Optimization of Kevlar and Coir Fibre Reinforced with Epoxy Based Composites to improve machining characteristics- A Review

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Abstract. Composite materials are one of the materials that can show the improved properties in the field of mechanical, vehicle territories, so on. It is imperative to think about the machining and mechanical attributes before it will be applied for reasonable application. Machining characteristics incorporates traditional or non-traditional techniques, both the techniques having its own significance dependent on the kind of materials to be utilized. In conventional methods, the parameters includes cutting speed, drill bit materials, material composition, treatment of fibres, percentage of filler materials and in case of non-conventional methods, the parameter include pressure of water, type of abrasives, its flow rate (if abrasive water jet drilling is considered). This review paper gives about the idea that the parameters and gathering of impacting conditions can be reviewed and studied.

Keywords: Composites, Drilling methods, filler materials, treatment of fibres, influencing parameters and conditions.

1. Introduction and Literature Review

Optimization is the act of obtaining the better result under given circumstances. For example, in design, construction and maintenance of any system which includes engineering system design concepts. It helps to take the proper decisions to maximize the profit or benefit. So it is very important to analyze the practical situations of the system as a function of the decision variables. Thus optimization is a process of determining the best conditions that will exhibit the maximum or minimum value of function [1].

Janak Suthar et. al analyzed the application of Taguchi method in drilling of CFRP composites. The researchers make use of Taguchi’s orthogonal array and analysis of variance to carry out the experimental results. From the results of ANNOVA, it is concluded that the, feed rate is considered as one of the important cutting conditions or parameter which makes the impact on the
The delamination factor also the damage to the composite while drilling increases with the increase in the cutting parameters [2].

Krishnakant et. al studied the application of Taguchi method for optimizing the turning process by the effect of machining parameters. Turning is the important form of machining process which is mainly depends on various parameters which includes cutting and spindle speed, feed rate, depth of cut. MRR increases with increases in spindle speed & feed rate, the optimum results of spindle speed and feed rate obtained was 347rpm & 0.458mm/rev for level 2 and level3 respectively. The depth of cut also varies as same as the spindle speed and feed rate [3].

Meenu and Surinder Kumar experimented on the Optimization of the material removal rate in turning of Uni-Directional (UD) –GFRP using the particle swarm optimization technique. Researchers utilized the technique of swarm optimization to obtain the experimental results. The Taguchi L18 orthogonal array is used to perform experiments to analyze the MRR. In the research work, they come to concluded that, the better optimization of cutting parameters is necessary to obtain a high MRR. And maximum value of MRR obtained is 394.33mm²/sec, feed rate to be 0.2mm/rev, cutting speed as 159.58m/min and depth of cut as 1.3996mm [4].

Jean Luc Toupe et.al studied on optimizing the performance of natural fiber reinforced plastics composites. Researchers investigated on the optimization paths on the microstructure, matrix distribution over the fiber alignment and the mechanical properties of composites. The combination of phase compatibility and conditions optimization resulted in the better improvement in the properties. In reference to the microstructure, the optimization technique favored a balance between dispersion of fibers and additives in the matrix [5].

P Mani et.al reviewed on the optimization of process parameters of abrasive water jet machining of natural fiber based polymer composites. it is summarized that, the Abrasive water jet machining process is an important process to produce complex shapes over the composite materials and also less damage/defects can be obtained and this process also have few process parameters to be considered which includes abrasive flow rate, orifice diameter, MRR, depth of cut, etc. abrasive flow rate increases the MRR but decreases the surface roughness of the material. Thus, optimization technique is executed to improve the process characteristics depth of cut, surface roughness, MRR, etc. [6].

Ilknur Cavusoglu et.al experimented on the optimization of drilling parameters of glass fiber reinforced plastics via Taguchi method. Researchers mainly concentrate on the analysis and evaluation of delamination concept. By making use of Taguchi technique the optimum values with minimum of delamination are determined and these values are considered to be free of damage and delayed damage [7].

Shubham Singh et.al studied on the development and optimization of process parameters of microwaved cured polymer based natural fibre (coir) reinforced composite. Researchers used the Taguchi and ANNOVA techniques to analyze the optimum parameters. ANNOVA gives rise to understand the operational time parameters affects the UTS and fiber size [8].

B M Umeshgowda et.al investigated on the optimization of cutting parameters in drilling of epoxy resin composite material using Taguchi’s technique. From the research work, researchers conclude that, the lesser cutting speed, lower feed rate and higher drill diameter are required for the good surface finish. Optimization process serves to obtain the good surface finish, minimum tool wear, lesser delamination & circularity than before [9].
G Dilli Babu et.al studied the optimization of machining parameters in drilling hemp fiber reinforced composites to maximize the tensile strength using design of experiments. From the experimentation, it is cleared that, the Taguchi method gives an effective way analyzing the process parameters which will reduces the delamination and the residual tensile strength when compared to other optimization techniques [10].

Vimanyu Chadha et.al experimented on optimization of cutting parameters on delamination using Taguchi method during drilling of GFRP composites. Researcher observed that, the damage during drilling is caused by higher cutting speed and feed rate also increase in the layer of the composite materials. Feed rate is one of the important parameter influences on the delamination, lesser the feed rate the lesser will be the damage to the composite materials [11].

Balamurugan M et.al investigated on the machinability characteristics on delamination during drilling of hybrid reinforced epoxy polymer using Taguchi Approach. The analysis is done by making use of L9 Orthogonal array. Delamination results due to the increase in the drill speed which softens the fibers and the matrix. Feed rate will be the important cutting parameter than the spindle speed on the delamination factor observed by the researchers [12].

K. Vignesh et.al experimented on the Optimization of Process Parameters to Enhance the Mechanical Properties of Bone Powder and Coir Fiber Reinforced Polyester Composites by Taguchi Method. The important factor for the performance improvement is identified by the ANOVA as the coir fiber diameter as 53.49. The Grey-Taguchi method shows a better improvement in the mechanical properties [13].

Abeer S. Eisa studied on the optimization of drilling parameters for GFRP composite using Taguchi method. The analysis is conducted by making use of Taguchi’s orthogonal array and analysis of variance. Delamination factor increases with the increase in cutting speed and the feed rate. Low feed rate and high cutting speed results in the decrease in the surface roughness. ANNOVA results highlights the feed rate is the important cutting parameter [14].

Thingujam Jackson Singh et.al studied on the Multi-response parametric optimization in drilling of bamboo/Kevlar fiber reinforced sandwich composite. In this research work, the researcher concentrates on the Taguchi GRA and ANNOVA techniques to determine the optimum level combination of process parameters. From the analysis, it is observed that, feed rate is one of the major cutting parameter than the cutting speed. Optimal cutting speed and lesser feed rate results in the increase in the drilled specimen of the composite and to minimize the delamination damage [15].

2. Conclusion

Mechanical and machining characteristics are the important parameters to be considered for the manufactured composite materials. Optimization techniques like Taguchi’s method and Analysis of variance (ANNOVA) which decided the optimum conditions or gives the optimum parameters to be considered. From the review of this paper,

➢ Feed rate is one of the important parameters which influences the delamination and surface roughness
➢ Cutting speed improves the material removal rate i.e., as the cutting velocity expands material evacuation rate increments.
➢ Optimization also gives the idea about the phases, additives or fillers in the matrix, dispersion of fibers through experimentation results.
➢ Surface finish is also observed through different cutting parameters.
➢ Mechanical properties also analyzed through optimization techniques.
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