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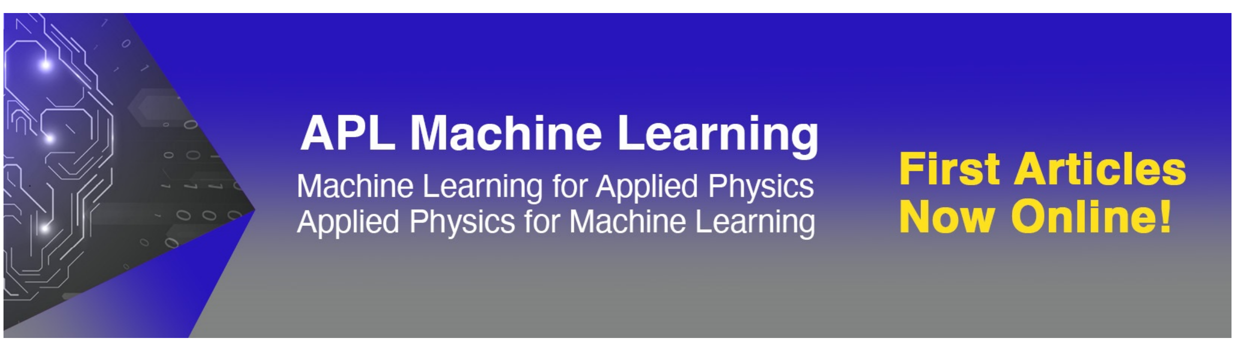

# The Influence of Aluminum Metal Matrix Composite Reinforcement –A Mini Review

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**Abstract**. The joined influence of fortifying metal matrix composites with separate and numerous particle reinforcing agents like hybrid metal matrix composites are utilized greatly in the manufacturing industry. This is attributed to the enriched mechanical and wears characteristics such as strength, impact and wear resistance. In the present study, a series of research undertakings were carried out. This paper directs the technologists and scientists towards the appropriate collection of materials by their constituents in the field of study and diverse methods used in the fabrication of metal matrix composites, especially on the metallurgical stir casting process.

**Keywords**: Aluminum alloy, Reinforcements, Stir casting, MMC, Hybrid composites.

## INTRODUCTION

Aluminium alloy is an important material in various fields of engineering owing to its low cost, light-weight, availability and mechanical features. However, some of its properties may not be suitable for industries like the fan blade industry due to wear effects observed in service, hence the reason for the introduction of metal matrix composites (MMCs) [1]. By reinforcing aluminium with natural products such as clay having high silica content, low purchase cost and availability the industries need for lighter metals of high specific strength, rigidity, ductility and thermal resistance will be met. Recent engineering applications make use of materials which are lighter, stronger or cheaper [2]. A nice instance is a growing interest in creating products with exceptional strength to weight ratio. These materials are ideal for automotive utilization in which fuel economy with enhanced motor efficiency is very critical [3]. These desired properties can be achieved with a combination of various materials of varying mechanical properties. AA6061 alloy are extremely corrosion-resistant, displays adequate strength and utilized greatly in the automobile industry [4].

## REINFORCEMENT OF MATERIALS

Numerous methods are used in the fabrication of MMCs. The metallurgical stir casting process is employed as a standard method due to its distinctive properties. The method involves the addition of particles into the melted material and is stirred properly for a uniform blend with the aluminium alloy [5]. The compositions of the produced MMCs are triggered by the form, dimension and percentage weight of the reinforced particles and their dispersal in the matrix [6]. Over the previous two decades, research in the area of light-weight, great functionality, environmentally friendly and wear-resistant products has moved from monolithic to composite materials. Aircraft, cargo and military industries use aluminium metal matrix (AMMC) because of the proportion of excellent wear strength, steepness, light-weight, high strength to wear ratio and improvements of heat and electrical characteristics they possess. A few examples of the metal matrix composites currently required in various applications such as the aerospace industry, electronics, and automotive sectors are the magnesium, copper and aluminium matrix composites (AMCs) [7]. The most commonly used metal matrix today are aluminium matrix composites (AMC) and hybrid aluminium matrix composite (HAMC). The aluminium matrix is known as aluminium composites comprising aluminium or alloy as the base material and as

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reinforcement of non-metals. The reinforcements can be supported with whiskers or particulates in weight percentage or volume percentage and in distinct types of fibre. More than one material is added to the base metal (aluminium) for the hybrid aluminium matrix composite (HAMC) [8].

## STIR CASTING METHODOLOGY

Stir casting is a method in which a mechanical stirrer forms vortex for mixing the reinforcement in the molten matrix. Its simplicity, cost efficiency, mass-production applicability, near-net forming and easier control of a composite structure make it a better process for the production of composite metal matrixes. FIGURE 1 comprises of a mechanical stirrer, furnace and reinforcement feeder which demonstrates the stir-casting configuration. The furnace is used for heating and melting products. To prevent sticking strong solids in the floor of the crucible, immediate pouring of the blended slurry is needed after mixing, making the ground pouring furnace more appropriate for stir casting. The vortex is created by the mechanical stirrer which contributes to the mixing of the reinforcement that is poured into the melt. The stirring rod and the impeller blade makes up the stirrer. The handle of the impeller is accessible in different dimensions and forms. A more favoured blade is the three-number flat blade as it contributes to lower energy usage fluid stream model in the crucible. This stirrer is linked to the varying velocity engines which are fitted with a filter to control the stirrer's spin velocity. Also, through the feeder connected to the furnace, the reinforcement powder is supplied to the melt. A sand mould or a permanent mould or a lost-wax mould can be used for pouring the mixed slurry [9].

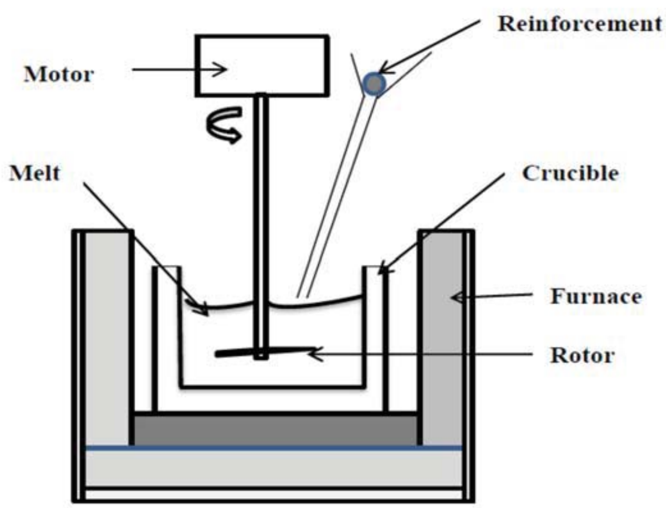


**FIGURE** 1. Stir casting experimental set up

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## LITERATURE REVIEW

A new production of aluminium matrix composites with agricultural waste derivatives that supplement synthetic reinforcement has been developed. The production of aluminium matrix composites uses agricultural waste derivatives to provide certain advantages. A few farm waste was transformed into ash and their acceptability for use as a base reinforcement was studied [16]. Pawar and Abhay, (2014) produced aluminium/SIC composite for spur gear. The results of the hardness test depict improvement in hardness with an increasing percentage of silicon carbide. They concluded that these composites may be used for the production of energy transmission components such as gears which are constantly loaded. They also added that stir casting was more economical for aluminium composite development [10]. Ma et al., (2013) performed an experiment with palm oil fuel ash particles on aluminium alloy with a sieve size of 75 µm. It was discovered that the impact strength, tensile and the resistance to wear of the composite improved as there was a significant increase in palm oil fuel ash % weight added [11].

Prasad and Acharya (2006) carried out an experiments with red mud on aluminium through the impeller mixing process. It was discovered that the scattering of the red mud in the aluminium matrix enhanced the resistance to wear and hardness of the composite, also there was a significant improvement in tensile and compressive strength as the reinforcement was added [12]. Rajmohan et al., (2013) examined the impact of mica on the mechanical and wear characteristics of silicon carbide reinforced aluminium matrix composites with a weight of 10 %. In the 10 % SIC reinforced aluminium composites, the percentage of mica was 6 %. The wear, tensile strength and hardness were greater than single reinforced silicon carbide aluminium composites for hybrid composites consisting of mica and silicon carbide. As additions, the development of a safe mechanical mixing layer which was produced on composites that reduce thermal loss was linked to the reported higher wear intensity. The greatest resistance, wear power and hardness was gotten at the hybrid composites containing 3 % mica. These characteristics decreased as the mica content rose to 6 %. Further trials are necessary to examine why the variation was not reported [13].

Ravindran et al., (2013) studied the mechanical characteristics and microstructures of aluminium hybrid nanocomposites using graphite as a solid lubricant. The composites had 5 % silicon carbide weighing up to 10 % graphite content [14]. Hardness, tensile strength and wear strength were reported to have risen with increasing reinforcements. The hybrid composites had higher mechanical features than the single fortified aluminium 5 % silicon carbide composite with the highest strength and resistance to wear of silicon carbide 10 % by weight [14]. Red mud is otherwise known as a remnant of bauxite which is an industrial waste by-product obtained from the Bayer process of producing alumina from bauxite. It major constituents are silicon oxide, iron oxide, and aluminium oxide, also $Na_2O$, $TiO_2$, CaO and MnO in small quantities. The process of utilizing, storing and disposing of red mud has become a severe concern for the environment; therefore the possibility of using red mud in metal matrix composites as reinforcement can be viewed as a good practice of turning waste to wealth [15].

A new production of aluminium matrix composites with agricultural waste derivatives that supplement synthetic reinforcement has been developed. The production of aluminium matrix composites uses agricultural waste derivatives to provide certain advantages. A few farm waste was transformed into ash and their acceptability for use as a base reinforcement was studied [16].

## CONCLUSION

The present review shows that thorough study has been done to expand the features of different aluminium based MMC by creating their composites with various ceramic and agro–waste materials. Stir casting is the cheapest process for the production of metal matrix composites. The elemental composition increases with the inclusion of ceramic oxide reinforcing agent into the matrix. The knowledge of its operating parameters and different fabrication techniques are needed for the production of composite material. The controlling of the process factors resulted in the improved characteristic in the developed composites.


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