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A Review on Characteristics and Mechanical properties of Aluminium Matrix Composite using Stir Casting Process

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Abstract: *Aluminium Matrix Composites (AMCs) refer to the kind of light weight high performance aluminum centric material system. AMCs consist of a non metallic reinforcement which included into aluminum matrix which offers advantageous properties over base material. Here aluminum LM25 is selected as matrix material, while ZrO2 is selected as reinforcement material. The ZrO2 is added in 3%, 6%, 9% and 12% of weight to LM25 alloy to fabricate the MMC. Stir Casting is a liquid state method of composite materials fabrication, in which a dispersed phase is mixed with a molten matrix metal by means of stirring. In this paper we expect that the properties of aluminum composite such as tensile strength, Impact strength, and hardness will improve with the effect of ZrO2 in matrix material.*

Keywords: *LM 25 Alloy; Zuirconia; Modified stir casting; mechanical properties;*

I INTRODUCTION

Composite material is a material composed of two or more distinct phases (matrix phase and reinforcing phase) and having bulk properties significantly different from those of any of the constituents. Favorable properties of composites materials are high stiffness and high strength, low density, high temperature stability, high electrical and thermal conductivity, adjustable coefficient of thermal expansion, corrosion resistance, improved wear resistance etc.LM25 is mainly used where good mechanical properties are required in castings of shape or dimensions requiring an alloy of excellent castability in order to achieve the desired standard of soundness.LM25 finds applications in the food, chemical, marine, electrical and many other industries, and above all - in the automotive industry where it is used for wheels, cylinder blocks and heads.

Study of mechanical properties and wear characteristics of LM25/ZrO2 hybrid metal matrix composite. Composite specimen of reinforcements ranging from 0 to 30 wt-% were fabricated using liquid metallurgy route[1].Property analysis of aluminum (LM25) metal matrix with ZrO2 as reinforcing materials and investigated that functionally graded composite cylinder shows improved hardness towards outer periphery, due to the presence of higher volume fraction of ZrO2 particles [2].Conventional stir casting technique to prepare the cast A356/ ZrO2 composites and found a good combination of improved properties [3].

The influence of process parameters of stir casting in making aluminum metal matrix composites with 5% ZrO2 of 400 grit size and observed that the mechanical properties such as hardness, impact strength, tensile strength of the composites found increased with increasing the grit size [4].The wear behavior of LM25 and its composites reinforced with ZrO2.The results revealed that the

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reinforcement has improved the wear resisting property of LM 25 alloy [5].The wear behavior of aluminum ZrO2 composites and concluded that higher the volume fraction of ZrO2 reduces the weight of the aluminum alloy as well as wear rate [6].

The main focus of the proposed work is to study the influence of percentage volume fraction of ZrO2 in matrix aluminum on mechanical properties such as tensile strength; hardness and impact strength. We are expecting that the mechanical properties like impact strength, tensile strength and hardness of aluminium matrix with ZrO2 reinforcement would be improved.

II. Experimental Details

Selection of Material

The Aluminum – Silicon – Magnesium (LM25/ 365) was chosen as the material for the matrix.ZrO2 is selected as the reinforcement for its major advancements such as low density, high strength, high thermal conductivity and higher elastic modulus. The table 1 shows the chemical compositions of the LM25.

Table 1: Composition of Aluminium Alloy (LM25) % Wt.

Cu	Si	Mg	Fe	Mn	Ni	Zn	Pb	Sn	Ti	Al
0.20	7.50	0.06	0.50	0.30	0.10	0.10	0.10	0.05	0.02	Balance

Preparation of the Composite

Figure 1 shows the whole setup of stir casting apparatus

Fig.1 Stir Casting Apparatus

The composites were mainly fabricated using liquid stir casting technique which was initiated in 1968 when S.Ray introduced alumina particles into aluminum melt by stirring molten aluminum alloys containing the ceramic powders. Stir casting is suitable for manufacturing composites with up to 30% volume fraction of the reinforcement. The stir casting setup is shown in Figure 2.

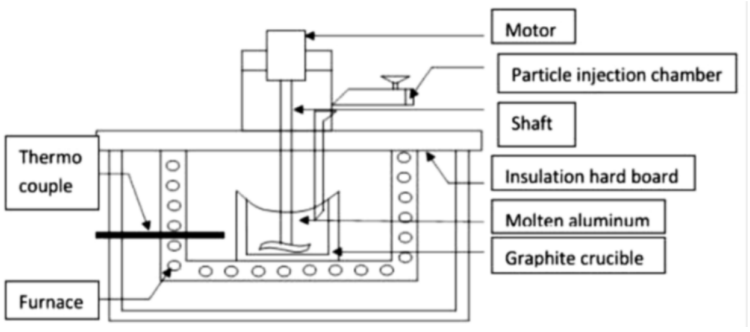

Fig.2 Stir casting setup

The furnace temperature was first raised above the melting point of aluminum LM 25(450°C) to melt the aluminum alloy completely and then cooled down just below the liquids temperature to maintain the slurry in a semi-solid state. The reinforcement particles

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ZrO2 was preheated to a temperature of 800°C in a brick walled furnace. The preheated reinforcement material were added and mixed. Mechanical mixing was the preferred stirring technique to ensure the proper mixing of the reinforcement in matrix metal. The mixing was carried out for several minutes at a normal stirring speed of 420-480 rpm.

Then the molten mixture was poured in the pre heated die to prepare the casted work piece. The samples were prepared with different volume fraction of ZrO2 (3%, 6%, 9% and 12 %.).The prepared samples were tested for tensile strength, hardness, and impact strength.

III. Results and Discussions

Properties of aluminium (LM25) with reinforcement material as zirconium di-oxide (ZrO2) alloy are studied and significant increase in hardness of the alloy matrix was seen with the addition of ZrO2 particles. This indicated that the existence of particulates in the matrix improved the overall hardness of the composites. This is due to the fact that aluminum is a soft material and the reinforced particles being hard, contribute positively to the hardness of the composites. By above references, we are expecting that the mechanical properties like impact strength, tensile strength and hardness of aluminium matrix with ZrO2 reinforcement would be improved.

IV. Conclusions

The following conclusion can be drawn from the present work

1. Stir casting technique can be considered as an effective liquid based technique for making the Aluminium metal matrix composites.
2. Mechanical properties such as tensile strength and hardness increases with increasing the percentage contribution of ZrO2 reinforcement.

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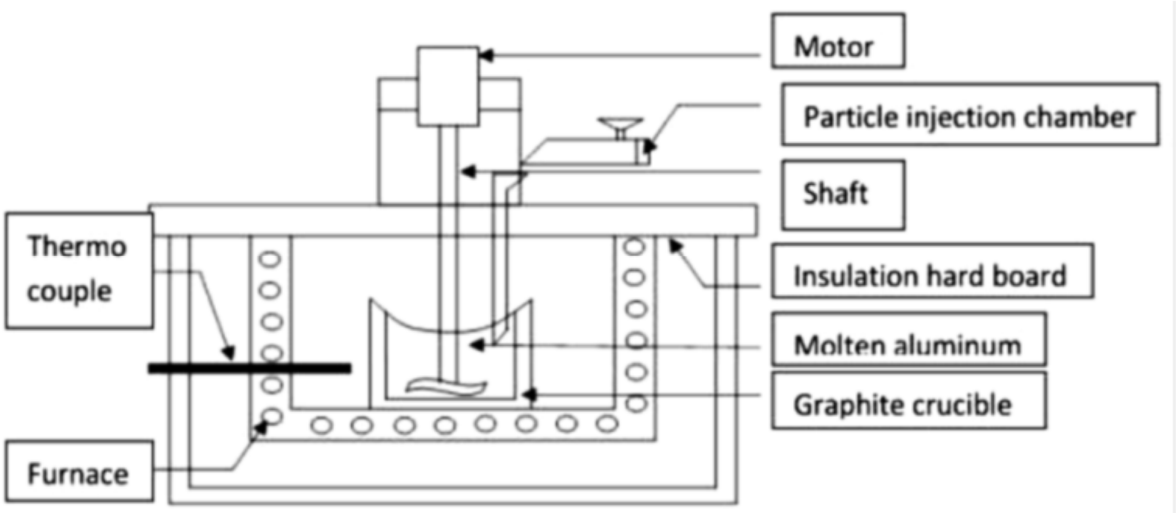

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