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Optimization of Stirring Process Parameters for the Production of Aluminum Matrix Composites

***Pavithra G, Kevin.M, John bestas Y, Kameshkumar S, Sagai Francis Britto A**
Rohini College of Engineering and Technology, Palkulam, Kanyakumari District
*Corresponding author: **pavithra060302@gmail.com**

Abstract: *Work is being done to examine the properties of a metal matrix hybrid substance consisting of the aluminum alloy AA6026 and the silvery-white metal beryllium.Because of their malleable mechanical properties, such as very high strength to weight ratio, superior wear resistance, greater stiffness, better fatigue resistance, controlled co-efficient of thermal expansion, and good stability at elevated temperature, hybrid aluminum matrix composites are increasingly being used in the automotive and aerospace industries. Because of its adaptability, low cost, and suitability for mass production, stir casting is a popular technique in the commercial manufacturing of HAMCs. The expected characteristics of HAMCs are controlled by the distribution of the reinforcement particles in the finished mixture. Parameters of the stirring process, however, control how evenly supplements are distributed. Optimal selection of stirring factors and their impact on particle dispersion remains a challenge for rapidly developing fields of study. In this work Al alloy (AA6026) strengthened with 5%, 10%, and 15% beryllium (Be) are being made with the aid of using stir casting technology, and these composites mechanical properties like tensile and micro hardness measurements are conducted to learn more about the material properties of these novel alloys.*
Keywords: *Hybrid Composite, Tensile Strength, Micro Hardness.*

1. INTRODUCTION

In the fields of aircraft, automotive, and thermal power plant engineering materials, aluminum alloys are generally favored. Its light weight and high sturdiness are two of its primary selling points. Because of its great strength, low weight, and steadiness, beryllium metal is used in high-performance brakes on military airplanes and in space optical systems.
N. Subramani et al. [1] analyzed the tensile properties of composites made by stir casting (AL6061 & AL2024 strengthened with SiC, B4C and graphite). The mechanical characteristics, such as Tensile and BHN, will decline as the proportion of SiC, B4C, and graphite is increased. The production of A356 with SiC composites made via the stir casting method has been analyzed by Phuriphutsaenpong et al [2]. SiC weight increased to 15% to achieve the greater hardness rating. The nanoscale hardness will diminish after 20% SiC is added to the mix. The fabrication of AA6351-SiC composites using a swirl casting method has been studied by Mohanavel et al [3]. Maximum hardness and tensile strength of 60.3 BHN and 206 MPa can be achieved with a SiC weight of 12%. R. Srinivasan et al [4] has examined the mechanical behavior of AA6063 reinforced with 6% of ZrO2 and 3% of Cast Aluminium Alloy through stir casting process. It obtains the optimum tensile strength of 149 MPa. In a study by V. Mohanavel et al. [5], the alloys of AA6351 with SiC made via the stir casting method were analyzed; the reinforcement of SiC at 12% yielded the highest values of hardness and tensile strength. Composites of AA6063 and SiC, made using a stir casting technique, have been studied by Ashok kumar R and Krishna kumar TS [6]. Up to 12% weight of SiC powder can be added to the substance to enhance its microhardness. The highest achievable microhardness is 93.06 HV.
Production and classification of Al strengthened with TiB2 metal matrix composite has been worked on by Pankaj kumar et al [7]. Here, TiB2 reinforced with (Al) at a ratio of 6% yields the greatest strength, while TiB2 reinforced with (Al) at a ratio of 12% yields the enhanced hardness. As the proportion of TiB2 rises, so does the toughness in this case. Composites of Al6061 and Al2O3 have been studied by Barath V. et al. [8]. When fortification (6,9,12 wt) is added to microhardness, the result is a higher hardness. The alloys of AZ91 have had SiC particles embedded in them by K.K. Ajithkumar et al [9]. When the percentage of SiC granules is increased from 5% to 10% to 15% to 20% to 25%, the final tensile strength decreases. The microhardness rating of HV can be improved by including SiC particles. Composites of AA7050 and B4C, made through stir casting, have been studied by Srinivas Reddy Mungara et al. The UTM and BHN numbers went up as B4C was increased from 0% to 2% to 4% to 8%.

2. EXPERIMENTAL WORK

In this work Al 6026 which has excellent corrosion resistance and high thermal conductivity is being used. The Al 6026 is being reinforced with beryllium which have high melting point and strong metal. The stir casting of the new material is shown in figure.

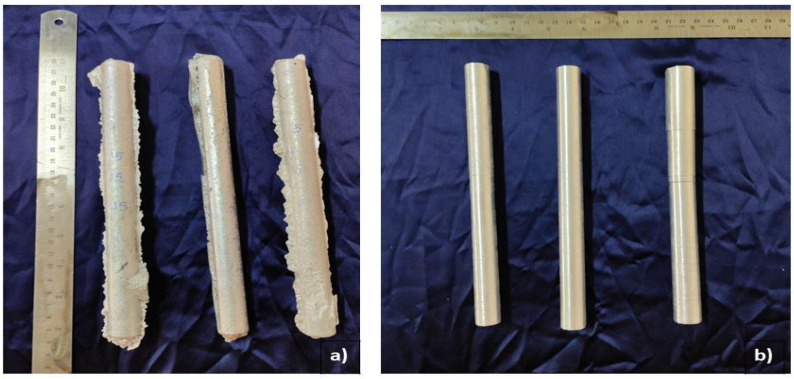

Figure 1. Test Specimen (a) Casted, (b) Machined

FIGURE 2. Tensile Testing Machine

In this work beryllium is used in 5%,10% and 15% of weight% as the reinforcement metal with aluminium 6026 with help of stir casting technique. The specimen prepared is carried out with Tensile test as per the ASTM standard.

FIGURE 3. Micro Hardness Testing Machine

The standard is (ASTM D3039). The test is carried out in the UTM (Universal Testing Machine-(UNITEK-94100)). The specimen is also carried out with microhardness testing. Thus, the testing is done in the Vickers Hardness testing machine (HMV-2T).

3. RESULT AND DISCUSSIONS

In this work three specimens are prepared. 5% Beryllium with 95% AA6026, 10% Beryllium with 90% AA6026, 15% Beryllium with 85% AA6026 which is prepared by stir casting is subjected to tensile and microhardness testing.

The test results of the Tensile test are shown in table. Here the sample B, (10% Be with 90% AA6026) gives high strength. Thus, increasing the addition of Be with AA6026 gives high strength up to certain limit of 10%. After 10% the strength deteriorates.

TABLE 1. Tensile strength of test Specimen

Sample Name	Composition	Tensile Strength
Sample A	5% Be with 95% AA6026	198.84 MPa
Sample B	10% Be with 90% AA6026	196.40 MPa
Sample C	15% Be with 85% AA6026	198.84 MPa

Micro hardness testing is carried out in the Vickers hardness machine. Thus, the results of the micro hardness testing are given in Table 2.

By comparing the samples, the hardness first decreases and then increases. Here we don't need much hard material. So, we take the sample B, (10% Be with 90% AA6026) gives enough hardness.

TABLE 2. Micro Hardness Test Results

Sample Name	Composition	Micro Hardness
Sample A	5% Be with 95%AA6026	102.54 HV
Sample B	10%Bewith90%AA6026	91.52 HV
Sample C	15% Be with 85% AA6026	94.45 HV

4. CONCLUSION

Here in this work, we took three specimens. Then these specimens are carried out with Tensile test and Micro hardness testing. In Tensile test the sample B (10% Be with 90% AA6026) gives high tensile strength. And also, in Micro hardness test the sample B (10% Be with 90% AA6026) gives enough hardness.

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