Effects of Reinforcement of Aluminium Oxide And Titanium Di Boride on Mechanical Behaviour of Aluminium Based Composites

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Abstract- *The goal of this study was to better understand the mechanical behaviour of a composite made of aluminium alloy Al6063 and strengthened with aluminium oxides and titanium diboride. Stir casting is used to create composites. Castings with and without reinforcement are made (percentile range from 0 percent to 6 percent with increment of 2 percent). The mechanical behaviour of pure base metal (Al6063) is investigated when contrasted to varying weight percentages of reinforcements. In the last several years, composite materials have been a major emphasis. Composites are becoming more important and valuable structural materials, and this trend is expected to continue. Polymer composites are likely to become the next major application area for polymers. The terms "aluminium matrix composite" (AMC) and "hybrid aluminium matrix composite" refer to two distinct types of aluminium matrix composites (Hybrid AMCs). In the automotive and aerospace sectors, (HAMCs) are gaining popularity because of their tear, to have a large strength-to-weight ratio, and other such properties.*

Keywords- Aluminium-6063, TiB2+AL2O Stir casting Process, Physical and Mechanical properties.

I. INTRODUCTION

A composite is a system of materials composed of two or more constituent parts that are macroscopically bonded and linked. Composite materials are often made up of a matrix (polymers, metals, or ceramics) and a reinforcement (fibres, flakes, or fillers). Reinforcement is held in place by the matrix, which also transfers the weight to it. increases the matrix's overall mechanical properties as a reinforcement There are more qualities in a composite than there are in its separate components, and the quality of its constituent materials has a major influence on its features. Their dispersion and inter dependence. It has been possible for metal matrix composites to fulfil all of the component designers' desired notions so that they may respond to the particular needs of varied technical applications infused into the soft metal matrix. Metal matrix composites may be made from a variety of metals, including titanium, magnesium, copper, nickel, and aluminium. Aluminium, on the other hand, is the most often used basic metal because to its light weight, strength, properties, imperme ability, and cheap price. Composites made of a metal matrix and a reinforcing material are known as MMCs (metal matrix composites). 1.c., ductility and toughness as well as high strength and modulus may be found in these materials .The strong shear/compression strength and high service temperature characteristics of metal matrix composites make them an excellent choice for the production of products. They might be used in a variety of fields, including aircraft and automobiles.

II. LITERATURE REVIEW

Massardier et al. (1993) .[1]The mechanical properties of an aluminum-based composite reinforced with performs were studied by Elf-Atochem. The a-alumina platelets used in these performances were randomly organised hexagons and mono crystals. Between 13% and 35% of a performance's platelet volume fraction was changed. An A9 pure aluminium matrix (99.9 percent Al) or a 6061 aluminium alloy (1 percent Magnesium, 0.6 percent Silicon) were used to manufacture composites using the squeeze-casting technique. Flow stress and ultimate tensile strength increased in response to material variable variables in metals, according to their investigation. Because of these advantages, tensile ductility is reduced .Clyne (1995) [2],There are a variety of types of metal-reinforced composites. Metal Matrix Composites: An Overview.. Aluminum, magnesium, and titanium are the most often used matrix metals because of their low weight and high temperature resistance. Reinforcing ceramics such as AlbO:, SiC:, and B4C are often used. These may be used as long threads, short whiskers, irregular or spherical particles, or any combination there of .Matrix, reinforcement, and interface are the three basic components that influence the properties of completed composites. Hashim et al. (2002) .[3]It was determined that the optimal stirring speed and other parameters for simulating fluid movement were For the purpose of developing optimal flow patterns, the impeller's placement was investigated Naher et al. (2003) .[4] Studies using liquids with characteristics similar to aluminium melt

and Sic particles as reinforcements were conducted at scaled-up levels. The experiment was carried out in a transparent crucible, and flow patterns were recorded. Ravi et al. (2007) .[5]The influence of mixing settings on the stir casting fabrication of Al-SiC composites was examined using a water model. The impeller blade's angle The impeller rotation speed and direction were employed as stirring parameters. the assemblage Lu and Lu (2010) .[6] Finite element analysis was used to assess how various stirring parameters, such as blade angle and speed, affected the flow pattern. The size of the impeller and the form of the stirrer Overflow is defined by the following: M. Indra Reddy et al. (2018

III. EXPERIMENTAL

A. Matrix material

A6063 was employed in this study. Aluminum is the primary metal in A6063 alloys (Al). Alloying elements include copper, magnesium, manganese, silicon, and zinc. There are several uses for this hypoeutectic Al-Si alloy, including those in the automotive and avionics industries

Table:1 The chemical composition of Aluminium 6063 :

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
Al6063	0.60	0.35	0.10	0.10	0.90	0.10	0.10	0.10	Bal

B. Reinforcement Material

Here we have used two different types of reinforcements are Aluminium oxide and titanium di boried were utilised as reinforcing materials in the study. boride (TiB2) is used in high-tech structural and functional applications such as denfence.

C. Experimental Procedure

For the manufacturing of metal matrix composites, stir casting is an ideal method because of its cheap cost, high production capacity, and ease of use. enhanced composite structural management and almost net shaping. During the stir casting process, the mechanical stirrer is used in conjunction with a variable speed motor to regulate its speed. Stirring has a substantial influence on the final microstructure and mechanical properties of cast composites because it alters the distribution of reinforcements throughout the matrix. The mechanical properties of AMCS and HAMCS are determined by the distribution of reinforcements in the composite.Reinforcement placement is affected by stirring settings.

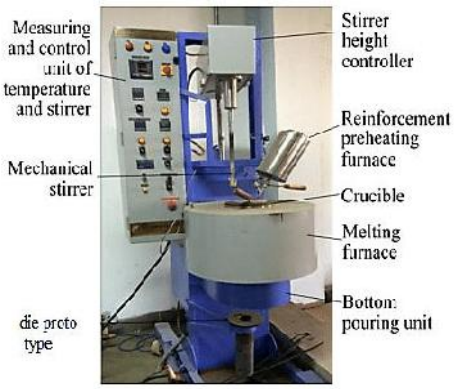
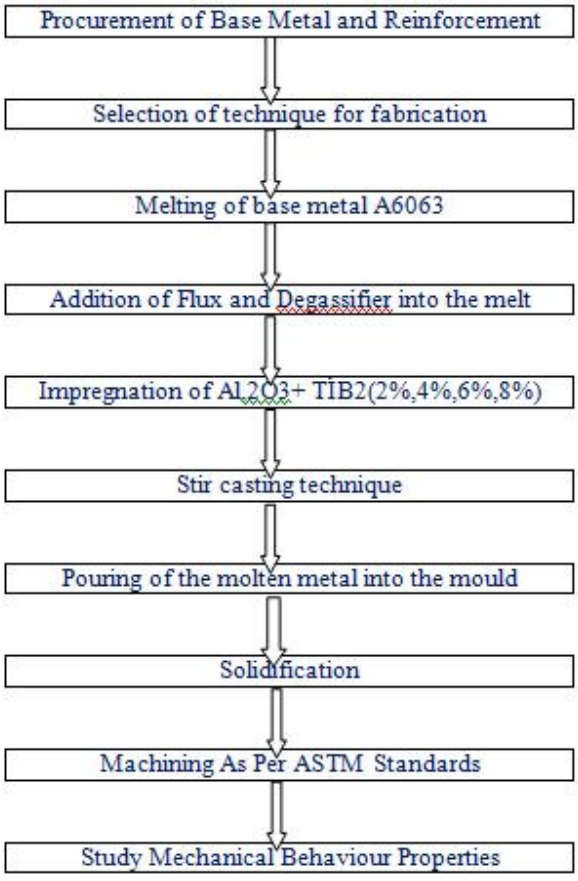


Fig-1: bottom pouring stir casting machine

D. Methodology:



IV. EXPERIMENTALSETUP

Fig – 2: Three Fingers Die

1 . MICRO STRUCTURE

The structure of a material's prepared surface as viewed under a microscope magnified above 25X is characterised as microstructure, which is the material's very small scale structure. For example, a material's microstructure may have an enormous influence on its physical properties such as its toughness and ductility as well as its hardness and corrosion resistance. The tests will be carried out using a computer-aided microscope.

Fig – 3: microscopy testing machine

2. Compression Strength:

To put it another way, compressive strength is an object or material's or structure's ability to handle loads that trend toward shrinking in size rather than those that tend toward expanding. Compressive strength, on the other hand, resists compression, whereas tensile strength, on the other hand, opposes tension. Compression testing often makes use of the UTM

. Fig – 4: Universal testing machine

3. Hardness:

The ability of a material to withstand localised deformation, such as impacts, indents, or scratches, is what is meant by the term "hardness.". As a well-known physical trait, it is more complex than other qualities since it is linked to a wide range of loading forces.. Simply said, hardness is an indicator of how well a material performs in a certain hardness test.A wide range of hardness testing methods and procedures are currently available to scientists.

In this piece, we'll take a look at four different ways to measure indentation hardness.

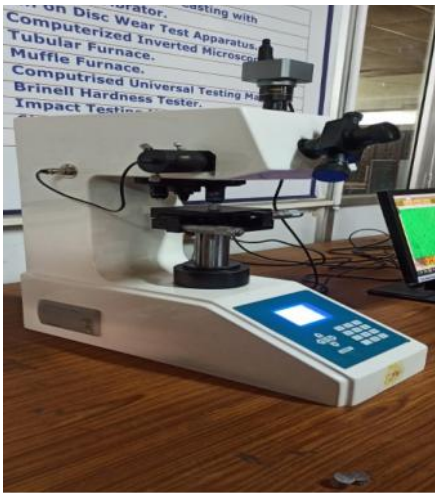


Fig.5 Vickers Hardness Testing Machine

4 WEAR

The gradual erosion of a material from the surfaces of solids that are prone to contact and sliding is referred to as wear. Contact surfaces are harmed by wear. They may be designed in a number of styles (abrasion, fatigue, ploughing, corrugation, erosion and cavitation). Abrasive wear causes permanent changes in body forms as well as the production of

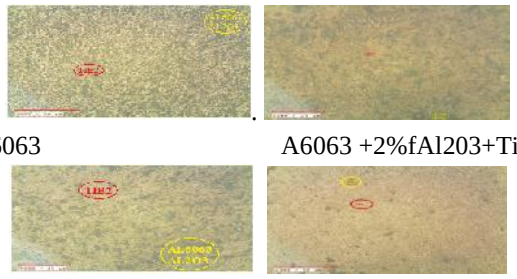
gaps between contacting substances.. A surface's wear depth profile is a helpful measureof the lost material.

Fig.6 Wear Testing Machine

V. RESULTS AND DISCUSSIONS

A. The microstructure

Reinforcement distribution is shown via microstructure analysis. Composite mechanical characteristics are determined by how well the aspirant and matrix are mixed together. The microstructures of A6063 reinforced AL2O3 and TIB2 are shown in Figures 5.l to 5.4. Number of intercepts and Grainnumber in composite materials



A6063 A6063 +2%fAl203+Tib2

A6063+4%(A1203+Tib2 A6063+6%(A1203+Tib2

Fig.7 Microstructures with variation of reinforcements

B. Compression Strength:

From these results, it is observed that the compressive strength of AMCs is better than unreinforced material. Finally in this test the maximum breaking point and maximum displacement occur at 6% of reinforcement so the best compressive strength was observed at this reinforcement fraction. compression strength graph Vs composite material Figure clearly shows the variation of the compressive strength of the composites with increase in there inforcement concentration in them. The Compressive strength values of AMCs with varying wt.% of Tib2 and Al2O3 reinforcements..

Fig.8 The above bar chart represents ultimate load Vs % of reinforcement.

C. Hardness

Below chart shows, the relation between Hardness and wt. % of reinforcements of fabricated composites. Fromthe Hardness results, it is observed that the Hardness of AMCs is greater than unreinforced Al. Increasing of Hardness in AMCs can be attributed due to the bonding between reinforcements and the basemental.From the obtained results it is observed that hardness value is increasing with increase of reinforcement material.

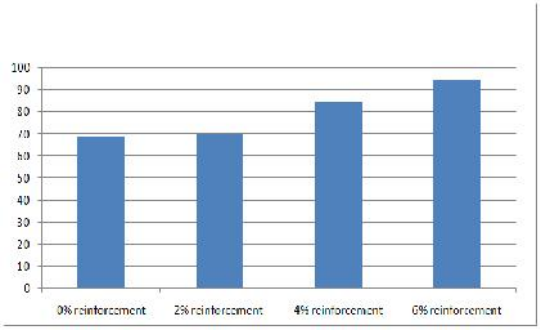


Fig.9 The bar chart above depicts hardness vs percent reinforcement.

D. Wear

The gradual erosion of a material from the surfaces of solids that are prone to contact and sliding is referred to as wear. Contact surfaces are harmed by wear. They may be designed in a number of styles (abrasion, fatigue, ploughing, corrugation, erosion and cavitation). Abrasive wear causes permanent changes in body forms as well as the production of gaps between contacting substances**.**. A surface's wear depth profile is a helpful measureof the lost material.

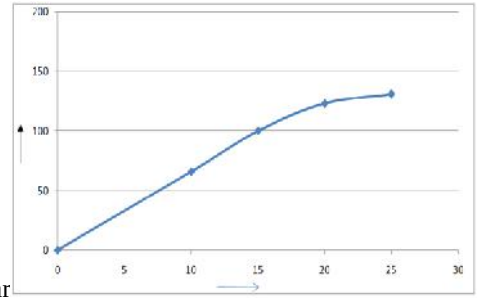


Fig.10 Graph on wear and load of 6% reinforcement

VI. CONCLUSIONS

Hybrid metal matrix composites A6063+4% (A1203+Tib2) were fabricated using the stir casting method with four different weight ratios of A1203+Tib2) particles (Three different samples were taken ,(1+1)% ,(2+2)% . ,(3+3)% The following conclusions from the experiments were obtained

- Al6063 was used as the matrix, aluminium oxide as one reinforcement, and titanium diboride as the other.
- Experimentation was used to analyse the mechanical qualities of the casted components Properties
- According to the microstructure data, the reinforcements are evenly dispersed in 2 percent to percent of the samples.
- It clearly shows that increasing particle dispersion uniformity results in better mechanical behaviour.
- At 6% reinforcement, the composite has a high compression strength, hardness, and wear.

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