved the combination straightforwardly to a formed shape before complete hardening. In this interaction, the significant thing is to make acceptable wetting between the particulate support and the liquid metal. Miniature primary inhomogeneties can cause eminently molecule agglomeration and sedimentation in the liquefy and thusly during hardening. Inhomogeneity in support appropriation in these cast composites could likewise be an issue because of communication between suspended fired particles and moving strong fluid interface during cementing. This cycle enjoys significant benefit that the creation expenses of MMCs are exceptionally low.



b) Application of Hybrid composite

I. Aeronautical Applications

- Rotating blade sleeves in helicopters.
- Flight control hydraulic manifolds.
- Sail plane wing

The utilization of composite materials in the aviation vehicles is abundant and in numerous applications, it is the solitary useful material. Composite materials are utilized in airplane for essential (radomes and dielectric boards) and auxiliary (entryways, ring tips, channels and fairings) structures. The materials used for wall construction are E-glass rovings and epoxy resin because of their good electrical as well as mechanical properties. The technique adopted is polar winding. The secondary components fabricated from boron-epoxy composites are also available in foreign countries. The materials used for wall construction are E-glass rovings and epoxy resin because of their good electrical as well as mechanical properties.

II. Wind Power Generation:

- blades.
- blade sleeves
- Rotor
- Hub
- Tower

II.Problem Statement

To obtain sufficient wetting of particle by liquid metal and to gate a homogeneous dispersion the fly ash and alumina particles in present study Aluminium metal matrix composite were fabricated by different processing temperature with different holding time to understand the influence of process parameter on the distribution of particle in the matrix and result mechanical properties. Ordinary mix projecting cycle has been utilized for delivering broken molecule supported metal network composites for quite a long time. The distribution is examined by hardness distribution, tensile testing, compressive testing and impact testing.

III.Objectives:

The vital targets of current work are as given beneath:

Manufacturing of Aluminum alloy composite by using stir casting method.

To use Stir casting method as it simple and flexible.

To Study the mechanical & wear characteristics of the composite material and to observe the change in wear resistance of composite material with Al 356.

To break down the impact of composite support on Al356.

To compare the properties of hybrid reinforced composite with individually reinforced composite.

To develop mathematical model to predict result of composite reinforcement by using regression Analysis.

IV. Scope:

This can further be extended by varying geometrical angle of Stirrer & by varying stirring Speed.

Results is a function of reinforcement Grain Size.

Other metal Matrix composite can be manufactured and tested by using Stir casting.

V. Methodology:

In this thesis there are two methods are used to comparison of mechanical properties of composite material, Experimental and Numerical Methodology.

In Experimental methodology following methods are performed

I] Tensile Test

a) Ultimate Tensile Test

b) Yield Tensile Test

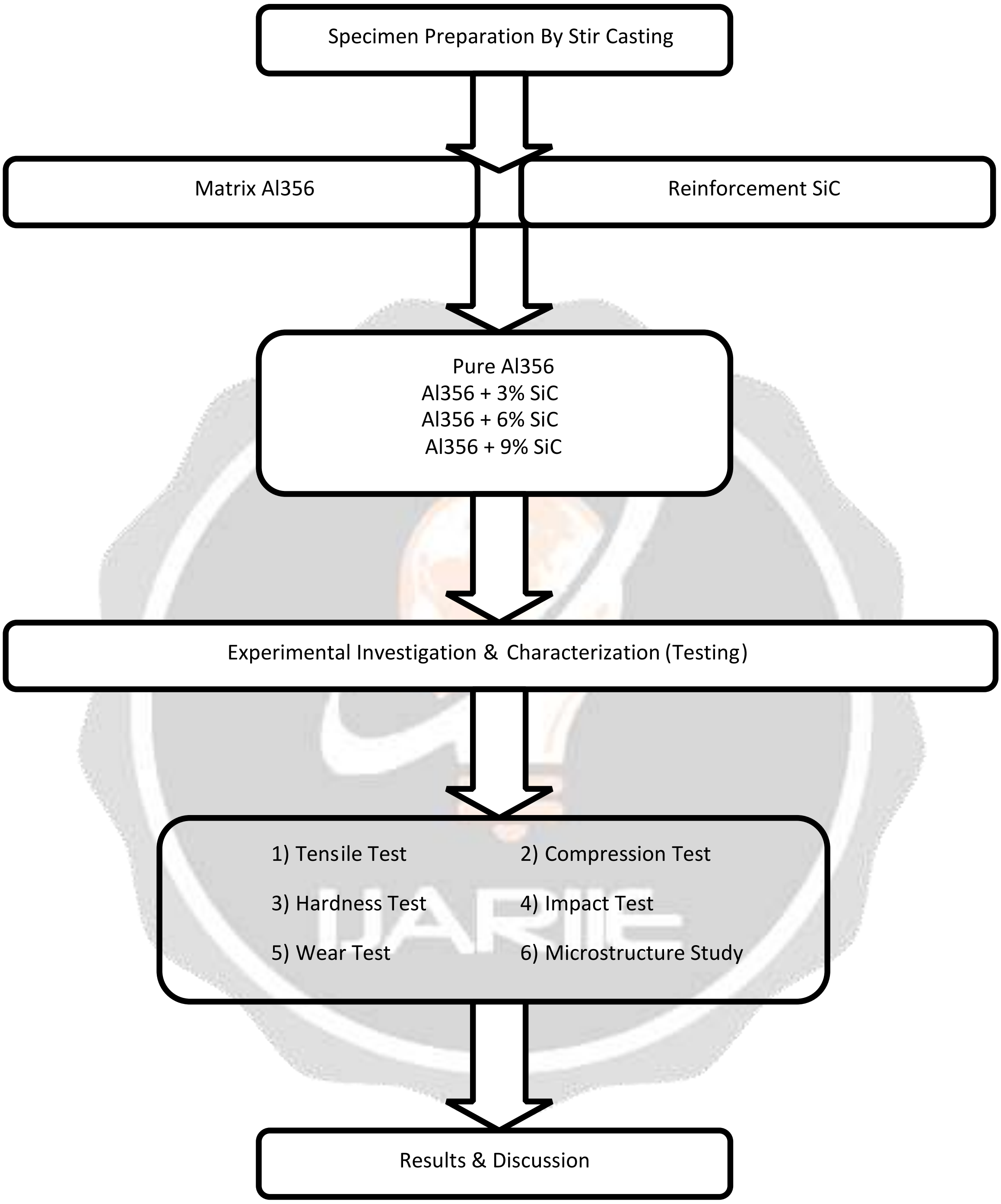
c) Ductility Test

II] Compressive Test

III] Hardness Test

IV] Impact Test

VI. Experimental Method



VII. Numerical Method

a) Tensile Test / Compressive test

Ultimate stress and yield stress are calculated from experimental load and area as per BS Standard.

Stress = ………………………. (1)

b) Hardness Test

The hardness of given composite specimen is calculated by using brinel hardness test.

BHN = ………………… (2)

Where P= Applied Load in kg D= Diameter of indenter in mm
d= Diameter of indentation in mm

c) Impact Test

In this test Toughness is calculated by using a definite mass and use of gravitation force.

Toughness = mg (h – h') ………………………… (3)

Where, m- mass of striking hammer in kg

g - Gravitational force

h - Height of hammer before impact

h' – height of hammer after impact

VII. Matrix & Reinforcement Material

We have manufactured, hybrid MMCs containing Al356 as matrix, Fly Ash &Alumina (Al_2O_3) as reinforcement by varying weight % i.e. 4%,8%,12%,16%,and 20% of both Fly ash and Al_2O_3 by stir casting method.

a)Aluminium alloy (Al356)

Al356 alloy was chosen as it is having good castability, weldability and good resistance to corrosion. Table 4.1 gives the composition of Pure Al356 alloy. Table 4.2 gives the Mechanical properties of Pure Al356 alloy.

Fig-1 Pure Aluminum alloy Al 356

Table 1: Composition of Pure Al356 alloy

Composition	**Si**	**Fe**	**Cu**	**Mn**	**Zn**	**Mg**	**Ti**	**Al**
Wt.%	7.24	0.26	0.17	0.24	0.10	0.43	0.05	Bal

Table 2: Mechanical properties of Pure Al356 alloy.

Elongation %	**Hardness (BHN)**	**UTS (N/mm^2)**	**Elasticity (N/mm^2)**	**Yield Strength(N/mm^2)**
2.2	90	151.27	71	141.18

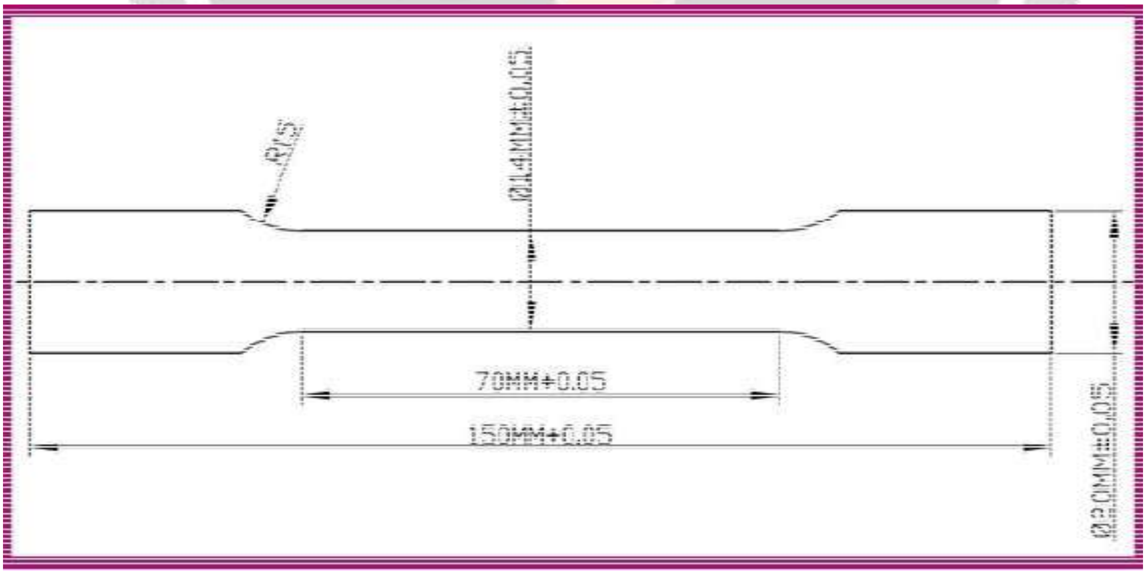


Fig-2 Tensile test specimen

Procedure to find out Gauge diameter and Gauge length:

As per BS 1490 standard, Tensile stress of Al356 alloy is 150 MPa.

And Load capacity of UTM machine is 30000 N (i.e. safe load 10% of 300 KN)

- Diameter of Tensile bar calculated as,

Stress = Applied Load Capacity of UTM / Cross-sectional Area of Test Bar

$150 = [(30000) / (3.14*d^2/4)]$

∴d≅ 14.00 mm

And gauge length as per Indian Standard is,

$L_0 = 5.65\sqrt{\text{Area of bar}}$

$= 5.65*\sqrt{(3.14 * d / 4)}$

$= 5.65*\sqrt{(3.14 * 14 * 14 / 4)}$ $L_0 =$ 70.00 mm

∴ Gauge length of specimen is 70 mm and gauge diameter is 14 mm.

VIII. Acknowledgment:

I would like to take this opportunity to thank one and all that provided their valuable advice and guidance without which this Project Stage-I would not have been completed. I thank all who have helped me directly or indirectly but some in particular have to be singled out since they have given me more than just guidance. My profound thanks to Prof.Shitole J.S , my Guide for his invaluable advice and constant encouragement to complete this Project Stage-I report in a successful manner. I am thankful to Prof Kathale S.S Head of the department for his kind support and providing all facilities and academic environment for my project work. I would like to express my gratitude to our esteemed Principal for his encouragement.

IX.REFERENCES:

[1] Sharanabasappa R Patil., B.S Motgi., “A Study on Mechanical Properties of Fly Ash and Alumina Reinforced Aluminum Alloy (LM25) Composites”.Volume 7, Issue 6(July. -Aug. 2013), PP 41-46.

[2] Sandeep Kumar Ravesh, T. K. Garg” Preparation & Analysis for Some Mechanical Property Of Aluminum Based Metal Matrix Composite Reinforced With Sic & Fly Ash”International Journal of Engineering Research and Applications (IJERA) Vol. 2,Issue 6 Nov- Dec 2012, pp.727-731

[3] MahendraBoopathi., M., K.P. Arulshri and N. Iyandurai., “Evaluation of mechanical properties of Aluminum alloy 2024 reinforced with silicon carbide and fly ash hybrid metal matrix Composites”American Journal of Applied Sciences, 2013 10 (3): 219-229.

[4] K.K. Alaneme, B.O. Ademilua, M.O. Bodunrin “Mechanical Properties and Corrosion Behavior of Aluminum Hybrid Composites Reinforced with Silicon Carbide and Bamboo Leaf Ash”Tribology in Industry Vol. 35, No. 1 (2013) 25- 35.

[5] S. CemOkumus., SerdarAslan., RamazanKarslioglu.,Denizgultekin. “Thermal Expansion and Thermal Conductivity Behaviors of Al- Si/SiC/graphite Hybrid Metal Matrix Composites (MMCs)” ISSN 1392–1320 Materials ScienceVol. 18, No. 4. 2012.

[6] M.Sreenivasa Reddy., Soma V. Chetty., 3Sudheer Premkumar. “Effect of reinforcements and heat treatment on tensile strength of Al-Si-Mg based hybrid composites” Int. Journal of Applied Sciences and Engineering Research, Vol. 1, No. 2, 2012