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Fabrication of Aluminium Matrix Composite Plates by Aluminium 6351 Alloy and Aluminium Oxide

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ABSTRACT: *Aluminium matrix composites have become attractive for engineering structural applications due to their excellent specific strength property and became as alternative to the conventional materials particularly in the automotive, aerospace and defence industries. The combination of Aluminium alloy 6351 and Alumina are the source of the project. The project deals with the manufacturing of AMC's plates at different percentages of reinforcement. The Aluminium matrix composite plates were prepared through stir casting process. The microstructure study was performed on scanning electron machine and identified the presence and equal distributions of Alumina.*
Keywords: *Aluminium 6351, Alumina, Stir Casting, SEM*

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. Composites materials are made to take advantage of different properties of metals, polymer and ceramics. In composite materials there is a matrix and a reinforcing material. The strength of the composites is generally in between matrix and reinforced material but sometimes it is even higher than the pure matrix and pure reinforced material. The particulate reinforced Aluminium matrix composite are gaining importance because of their low cost with advantages like isotropic properties and the possibility of secondary processing facilitating fabrication of secondary components. Cast Aluminium matrix particle reinforced composites have higher specific strength, specific modulus and good wear resistance as compared to unreinforced alloys [6]. In AMC's one of the constituent is Aluminium alloy and is termed as matrix phase. The other constituent is embedded in this Aluminium alloy matrix and serves as reinforcement, which is usually non-metallic and commonly ceramic such as Al_2O_3, SiC etc. In a stir casting process, the reinforcing phases are distributed into molten matrix by mechanical stirring. In stir casting process alumina particles are mixed into an aluminum melt by stirring molten aluminum alloys containing the ceramic powders. Mechanical stirring in the furnace is a key element of this process. The resultant molten alloy, with ceramic particles, can then be used for die casting, permanent mold casting, or sand casting. Stir casting is suitable for manufacturing composites with up to 30% volume fractions of reinforcement [7].

II. OBJECTIVE

The main objective of the present work to find the effect of reinforced material Aluminium oxide in Aluminium 6351 alloy. The process in present work is started from manufacturing of Aluminium composite plates with reinforcement of Aluminium oxide particles with 5%, 10% and 15% through stir casting process. The manufactured plates are analyzed using scanning electron microscope for the presence and distribution of Aluminium oxide in Aluminium 6351 alloy.

III. LITERATURE SURVEY

Al 6351 has high corrosion resistance due to the superior corrosion resistance, Al 6351 offers extremely low maintenance. In this investigation the tensile strength on circular rod specimen of Al 6351 is found by applying the loads on universal testing machine [1]. The tensile behaviour of $6063/AL_2O_3$ metal matrix composites which is fabricated by the investment casting process and the process is observed with 10%, 20% and 30% volume of alumina. It was concluded that as the volume of alumina increases, the yield strength and fracture strength also increases [2]. The behaviour of Aluminium Cast Alloy 6063 with alumina composite is investigated. The experiment is conducted with different percentages of alumina. Various mechanical tests were conducted and concluded that AMC's have been successfully fabricated by stir casting technique with fairly uniform distribution of AL_2O_3 particles [3]. The effect of elemental metal such as Cu-Zn-Mg in Aluminium matrix reinforced with various reinforcement percentages of Al_2O_3 particles through stir casting. The investigation concluded that AL_2O_3 yields best combination of strength and ductility [4]. The formation of Aluminium oxide and importance of Aluminium oxide for the formation of Aluminium alloy is explained. Chemical and physical properties, manufacturing process and applications of Aluminium oxide were discussed [5].

IV. EXPERIMENTAL WORK

The Aluminium alloy 6351 flat having dimensions of 50mm x 1600mm and thickness of 12mm and Alumina with particle size of 2µ was utilized for the experimentation. The Aluminium matrix plates required are made by using AA 6351 flat 50mm width x 12mm thick melted in a furnace using a graphite crucible. The quantity of reinforcement was processed by using weight percentage and the reinforcement is done with 5%, 10% and 15%. The powder alumina was mixed with the molten liquid Aluminium alloy 6351 by using mechanical stirrer as shown in the Fig. 1 stirred at 750rpm for 15min. After that slag is removed and the molten material was poured into the die as shown in the Fig. 2. The die used for experimentation is made of sand by using wooden pattern with dimensions 205mm x 105mm x 12mm.

Fig. 1 stirring of Aluminium with Aluminium oxide

Fig. 2 pouring molten material in to die

The casted AMC's plates are subjected to cold rolling to reduce porosity and milling operation was performed to obtain required dimension of 200mm x 100mm x 5mm. These dimensions are taken to perform friction stir welding on AMC's plates for further process. Finally microstructure analysis was carried on different percentages of AMC's plates with 1cm specimens as shown in Fig. 3 by using scanning electron microscope.

Fig. 3 SEM specimens

V. RESULTS

The microstructure of Aluminium composite plates through SEM revealed the microstructures of various reinforcements. SEM images had shown in Fig. 4 to 6 displays the microstructure of the base materials with 5%, 10% and 15% reinforcement of Aluminium oxide in Aluminium 6351 alloy. The images showed the mixing of material and presence of Aluminium oxide particles in the work pieces and there uniform distribution.

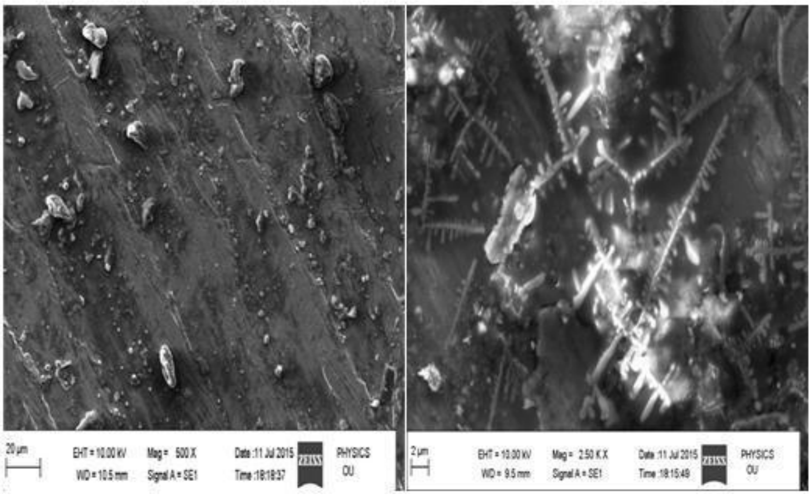

Fig. 4 microstructure of 5% reinforcement at 500 X and 2.50k X

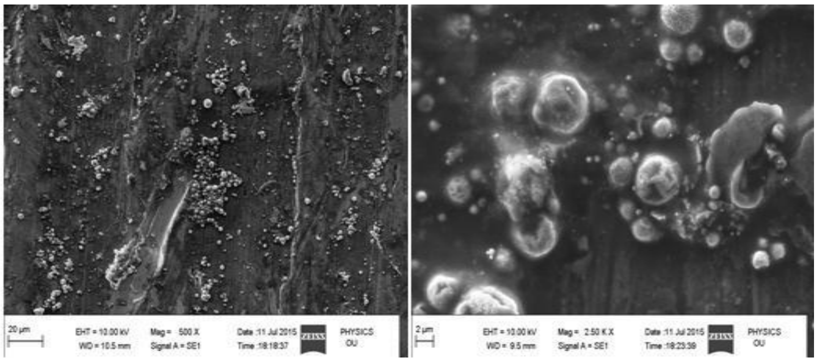

Fig. 5 microstructure of 10% reinforcement at 500 X and 2.50k X

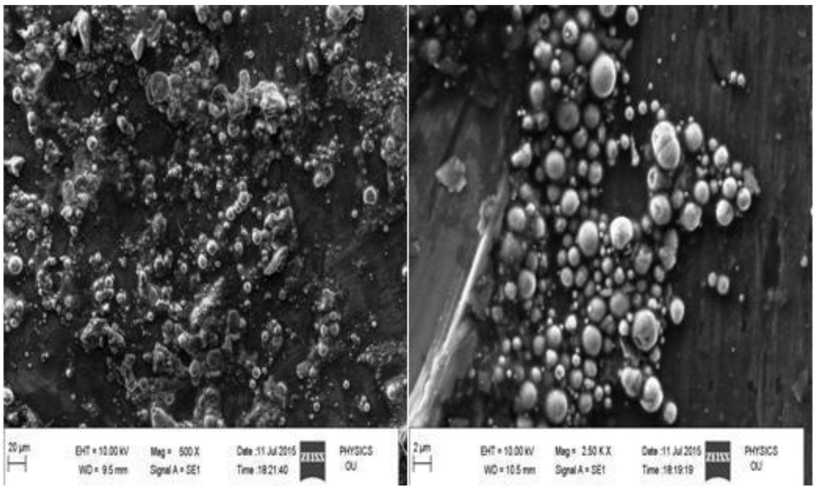

Fig. 6 microstructure of 15% reinforcement at 500 X and 2.50k X

The microstructure of Aluminium oxide was obtained clearly through SEM image at 5000 X magnification in 15% reinforcement as shown in Fig. 7.

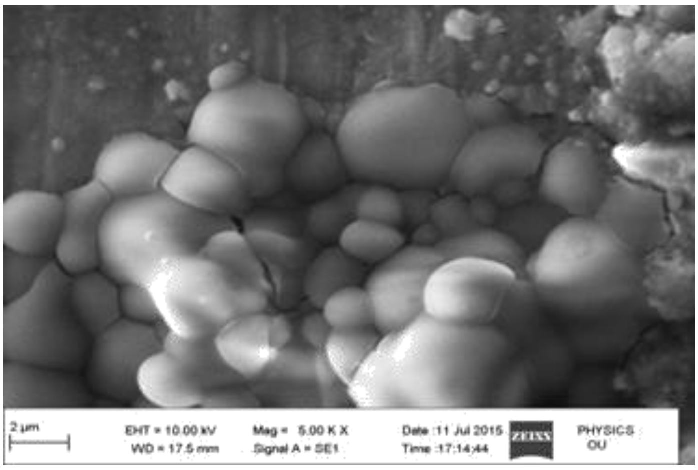

Fig. 7 microstructure of Aluminium oxide at 5000 X

VI. CONCLUSION

The experimental work of Al 6351 reinforced with AL_2O_3 particles and leads to the following conclusions:

- The required Aluminium matrix composite plates are manufactured using stir casting process without porosity.
- The porosity was reduced through cold rolling process.
- The microstructures of various reinforcement plates revealed a pattern mixture of the Aluminium composite consisting of AL_2O_3 reinforced with Aluminium 6351.
- The microstructure at 5000 X shows the presence of AL_2O_3 in Aluminium 6351 alloy.

REFERENCES

[1]. M. V. Niranjan Reddy, M. Nikhil Reddy, K. Vijay Kumar, Parthasarathy Garre, Experimental Investigation of Tensile Strength on Al 6351 to the Aerospace Structural Applications, *International Journal of Mechanical Engineering and Technology, Vol. 5,* 2014, pp. 110-114.

[2]. Chennakesava Reddy, A. Essa Zitou, Tensile Behavior of 6063/AL_2O_3 Particulate Metal Matrix Composites Fabricated by Investment Casting Process, *International Journal of Applied Engineering Research, Vol. 1,* 2010, pp. 542-552.

[3]. Ajay Singh, Love Kumar, Mohit Chaudhary, Om Narayan, PallavSharma, Piyush Singh, Bhaskar Chandra Kandpal, Som Ashutosh, Manufacturing of AMMCS using Stir Casting Process and Testing its Mechanical Properties, *International Journal of Advanced Engineering Technology,* 2013, pp. 26-29.

[4]. Muhammad Hayat Jokhio, Muhammad Ibrahim Panhwar, Mukhtiar Ali Unar, Manufacturing of Aluminium Composite Material using Stir Casting Process, *Mehran University Research Journal of Engineering & Technology, Vol. 30,* 2011, pp. 53-64.

[5]. Karen Davis, Material Review: Alumina (AL_2O_3), *School of Doctoral Studies (European Union) Journal,* 2010, pp. 109-114.

[6]. Sudpit Kumar, *Production and Characterisation of Aluminium-Fly Ash Composites using Stir Casting Method*, Department of Metallurgical and Material Engineering, NIT Rourkela, 2008

[7]. Rajeshkumar Gangaram Bhandare, Parshuram M. Sonawane, Preparation of Aluminium Matrix Composite by Using Stir Casting Method, *International Journal of Engineering and Advanced Technology, Vol. 3,* Dec. 2013, pp. 61-65