Optimization of Machining Characteristics of AL5052 Hybrid Metal Matrix by EDM

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***Abstract*—Metal matrix composites, in particular, Aluminium Matrix Composites are gaining increasing attention for applications in aerospace, defence and automobile industries. The use of nonconventional machining techniques in shaping aluminium metal matrix composites has generated considerable interest as the manufacturing of complicated contours such as dies. Electrical discharge machining (EDM) appears to be a promising technique for machining metal matrix composites. The objective of this work is to investigate the effect of Electrical Discharge Machining (EDM) parameters on the predominant machining criteria. The Al 6063 metal matrix composite reinforced with 15% Al2O3, 7% B4C is used as work material, the copper material is used as electrode. The input parameters chosen are current, pulse on time and pulse off time to measure the machining criteria's metal removal rate, tool wear rate and surface roughness. The optimal condition of input parameters is to be find by using Box-Benhken design of experiments of response surface methodology (RSM).**

I. INTRODUCTION

Composite material is a material composed of two or more distinct phases (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of the constituents. Matrix phase: The primary phase having a continuous character is called matrix. Matrix phase is usually more ductile and less hard in nature. It holds the dispersed phase and shares a load with it. Dispersed (reinforcing) phase: The secondary phase (or phases) is embedded in the matrix in a discontinuous form. This secondary phase is called dispersed phase. It is usually stronger than the matrix phase, therefore it is also called as reinforced phase.

II. PROCEDURE

In stir casting the discontinuous reinforcement is stirred into molten metal, which is allowed to solidify. Stir casting is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring. Stir Casting is the simplest and the most cost effective method of liquid state fabrication. The liquid composite material is then cast by conventional casting method and may also be processed by conventional metal forming technologies. In Stir Casting the dispersed phase is limited (usually not more than 30 vol. %). Distribution of dispersed phase throughout the matrix is not perfectly homogeneous here are local clouds (clusters) of the dispersed particles (fibers) here may be gravity segregation of the dispersed phase due to a difference in the densities of the dispersed and matrix phase.

The technology is relatively simple and low cost. Distribution of dispersed phase may be improved if the matrix is in semi-solid condition. The method using stirring metal composite materials in semi-solid state is called Rheocasting. High viscosity of the semi-solid matrix material enables better mixing of the dispersed phase. Stir casting technique is one of the popular Liquid Metallurgy Route (LMR) and also known as a very promising route for manufacturing near net shape hybrid metal matrix composite components at a normal cost. In order to achieve good binding between the matrix and particulates, one weight percent of magnesium alloy is added.

III. RESPONSE SURFACE METHODOLOGY

In statistics, response surface methodology (RSM) explores the relationships between several explanatory variables and one or more response variables. The main idea of RSM is to use a sequence of designed experiments to obtain an optimal response. Response surface methodology uses statistical models, and therefore practitioners need to be aware that even the best statistical model is an approximation to reality. In practice, both the models and the parameter values are unknown, and subject to uncertainty on top of ignorance. Of course, an estimated optimum point need not be optimum in reality, because of the errors of the estimates and of the inadequacies of the model. Nonetheless, response surface methodology has an effective track-record of helping researchers improve products and services: For example, Box's original response-surface modeling enabled chemical engineers to improve a process that had been stuck at a saddle-point for years. The engineers had not been able to afford to fit a cubic three-level design to estimate a quadratic model, and their biased linear-models estimated the gradient to be zero. Box's design reduced the costs of experimentation so that a quadratic model could be fit, which led to a (long-sought) ascent direction.

IV. NECESSITY OF MACHINING PROCESS

Advanced engineering materials are gradually becoming very important material for their scope and applications in advance manufacturing industries due to their high fatigue strength, thermal shock resistance, high strength to weight ratio, high hardness etc., Because of such superior properties, engineering composite have got wide industrial applications in the production of aero space's, unmanned area vehicle (UVA), high performance cars, fiber glass tanks and tubes, wind turbine blades etc., Hence it is essential for developing an efficient and accurate machining method for processing advanced materials at accurate manner. However, the improved properties of the aluminium based MMC pose new challenges to the present manufacturing engineers, as often haunted by the needs of machining those materials economically, efficiently and also attempting to specify the precision and accuracy. Hence, tremendous needs have been arisen for developing efficient, accurate as well as cost effective machining methods for processing the aluminium based MMC.

V. CONCLUSION

The following conclusions are derived from the Electrical Discharge machining of Al 6063 metal matrix composite reinforced with 15% Al2O3 and 7% B4C are as follows.

1. By the analysis of SEM can be concluded that,how the aluminium oxide and boron carbide was equally dispersed by stiring and the strength of the structure and particle is checked.
2. By EDM samples will be machined with input parameters and optimized by the DOE software. Finally by taking all results and comparison of existing experimental values the composition of casted samples 15% Al2O3 and 7% B4C will be analysed.

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