ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. 2, Special Issue 12, April 2016.

Modeling and analysis for surface roughness and material removal rate in machining of UD-GFRP S2 using PCD tool

Gokulkumar R1, Francis Xavier rajan A2

P.G Student1, Assistant Professor 2

Department of Mechanical Engineering, Christian College of Engineering and Technology,

Oddanchatram, Tamil Nadu, India

gokulemesh@gmail.com
afxrajan@gmail.com

Abstract- **In the present paper, an effective approach for the optimization of turning parameters based on the Taugchi's method with regression analysis is presented. This paper discusses the use of Taugchi's technique for minimizing the surface roughness and maximizing the material removal rate in machining unidirectional glass fiber reinforced plastics (UD-GFRP S2) composite with a polycrystalline diamond (PCD) tool . A multiple objective utility model has been studied to optimize both the dependent a parameters. Experiments were conducted based on the established Taguchi's technique L18 orthogonal array on a lathe machine. The cutting parameters consider were tool nose radius, tool rake angle, feed rate, cutting speed, depth of cut and cutting environment (dry, wet and cooled) on the surface roughness and material removal rate produced. The performances of the cutting tool were evaluated by a measuring surface roughness and material removal rate. A second order mathematical model in terms of cutting parameters is also developed using regression modeling. The results indicate that the developed model is a suitable for prediction of surface roughness and material removal rate in machining of unidirectional glass fiber reinforced plastics (UD-GFRP S2) composites. The predicted values and measured values are fairly close to each other. The results are confirmed by further experiments.**

Keywords- **UD-GFRP S2 composites, ANOVA, utility concept, regression modeling, surface roughness, material removal rate, polycrystalline diamond (PCD) tool.**

.

I. INTRODUCTION

Fiberglass composites are replacing many of the materials used in industries as they are economical. Glass fibre reinforced polymers (GFRP) are being used in variety of application that include oil, gas and corrosive environments. Machining of glass fibre-reinforced polymer (GFRP) composite materials have always been a challenge due to host of difficulties encountered such as fibre pullout, fibre fuzzing, matrix burning, and fibre-matrix debonding leading to subsurface damage, reduced strength and short product service life.

The necessities of machining FRP composites come from the requirement of the conversion of raw composite material into engineering component despite the ability to fabricate near-net shape components. The FRPs are one the 'difficult –to-machine' materials because of the fibre arrangement. Machining of composite parts creates discontinuity in the fibre and thus affects the performance of the part.

Besides, the mechanism of material removal is different from that single phased materials, such as metals. The material removal process is quite complex. Many variables such as the workpiece material, the cutting tool material, the rigidity of the

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 2, Special Issue 12, April 2016.

machine, the set up, the cutting feed, speed, tool wear and chip control must be considered.

II.LITERATURE SURVEY

MODELING AND ANALYSIS FOR SURFACE ROUGHNESS AND MATERIAL REMOVAL RATE IN MACHINING OF UD-GRPF USING PCD TOOL [1]

An effective approach for the optimization of turning parameters based on the Taugchi's method with regression analysis is presented. This paper discusses the use of Taugchi's technique for minimizing the surface roughness and maximizing the material removal rate in machining unidirectional glass fiber reinforced plastics (UD-GFRP) composite with a polycrystalline diamond (PCD) tool. A multiple objective utility model has been studied to optimize both the dependent parameters. Experiments were conducted based on the established Taguchi's technique L18 orthogonal array on a lathe machine. The cutting a parameters considered were tool nose radius, tool rake angle, feed rate, cutting speed, depth of cut and cutting environment (dry, wet and cooled) on the surface roughness and material removal rate produced. The performances of the cutting tool were evaluated by measuring surface roughness and material removal rate. A second order mathematical model in terms of cutting parameters is also developed using regression modeling. The results indicate that the developed model is suitable for prediction of surface roughness and material removal rate in machining of unidirectional glass fiber reinforced plastics (UD-GFRP) composites. The predicted values and measured values are fairly close to each other.

PREDICTION OF SURFACE ROUGHNESS IN TURNING OF UDGFRP USING MATHEMATICAL MODEL AND SIMULATED ANNEALING [2]

Glass fiber reinforced plastic (GFRP) composite materials are a feasible alternative to engineering materials and are being extensively used in variety of engineering applications. Accordingly, the need for accurate machining of composites has increased enormously. During machining, the obtained surface roughness is an important aspect. The present investigation deals with the study and development of a surface roughness prediction model for the machining of unidirectional glass fiber reinforced plastics (UD-GFRP) composite using regression modeling and optimization by simulated annealing. The processparameters considered include tool nose radius, tool rake angle, feed rate, cutting speed, cutting environment (dry, wet, cooled)and depth of cut. The predicted values from surface roughness model are compared with the experimental values. The resultsof prediction are quite close with the experimental values.

EXPERIMENTAL INVESTIGATION AND OPTIMIZATION OF MILLING PARAMETERS IN THE MACHINING OF NEMA G-11 GFRP COMPOSITE MATERIAL USING PCD TOOL [3]

GFRP/Epoxy composite NEMA G-11 possesses excellent physical, mechanical and electrical properties at the both room temperature & elevated temperatures and finds wide applications, such as insulation in aerospace and defense systems. The material withstands temperatures in excess of 300°C and is considered a premier material for use as Class F insulation in electrical power 4

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 fibre 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 vertical HAAS TM-2 CNC Milling machine. The experiments were conducted according to L18 (OA). The four cutting parameters selected for this investigation are milling

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 2, Special Issue 12, April 2016.

strategy, spindle speed, feed rate and depth of cut. Response table of grey relational grade for four process parameters is used for the analysis to produce the best output; the optimal combination of the parameters. From the response table of the average GRG, it is found that the largest value of the GRG is for the up milling, spindle speed is of 1500 rpm, feed rate of 200 mm/min and depth of cut 0.2 mm. Milling strategies and feed rate have the most dominant roles in influencing the surface roughness.

III.OBJECTIVE

The main objective of this project is to minimize the material removal rate and maximize the surface roughness it can be analysis the using software, the objective is to make the simple and easier to install and quite affordable as well.

IV.PROBLEM IDENTIFICATION

The previous project to material of UDGFRP E glass type can be select the low strength of tensile stress, density, tensile modulus, specific density also low ,so the material life time and machining process to the surface roughness maximize to minimize the material removal rate.

V.USING SOFTWARE

A.*Rugosurf*

The powerful and reliable probe drive mechanism is housed in an aluminium alloy base. Operating keys are protected against liquid and dust ingress. The diamond tip provides excellent wear resistance. The RUGOSURF is easy to use and popular thanks to its ergonomic design and intuitive interface. A wide range of applications are facilitated by the standalone vertical adjustment holders (of up to 35 mm) and by the positioning pin that means it is compatible with any standard 8-mm-diameter measurement stand.8-mm-diameter measurement stand. The portable surface tester to be used to test the surface roughness to be measured. The data should be store on the system to print data for sheet. Then the data can be used draw the flow chat of surface roughness as well as.

B.Minitab

Minitab software is an analysis the surface roughness and material removal rate. Its need to improve quality with features like an interactive through analysis. It can good statistical analysis to use. The data can be import, arrange and analyze for spreadsheets, the input values are generate graphs for this software. Its can be access a complete set of statistical tools, including descriptive statistics, hypothesis tests, confidence intervals and normality tests. That optimize the processes using factorial, response surface, mixture taguchi designs.

VI.PROJECT PROCESS

The project requires the good material for industry and environmental, low cost to improve the manufacturing process. The project requires select the good material for the machining process to without any loss to gain the profit. The project process is the select material of the UD-GFRP S2 glass and the machining tool of PCD. And then using the analysis software of ROGUSURF, MINILAB as well as. Finally to verify the data for taguchi's method.

VII.CONCLUSION

Selection of material and material machining process, then analysis the surface roughness and material removal rate analysis software also selected. Then verify the analysis method of Taguchi method as well as selected.

REFERENCES

[1] *Surinder Kumar, Meenu Gupta, P.S. Satsangi and H.K. Sardana "Modeling and analysis for surface roughness and material removal rate in machining of UD-GFRP using PCD tool"* International Journal of Engineering, Science and Technology Vol. 3, No. 8, 2011, pp. 248-270.

[2] *Meenu and Surinder Kumar "Prediction of surface in turning of UDGFRP using mathematical model and simulated annealing" Surinder Kumar et al.,* International Journal of Advanced Engineering Technology E-ISSN 0976-3945

[3] *Hari Vasudevan, Ramesh Rajguru, Naresh DeshpandeSandip, Mane "Experimental Investigation and Optimization of Milling Parameters in the Machining of NEMA G -11 GFRP Composite Material using PCD Tool"*5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014

[4] *Mohd. Suhail Ansari, Deepak Sharma and Sagar Nikam* **"***Study of Cutting Forces and Surface Roughness in Turning of Bronze Filled Polytetrafluoroethylene"* International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 2 (2014)

[5] *Rajesh Kumar Verma, Saurav Datta and Pradip Kumar Pal "Machining of UDGFRP Composites*" International journals mechanical engineering andRobtics research ISSN 2278 –0149 Vol. 4, No. 2, April 2015

[6] *Rahul Dhabale, Vijaykumar S. Jatti, "Optimization of Material Removal Rate of AlMglSiCu in Turining operation using Genetic Algorithm*" WSEA Transcations on Applied and Therotical Mechanics.

[7] *Ragothaman A, Vijayaraja K, "Statically Test Method during Drilling of GFRP for Optimization of Cutting Parameters on Delamination"* ISR NATIONAL Journal of Advanced Research in Mechanical and Production Engineering and Development Volume: 1 Issue: 1 13-Oct-2014.

[8] *Jenarthanan M.P, Jeyapaul R,"Taguchi Analysis of surface roughness and delamination associated with solid carbide end mills with different helix angles in milling of GFRP composites*" First-Third Department of Production Engineering, National Institute of Technology Tiruchirappalli 620 015 Tamilnadu, India.

[9] *Meenu Gupta, Surinder Kumar, " Investigation of surface roughness and MRR for turning of UD-GFRP using PCA and Taguchi method"* Engineering Science and Technology, an International Journal 18 (2015) 70e81.

[10]*Surinder kumar, Meenu, P.S.Satangi, " A genetic algorithmic approach for optimization of surface roughness prediction model in turning using UDGFRP composite"* Indian journals of engineering and materials science vol.19 december 2012.

