International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 12 | Dec 2020 www.irjet.net p-ISSN: 2395-0072

"REVIEW ON DESIGN AND STUDY OF MECHANICAL PROPERTIES OF HYBRID METAL MATRIX COMPOSITES"

Lesan uddin al jehadi[1], Dr. J Satheesh[2], Dr. Mohammed Imran[3]

[1]PG Students Department of Mechanical Engineering.
[2]Professor Department of Mechanical Engineering.
[3]Assistant Professor Department of Mechanical Engineering.
[1][2]SJB Institute of Technology, Bangalore-560060.
[3]Ghousia College of Engineering, Ramanagaram- 562159

Abstract - *Innovative materials are required for the present world to use major technological applications, due to Lighter weight, greater strength, higher safety and better features. This has led to composite materials being developed. According to the literature survey, many research articles were published based on natural fibers and particulate matter. Given the above facts, this research concentrates on design and study of the mechanical properties of composites utilizing aluminum materials, silicon dioxide and graphite. Metal-matrix composites (MMC) have been leading products in aerospace and automotive industries. Owing to their outstanding mechanistic properties, including stiffness and high tensile strength, the MMCs have gained tremendous interest. Owing to its high stiffness and abrasive design, reinforcement components such as silica pieces are difficult to machine. The aim of this project is to improve the machinabilty of particle reinforced MMC with the addition of the powder lubricant graphite. Here in some ratio, weight of the silicon particle with weight of the graphite particle will be added to the aluminum alloy. This is known as hybrid metal matrix composite. SEM data gives the homogenous distribution of aluminum materials, silicon dioxide and graphite metal matrix composites.*

***Key Words*: Aluminium, silicon dioxide, Metal matrix.**

1. INTRODUCTION

The strong balance of strength, stiffness, toughness and density of traditional monolithic materials have limitations. Composites are the most exciting new materials to solve such limitations and satisfy the ever-increasing need for new technology.

Metal matrix composites (MMCs) have changed properties dramatically, including high specific resistance, special modulus and damping capacity relative to unreinforced alloys. Growing interest has been seen in low-density and low-cost composites. Now, for a few days, a composite particle reinforced aluminum metal matrix has gained significance since it is inexpensive, with benefits including isotropic properties and secondary processing possibilities which encourage the development of secondary components.

Cast aluminum matrix reinforced composites are tougher than unreinforced alloys and have greater specific power, module and good wear resistance. But machinability of the composite is very difficult due to its hard abrasive reinforcement particles silica or alumina. However, now a days to overcome this difficulty, the solid lubricant mica or graphite is added with MMC to improve its machinability. This type of composite, which is considered a hybrid metal matrix composite of more than one material as a reinforcement.

1.1 COMPOSITES

A. Why Use Composites?

Composite materials (shortened to composites) are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. It is composed of two distinct phases: Matrix phase and reinforcing phase.

1) Matrix phase

The primary phase, having a continuous character, is called matrix. Matrix is more ductile and less hard phase. It holds the dispersed phase and shares a load with it.

Eg. Polymers, Metals, Ceramics

2) Reinforcing phase

The second phase is embedded in the matrix in a discontinuous form. This secondary phase is called reinforcing phase. Dispersed phase is usually stronger than the matrix.

Eg. Fibers, Particles, or Flakes

A. Configuration of Composites

Composites are composed of

a. Resin system

The resins that are used in fibre-reinforced composites are polymers. All polymers exhibit an important common property in that they are composed of long chain like molecules consisting of simple repeating units.

Although there are many different types of resins in use in the composite industry, the majority of structural parts are made with three main types, namely polyester, vinyl ester and epoxy. The resin system used has good mechanical properties, good adhesive properties, toughness, resistance to environmental degradation.

b. Reinforcements

One of the constituents in composite materials is the reinforcement, as the name suggests, the main function of this is to improve the overall mechanical properties of the composite. It is the discontinuous and strong phase of the composite. This reinforcement can be either in the particle form or fibrous form. It can be natural or man-made. Many materials are capable of reinforcing polymers. Most commercial reinforcements however are man-made. Other composite reinforcements include carbon, aramid, polyethylene, polyester, silicon, silicon oxide and nylon. More specialized reinforcements for high strength and high temperature use include metals and metal oxides such as those used in aircraft or aerospace applications.

c. Fillers

Fillers are used to improve performance and reduce the cost of the composite by lowering the cost significantly more expensive resin and imparting benefits as shrinkage control, surface smoothness and crack resistance.

d. Additives

Additives are modifier ingredients that expand the usefulness of polymers, enhance the process ability or extend product durability.

The composites industry has begun to recognize that the commercial applications of 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 various reasons for the use of composites are due to

• To increase stiffness, strength and dimensional stability.

• To increase tough and impact strength.

• To increase heat deflection temperature.

• To increase mechanical damping.

• To reduce permeability to gases and liquids.

• To modify electrical properties.

• To reduce cost.

• To decrease thermal expansion.

• To increase chemical wear and corrosion resistance.

• To reduce weight.

• To maintain strength/stiffness at high temperatures while under strain conditions in a corrosive environment.

1.2 STIR CASTING TECHNIQUE

In a process of stir casting, the reinforcing phases are manually stirred into the liquid matrix. In 1968, when S started casting the metal matrix composites. S Through stirring molten aluminum alloys comprising ceramic powders S.Ray inserted alumina particles into aluminum molds. The mechanical stirring in the furnace is a major factor in this process. The resultant molten alloy is then used for casting, permanent casting, or ceramic casting of sand. Stir casting is suitable for composites of up to 30 percent volume reinforcement fractions.

The cast composites are also eliminated in order to eliminate porosity, boost the micro-structure and homogenize the distribution of reinforcement. The segregation of reinforcing particles induced by the surfacing and the settlement of reinforcement particles during melting and casting processes constitute a major concern in the stir casting method. The final distribution of particles in solids depends on the material properties and operating parameters of melting, mixing power, relative density, and solidification speed, like the wetting conditions for particles [15]. The particle distribution in the matrix depends on the mechanical stirrer geometry, parameters of stirrings, and the location of mechanical stirrer in the moulded matrix.

A two-step method of mixing is an important recent advancement of stir casting [16]. The matrix material is heated to a temperature larger than the liquids, so that the metal is completely melted. The melt is then refreshed to a semisolid temperature of liquids and solids. At this stage, the preheated particles are injected and mixed. The slurry is heated again and correctly mixed in a liquid state. This two-step system of mixing was used in aluminum processing. Stir casting is the most cost-effective of all proven composite metal production methods. That is why stir casting is the most popular commercial process based on aluminum today.

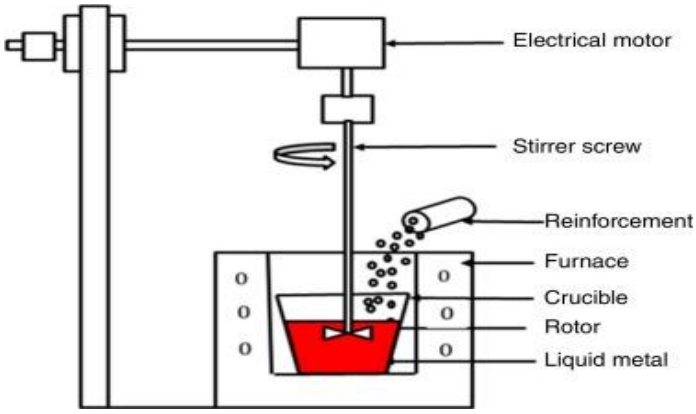

Fig 1- Stir Casting Method

1.3 RESEARCH BACKGROUND

Literally the term composite means a solid material that results when two or more different substances, each with its own characteristics, are combined to create a new substance whose properties are superior to those of the original components for any specific application. The term composite more specifically refers to a structural material within which a reinforcement material is embedded. And the engineering definition would also go alongside. A material system composed of a mixture or combination of two or more constituents that differ in form or material composition and are essentially insoluble in each other. In principle, composites can be fabricated out of any combination of two or more materials—metallic, organic, or inorganic; but the constituent forms are more restricted. The matrix is the body constituent, serving to enclose the composite and give it a bulk form. Major structural constituents are fibers, particulates, laminates or layers, flakes and fillers. They determine the internal structure of the composite. Usually, they are the additive phase.

2. RESEARCH GAP

Amitesh et al. [1] researched that Aerospace is a material concentrated industry. Insufficiency of gathering of materials to satisfy all the necessities of aeronautic trade alongside which increase request of economy and execution has driven the analysts to search for new material. Composite is the appropriate response. Despite the fact that flying machine uses various components in their development, the most significant of these is aluminum due to its low thickness, great cast capacity, high quality, consumption safe and great exhaustion quality. Nevertheless, its use is compelled because of its restricted quality and hardness. To conquer this, aluminum is joined with different components.

Harish K.Garg et al. [2] inquired that in the present examination, in view of the writing survey, the machining of mixed composition of Aluminum Metal Matrix composite (Al/Sic/Fly debris/Gr) is talked about. These MMCs can be machined and the machining parameters can be controlled with a good surface quality. These Aluminum Metal Matrix composites with multiple fortifications (MMC mixing) are extended due to enhanced mechanical and tribological properties and are thus a stronger replacement for single reinforced composites.

Shilpa P.S et al. [3] researched the impact of Boron Carbide support with Al2024.By receiving results, following method created the example by changing the wt. level of Boron Carbide. The examples are created according to the ASTM. At last, they come to realize that the hardness, tensile and yield efficiency of the fortification, Boron Carbide expanded by the wt. percentage. The degree of stretching reduces with the expansion in the piece of boron carbide.

F. Abdi et al. [4] examined the effect of the 5 wt percentage of TiB2 as an Al3561 fortification metal grid, i.e. 750c, 850c, 950c using mixture by procedure. They found that TiB2 particles are homogenously dispersed at the 950c temperature, with best results for tensile quality and hardness.

Sandeep Kumar Ravesh et al. [5] examined that the results of Sic's various weight division, i.e.2.5 percent, 5 percent, 7.5%, 10 and 5 percent of fly debris were studied with Aluminum 6061 metal frame composite using the blending technique. They noticed that the weight portion of the Sic molecule was increased by tensile quality, hardness and impact. Better rigidity of 115 N/mm2, hardness of 93RHN, and sturdiness esteem of 7.8 for 10% Sic and 5% reinforced fly debris were acquired.

K.L.Meena et al [6], the Sic mechanical properties reinforced by the Al6063 composite metal matrix material were studied using melt stirring technique, in which a number of reinforcement particle sizes (e.g., 200 mesh, 300 mesh, 400 mesh weights, i.e. 10%, 15 percent and 20 percent Sic) were performed. The stirring was conducted with the graphite impeller at 200 rpm for 15 min. In the aluminum matrix, a homogenous Sic particle dispersion was observed. With the improvement of the particle size and weight percentage, the tensile resistance, stiffness and yield strength has been strengthened and the percentage length and impact strength have been decreased as Sic particle size and weight percentage increased. Maximum hardness (HRB) 83 and impact intensity 37.01 Nm have been reached.

H.G.Rana et al. [7] with the assistance of Boron Carbide, they studied the mechanical properties and wear characteristics of Al7075. They believed that the usage of the Friction Stir casting of the examples developed uniformly blends and increases elasticity and hardness. The microstructures are now considered with the aid of the Image Analyzer.

Ram Narayan et al. [8] the effects of fly debris with mechanical combination characteristics were investigated of composite examples of aluminum 6061, produced by the Stir casting technique. They took the example of changing

zirconium (5% and 10%) and kept fly debris 10% by weight as a fixed rate. They saw the proximity of fly debris and zirconium hardness and tensile quality expanded. Where the extension diminished when contrasted with the unreinforced aluminum. The portrayal will be finished utilizing the filtering the electron magnifying instrument machine and picture analyzer.

S. Roseline et al. [9] the mechanical characteristics of aluminum composite MMC were studied with help of Zirconium alumina. They also established examples by adjusting the weight per rate. They tested the mechanical properties showing the hardness, tensile quality and impact quality of the varieties. The ideal outcome of mechanical properties was the separate fortification of 90 and 10 by weight of the lattice.

Jithin Jose et al. [10] they studied the effects of fly debris and zirconium (zirconium silicate) on the composite Aluminum 7075 with mechanical properties and implemented the Stir casting technology to compile the examples by modifying weight rates. They believed that zirconium was held at a constant weight and fly debris fluctuated during experiments.

M.Vamsi Krishna et al. [11] explored that Aluminum combination Materials considered to be the best choice with their extraordinary structuring restriction to give the materials the properties required. Aluminum compound Metal Matrix Composites (MMCs) are growing the wide distributed acceptance for applications in aerospace, mechanical and aviation, Due to its low thickness, good quality and outstanding unbending design. At present, the mechanical characteristics of the half and half composites have been designed and evaluated Al6061-SiC and Al6061-SiC/Graphite. The composites have been prepared using a stir casting technique in which the fortification measures are moved from 5 to 15 per cent in five wt. percent phases. The prepared composites are demonstrated by smaller basic investigations and thickness, and mechanical properties were assessed according to the models.

Meenakshisundaram. R. et al. [12] made an investigation of Metal network composites (MMC) have become driving materials in aviation and vehicle ventures and molecule strengthened aluminum MMCs have gotten significant consideration because of their great mechanical properties like hardness, high elasticity and so forth. Owing to their high hardness and rough nature, these materials are difficult to machine for strengthen components such as silica particles. The point of this task is to improve the machinabilty of molecule strengthened MMC with the expansion of the strong grease graphite. Here 12% by weight of the silicon carbide molecule with 5% by weight of the graphite molecule are added to the aluminum combination. This is known as mixing different composition of metal framework composite. To create this, stir casting procedure is utilized.

V.L. Krishna et al. [13] examined that Aluminum based network composites are the most investigated metal grid material to boost MMCs. In this analysis the impact of boron carbide on aluminum metal Matrix composites is studied. Graphite is used as an ointment. Aluminum Metal Matrix Composites of silicon carbide and boron carbide fortifications molecules find extended uses in the aircraft, aerospace, space, submerged and construction industries. The composite half mixture of the metal network, comprising of aluminum and different elements such as graphite, silicon carbide and boron carbide, is assembled into three different parts that alter boron carbide and silicon carbide contents and shall also be used to various measures such as toughness checking, pressure evaluation, malleable testing, less hardness and miniature scale basic examination.

R. Balaji et al. [14] explored that a composite metal lattice is a composite substance of two component parts, one metal, the other might be an alternative metal or another, such as a fired or natural alloy. It is called metal matrix composite at the period where at least three materials are available. Aluminum is utilized as a framework component attributable to its lesser weight and saw as the best option with its extraordinary limit of structuring a material to give desired properties. In this paper, creation of aluminum based metal grid composites by utilizing fluid metallurgy mix throwing technique and to examine the different mechanical properties like elasticity, yield quality, rate extension, sway quality and hardness have been recognized by changing weight part.

3. STATE OF THE ART

There are many research that has been carried out on Aluminium alloy in composites and particulate form. In this work I am Exploring AL 7068 alloy in carbon form as reinforcements in composites along with the addition of compounds like Silicon dioxide.

4 .SUMMARY OF LITERATURE SURVEY

The effect of AL 7068 alloy in carbon form on the mechanical and Thermal properties of the composite has not been effectively discussed so far and the addition of certain compounds like Silicon dioxide which in turn would affect the mechanical and Thermal properties are yet to be exploited and compared.

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