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Parametric Optimization In Machining of Hybrid Mmcs – A Review

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ABSTRACT

Metal Matrix Composites represents a category of substances that have giant applications because of their customizable choice within the preparation which results in changing properties which could have numerous applications based totally on the tailor made properties. Although we can find the various applications of MMCs it is a really hectic and tough task for any individual to forecast the exact parametric combination of machining them. An attempt is made by the researchers to gather and conclude the statement of better parametric combination in machining of MMCS has been made several times. Many procedural observations along with the results are described considering many mathematical, scientifical and statistical models build to

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analyze the effects of various parametric combination altogether. This paper focuses on the assessment made by using literature associated with the topic selected.

Keywords: Metal Matrix Composites (MMCs), Analysis of Variance (ANOVA), Response Surface Methodology (RSM), Grey Relational Analysis (GRA).

I.INTRODUCTION

MMCs are composed of a fairly tender and ductile metallic base material or ‘‘matrix’’ reinforced with a hard and brittle reinforcement material at the micron scale. The reinforcement can be within the shape of particles (generally on the order of 15 mm), whiskers (usually 2-3 mm diameter of approximately 10–15 mm duration), or fibers (generally 2-3 mm diameter). The advantages presented through these substances are their improved mechanical properties, especially within the regions of wear and tear, strength and stiffness. The maximum commonplace MMC is an aluminum matrix strengthened with SiC particles. Different mixtures with growing applications encompass magnesium and titanium alloys with silicon carbide (SiC), alumina (Al2O3) or boron carbide (B4C). MMCs are more and more ideal for advanced particular applications which integrate the toughness and ductility of the metal matrix segment, with the strength and hardness of the reinforcement section [6, 7].

In order to utilize the grade of MMCs in major applications as such the aerospace components, a major aspect to consider is the machining properties and the parameters associated with it. Although the research is going on, the procedure for proper machining is not available. Machining of MMCs is surely a difficult task as per the studies [8, 9]. The major applicational area of these grade of composites has taken shape in aerospace and automobile sector and finding the perfect procedure for machining is a very crucial finding and has been under consideration and working since 1970s [10], keeping in mind the cost effectiveness also. As discussed about the wide applications of MMCs industries are stepping back in utilizing these composites as they are under risk due to the difficulty involved in machining process [4]. Even though research reveals the lack of positiveness of traditional machining on the MMCs, the traditional methods cannot be forgotten [11]. The attempts have been made to build models considering the parameters involved in the machining process and effects on the system responses [12–15]. Also studies have been made on forecasting the cutting forces involved during the machining of composites [16–19]. This overview considers numerous research investigations which have been performed throughout many business international locations to decide the results of the parameters involved and the ability for machining of hybrid MMCs.

II. REVIEW OF LITERATURE

P Suresh et al, utilized the grey fuzzy algorithm to build a model suitable to predict multi level execution qualities in turning of Al hybrid composites (Al-SiC-Gr) and to check the quality of machined composites using the model.SiC-Gr particles were used with equivalent volume fraction with the tensile strengths of 210 204 and 170Mpa particularly. Results yield that the Al-10% SiC-Gr composite yield better machinability characteristics as compared to the 5% and 7.5%.Grey Fuzzy approach and grey relation analysis were compared and the conclusion was made the Grey fuzzy approach yields the better results comparatively.Grey fuzzy reasoning expanded from 0.619-0.891 which corroborates the improvement in the performance levels of parameters involved [26].

R Arun ramanath et al, carried out a survey based on the research following the parameters involved and the different responses which plays a major role in machining of FRPs. The study was majorly focused on the types of optimization techniques utilized to optimize the parameters involved in order to obtain the best results with respect to the major responses involved during different traditional methods of machining such as drilling, turning milling etc.,. Multi level decision attributes were considered along with the optimization processes which are advanced and new. AS known to everyone finding the best solution for obtaining better parameters and parametric combination of machining FRPs is a risky task, the information obtained by this particular review stand as an important scope for other researchers [27].

J S Pang et al, has made an attempt to optimize the parameters in dry end milling of hybrid MMCs (HNT with Al reinforced epoxy) using Taguchi technique.The work was carried out using the parameters such as speed, depth of cut and feed rate keeping the major responses as surface roughness and cutting force.L27 array was set to design the experiments (27) by considering the combination of parameters and to find end results of the responses. The task was to obtain the best combination of parameters and good responses in terms

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of lowest cutting force and very good surface finish with least surface roughness, which was satisfactorily done and obtained using taguchi method of optimization. The best combination of parameters for better surface finish was found to be 0.4mm, 1500 rpm and 60 mmpm (D, S and F respectively) and lowest cutting force was found with the combination of 0.6 mm, 1000 rpm and 40 mmpm.[28].

J Milton Peter et al, worked on the building of model to show the perfect characteristic behavior of the parameters involved in WEDM process of hybrid Al MMCs with boron carbide and flyash using GRA. Al hybrid composite is prepared using stir casting technique and the WEDM process parameters (pulse on time, pulse off time, wire feed, gap voltage and weight rate) were considered with three levels for the grey relational analysiswith the responses such as surface integrity and material removal rate. The effect of parameters was analyzed using analysis of variance. With the use of GRA there was a finding of better combination of parameters which led to better surface integrity and superior MRR [29].

Velmurugan C worked on the fabrication of Al MMCs and hybrid Al MMCs using stir casting technique and compare the effects of parameters involved in machining both category of composites. Common parameters (speed, depth of cut and feed rate) were considered for both the composites while machining with 3 levels. The DOE was done using taguchi technique with L9 array. The contribution of parameters was found out by using analysis of variance. The results obtained for both the composites were compared which stated that the Al hybride composite machining was better with the same level of parameters than that of the other category as there is a presenceof graphite in hybrid MMC which is itself a natural lubricant. The complete analysis involving taguchi formulation and ANOVA was done using MINITAB software which is user friendly. [30].

Ramanan G et al, made an attempt to show the superiority of MMCs over conventional alloys and discussed the disadvantages of using alloys in many applications over the mechanical properties which are more enhanced in the MMCS. Here the author has tried to make a point with respect to the utilization of MMCs and the machining procedure involved in the MMCs with 2 or 3 major constituents which improve the mechanical and chemical stability of the materials. A methodology named Response surface was used in order to predict the better combination of parameters while turning the composite under suitable conditions. DOE was done using L17 array with 17 experiments by altering the parameters (rate of cut, feed rate, and depth of cut). GRA was utilized for the prediction of better parametric combination and were found to be rate of cut - 250m/min, feed rate 0.06mm and depth of cut 1.5mm [31].

A Arun Premnath et al, showcased the investigation of better combination of parameters in processing and machining of Al hybrid composites (Al2O3 and Gr) prepared using normal stir casting technique using WC insert.Response Surface Methodology was used to build the model of parameters involving N, f, d and weight fraction and the responses considered were cutting force and surface integrity. A full central composite design with four factors and three levels was built. The input output relation was checked using RSM model.The corrective check was also made using the ANOVA with the contributions of the parameters being found. The experimental and the predicted results were compared and checked which reveal almost closeness of results. Hence conclusion was made to use the model which is built to be utilized effectively in processing and machining of hybrid MMCs. The ampleness of the model built was good which yielded the minimum cutting force of 132.8N and improved surface integrity of 0.28 mm. Surface wear and surface integrity was also studied using SEM [32].

T Rajmohan et al, had their work concentratedon the parametric evaluation of parameter involved in the machining (drilling) of hybrid MMCs (Al, SiC and Mica) produced using stir casting technique. The integrity of machined workpiece is considered to be measured using the output responses such as height of the burrs and roughness of the surface with the inputs being N, f an the percentage of Sic.Vertical drill machine is used for drilling and a model with Box– Behnken experimental design structure (BBD) is built. Drill with carbide as coating is used as the drill bit. The best results were obtained using the model and procedure used and the results were shown to be best among the other investigations [33].

Sakshi Sharma et al, worked on Al MMCs with the strengthening reinforcements in terms of ceramics, A conclusion in this work is made that the hybrid MMCs with ceramic material as reinforcement has the better quality with best light weight and best mechanical properties. The author so forth has worked on the findings of better parametric combination involved in machining of such composites by considering the different

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parameters involved in CNC turning of HMMCs targeting the responses such as surface integrity and MRR (high).RSM approach is utilized to build the statistical model and investigate the role of parameters on the responses. Central composite design is used for the generation of mathematical numerical to obtain the relationship between the responses and input parameters [34].

J Udayaprakash et al, analyzed the effect on of parameters involved in WEDM process of hybrid Al MMCs with flyash and B4C as reinforcements. The taguchi technique was used to design experiments based on the inputs such as pulse on and off time, wire feed and gap voltage with the responses or outputs as surface integrity and material removal rate.For finding the significance of parameters and their contribution on the changes of responses analysis of variance is used with S/N ratio to find the highest contributing factor. The graphs and the analysis were done using MINITAB software. Finally the confirmatory tests were also done to affirm the results obtained in terms of best parametric combination [35].

III. Conclusion

The extensive review made on the machining of hybrid MMCs showcases that the different models and techniques can be utilized in order to find the better parametric combination to obtain fine result in terms of the responses related directly to the quality of machining. By considering the results obtained by the different techniques used a further work is planned to be carried out on hybrid MMC machining by selecting the best possible analysis method and statistical model to prove the trustworthiness of the importance of best parametric combination in machining of hybrid MMCs.

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