A Literature Review on Optimization of End Milling Parameters for Glass Fibre Reinforced Plastic Material

Jatin Chauhan, Pramendra Jha, Vivek Singh, Swetha Kulkarni

Abstract: Objective of optimal cutting parameters is a very important issue for every machining process in today's manufacturing industries is to produce low cost, high quality products in short time. The selection order to enhance the quality of machining products and reduce the machining costs. It predict the optimal choice for each milling parameters such as Speed, Feed and Depth of cut. It is found that these parameters have a significant influence on machining characteristics such as Material removal rate (MRR), Surface roughness (SR) and Cutting force (F).By optimizing process we can reduce the cutting force and increase the life of the tool and improve the surface roughness (SR).The present study focuses on Surface Roughness and Material Removing Rate (MRR) aspects of Glass Fiber Reinforced Polymer (GFRP) work material. GFRP possesses excellent physical, mechanical and electrical properties at both room temperature & elevated temperatures and finds wide applications, such as insulation in aerospace and defense systems. The material withstands temperatures in excess of 155℃ and is considered a premier material for use as Class F insulation in electrical power generation and transmission equipments. Milling is one of the most practical machining processes for removing excess material to produce high quality surface. However, milling of composite materials is a rather complex task owing to its heterogeneity and poor surface finish, which includes fiber pullout, matrix delamination, sub-surface damage and matrix polymer interface failure. In this study, an attempt has been made to optimize milling parameters with multiple performance characteristics, based on the Grey Relational Analysis coupled with Taguchi method. The milling experiments were carried out on a CNC Milling machine. The experiments were conducted according to L9 (OA). The three cutting parameters selected for grade for this investigation are spindle speed, feed rate and depth of cut. Response table of grey relational four process parameters is used for the analysis to produce the best output; the optimal combination of the parameters.

Index Terms— Milling, Surface roughness, Cutting force, Grey relational analysis; Taguchi methodology.

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1 INTRODUCTION

Milling is the machining process of using rotary cutters to remove material from a workpiece by advancing (or feeding) in a direction at an angle with the axis of the tool.It covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes in industry and machine shops today for machining parts to precise sizes and shapes.

Milling can be done with a wide range of machine tools.The original class of machine tools for milling was the milling machine (often called a mill). After the advent of computer numerical control (CNC), milling machines evolved into machining centers (milling machines with automatic tool changers, tool magazines or carousels, CNC control, coolant systems, and enclosures), generally classified as vertical machining centers (VMCs) and horizontal machining centers (HMCs). The integration of milling into turningenvironments and of turning into milling environments, begun with live tooling for lathes and the occasional use of mills for turning operations, led to a new class of machine tools, multitasking machines (MTMs), which are purpose-built to provide for a default machining strategy of using any combination of milling and turning within the same work envelope.

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2 LITERATURE REVIEW

Different machining processes were optimized by the researchers to improve the quality of the tool G. Akhyar et al. [1] applied Taguchi optimization method for the optimization of cutting parameters in turning Ti-6%Al-4%V with coated and uncoated cemented carbide tools under dry conditions and high cutting speeds for better surface roughness. L27 orthogonal array including four factors such as Cutting speed, feed rate, depth of cut and tool grades with three levels for each factor was used to identify the optimal combination. They used ANOVA to determine the cutting speed and tool grade to be a significant factor that affected the surface finish

M. Y. Noordin et al.[2] used RSM to study the performance of a multilayer tungsten carbide tools while turning AISI 1045 steel with constant depth of cut and feed rate. To study the effects of three factors such as cutting speed, feed and side cutting edge angle (SCEA) on surface roughness and the tangential force using Face centered CCD. There are other factors that provide secondary contributions to the performance indicators. In the case of surface roughness, the SCEA2 and the interaction of feed and SCEA provides these contributions whilst for tangential force, the SCEA2,the interaction of feed and SCEA; and the cutting speed provides them.

Hari Vasudevan et al.[3] used Taguchi method to optimize the milling parameters on Glass Fibre Reinforced Plastic NEMA 11. In this study, an attempt has beenmade to optimize milling parameters with multiple performance characteristics, based on the Grey RelationalAnalysis coupled with Taguchi method. The milling experiments were carried out on a vertical HAAS TM-2 CNCMilling machine. The experiments were conducted according to L18 (OA). The four cutting parameters selected

forthis investigation are milling strategy, spindle speed, feed rate and depth of cut.

Mohammed T. Hayajneh et al. [4] build a multiple regression model for surface roughness to study the effects of spindle speed, cutting feed rate, depth of cut and their two way interactions. The cutting parameters were selected as four levels of cutting speed, seven levels of feed rate and three levels of depth of cut.The results showed the cutting feed as the most dominant factor and interactions cutting feed-depth of cut ,and cutting feed-spindle speed the most significant.

Ghhani J. A. et al. [5] optimized cutting parameters in end milling process while machining hardened steel AISI H13 with TiN coated P10 carbide insert tool under semifinishing and finishing conditions of high speed cutting. The effect of milling parameters such as cutting speed, feed rate and depth of cut along with their interactions on the process is studied using Taguchi method of experimental design (DOE).The study indicated the suitability of Taguchi method to solve the stated problem with minimum number of trials as compared with a full factorial design.

Shreemoykumarnayaket al.[6].TheInvestigation was carried outthe effect of machining parameters during dry turning of AISI 304 austenitic stainless steel. For this study HMT heavy duty lathe machine was used. They have adopted L27 orthogonal array with three machining parameters like cutting speed, feed rate and depth of cut and three importance characteristics of machinability such as material removal rate (MRR), cutting force and surface roughness (Ra) were measured. For the optimization of machining parameters, Grey relational analysis was used

Problem Definition

- Milling of composite material is very difficult process hence a work has to be carried out to improve surface roughness and material removing rate(MRR).
- While milling operation extra amount of cutting force will reduced the tool life. Therefore we can reduced the cutting force and increase the tool life.

Objectives of Experimentation:

To optimize milling operation by using composite material to improve surface roughness and material removing rate.
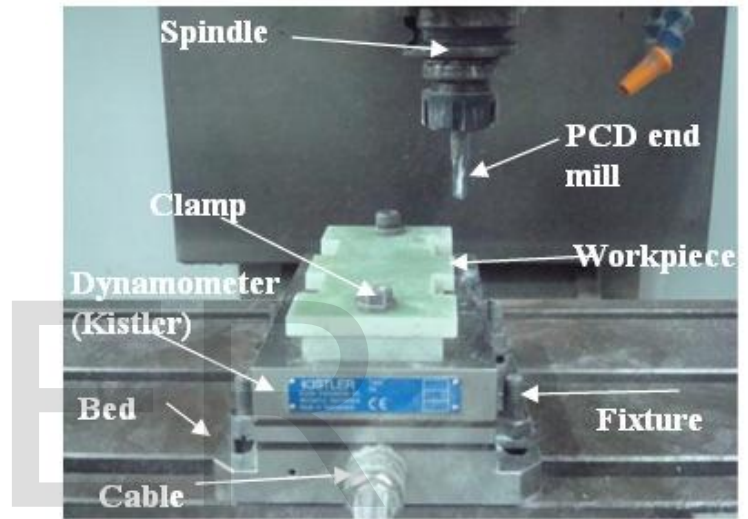

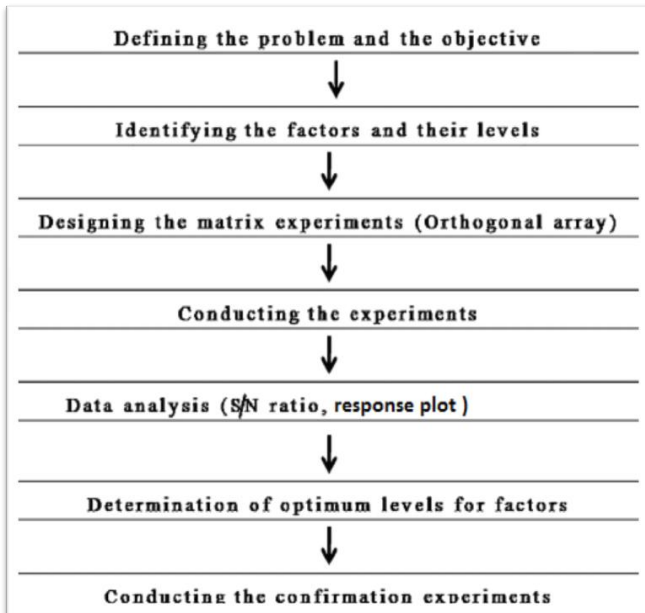**Figure 3. 2 Experimental set up.**

3 Methodology

Figure 3. 1 Methodology used for the study.

Table 1.Factors of Milling Process

SR NO.	CUTTING PARAMETERS
1	Spindle Speed (rpm)
2	Feed Rate (mm/min)
3	Death of Cut (mm)

Table 2.Output Parameters

SR NO.	PARAMETERS	TOOL
1	MRR	Weight Balance Machine
2	Cutting Force	Dynamometer
3	Surface Roughness	Surface Roughness Tester

4 EXPECTED OUTCOMES

1. At low cost increase production.
2. Reducing Surface Roughness will improve the quality as well as design of the product.
3. Increasing Tool life will reduced the time consumption.
4. Waste of material will reduced.

5 CONCLUSION

The conclusion of this literature survey is to do study the effect of various milling paramter on composite material.Milling strategy and feed rate have the most dominant roles in influencing the surface roughness and Material Removing Rate.This study will give the most appropriate optimal parameter for milling operation and it will help to improve the tool life and reduces the time consumption.

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