Analysis of Surface Roughness in Horizontal Milling Machine using Composite Material

Gaurav Tamrakar*

Assistant Professor, Department of Mechanical Engineering, Kalinga University, Naya Raipur(C.G)

*Email:gaurav.tamrakar@kalingauniversity.ac.in

ABSTRACT

This paper investigates the way to implement and testing of a lively controlled palletized work holding system for milling operations and the way to target a piece holding system for the control of unwanted vibration therefore decreasing the surface quality. As a result, degraded quality on the machined parts, shortens the tool life, and unsightly noise, hence is to be necessarily damped out. As a result, unwanted vibrations & noise must be arrested so as to make sure higher accuracy and surface finish alongside productivity. The arose vibrations on a slotted table and Horizontal miller are damped out using composite structure as a substitute for the bottom of the work piece. Experiment wise investigation of the Poly vinyl chloride (PVC) plates is fixed on the slotted table below the work piece specimen milling operation is administered work piece specimen as C64 plate. All setting of experiment is administered response surface methodology (RSM) design of experiment and also finds out which factor influence the surface roughness.

KEYWORDS: Milling machine, Poly vinyl chloride (PVC) plate, Composite materials, Surface roughness, Response surface methodology, C64Plate

INTRODUCTION

Metal cutting is one among the foremost significant manufacturing process within the area of fabric removal. Metal cutting are often defined because the removal of metal from a piece within the sort of contribute order to get a finished product with desired attributes of size, shape and surface roughness. Machining condition plays a really important role in estimating the performance of machining operation. The machining conditions like cutting speed, feed rate, depth of cut, affect the operation in great extent. These parameters must be taken to optimize the machining operation. The target of present work is to analyze the effectiveness of milling parameter on surface roughness (Ra) and the test performed in horizontal miller. The work piece material is C64 steel. The effect of feed rate, cutting speed and depth of cut on surface roughness were studied using MINITAB analysis software. Taguchi method was used to design the experiment and optimization. The Analysis of Variances (ANOVA) was to determine the cutting parameters significantly affecting the surface roughness.

LITERATURE REVIEW

Bhagat et al.(2014)performed AN experiment on AISI 52100 steel (D3 type) in miller . They studied the effectiveness of edge parameter on surface roughness (Ra) and metal removal rate (MRR).Davim (2003)used Taguchi methodology in analysis development. The cutting conditions like feed rate, depth of cut and speed influence the surface end. Suresh et al. (2002) performed an experiment, Die steel (D3 type) used for work piece material and machining performed throughout this work piece. Tin coated W inorganic compound (CNMG) was used for cutter. Trivedi et al. (2014) throughout this analysis work, the slotted table horizontal miller are used for machining purpose and so the work piece material is mild steel plate. Wankhede et al.(2 0 1 6) throughout this analysis, the experiment performed on slotted table horizontal miller. Rao et al. (2013) throughout this analysis, a trial has been created to review the result of cutting parameters like depthof cut, speed, feed rate that influence the quality of surface roughness. Akhyar et al. (2008)throughout this analysis Taguchi methodology is utilized to optimize the cutting parameters in turning operation. Kopac et al. (2007)throughout this analysis numerous flank edge parameter designed to optimize the edge surface roughness, cutting force, material removal rate at intervals the machining of AN alloy casting plate. Ghani et al. (2004)the target of this analysis is to optimized the cutting parameters like cutting speed, feed rate and depth of cut in finish edge method miller accustomed machining the hardened steel AISI H13 with Tin coated P10 inorganic compound insert tool. Kumar et al. (2014)throughout this analysis confirm the best optimum cutting parameter leading to most metal removal rate (MRR) and minimum roughness by Multi Objective Genetic algorithmic program (MOGA) with desegregation response surface methodology (RSM) in face edge of Al 6061alloy.Singh et al. (2 0 1 4) this study evaluates the machining performance of EN24 steel. The machining operation perform by CNC machine with inorganic compound finish mill cutter Taguchi style of experiment

ISSN- 2394-5125 VOL 6, ISSUE 06, 2019

use for experimental purpose and study the response variables like MRR and surface roughness.

PROBLEM IDENTIFICATIONS

From the available literature, it is often seen that though some work has been reported on influence of milling parameters on surface roughness and cutting forces measurement of the machined surface, no attempt has thus been made to material using for increasing the roughness responses. Therefore, there should be research Endeavour to use to material in miller to achieve reasonably low value of SR

OBJECTIVE OF RESEARCH WORK

The objective of this experimental work is to measure the surface roughness and analyze them to work out response characteristics of a piece specimen mounted on varying multi-layered stacked sheets of PVC during machining operations and also evaluate the consequences of various cutting parameters like feed rate, cutting speed, depth of cut on work piece of C64

EXPERIMENTAL DETAILS

Table1: The properties of composite material

Name of the Material	Material Type	Cross section (mm)
Poly vinyl chloride (PVC)	Thermoplastic	210x210x5

The work specimen of 210mm x 210mm x10mm is C64 Alloy steel square plate which is thoroughly cleaned, degreased and polished. Table 1 shown the properties of composite material. It has been drilled at four corners for fixing on the bed of the milling machine

Table 2: Machining parameter and their level

Control Parameter					
Parameter	Symbol	Level			Unit
		1	2	3	
Feed	F	16.0	20.5	25.0	mm/min
Speed	S	180	230	280	RPM
Depth of cut	d	0.01	0.02	0.03	mm
No. of plate	n	1	3	5	

Design of Experiments by Taguchi Approach in Minitab Software: L27 basic types of standard orthogonal arrays (OA) used for the experiment of Taguchi parameter design. Since three factors are taken in the experiment, three level of each factor are considered. Therefore, an array L27 is selected for the experiment. Table2.shown design of experiment by Taguchi Method and Table 3 shown experimental result

Table 3: Experimentalresults

Run no.	F (mm/min)	S (RPM)	d (mm)	No. of plates	(Ra)

1	16.0	180	0.02	3	0.82
2	25.0	180	0.02	3	1.21
3	16.0	280	0.02	3	2.05
4	25.0	280	0.02	3	1.64
5	20.5	230	0.01	1	1.42
6	20.5	230	0.03	1	1.73
7	20.5	230	0.01	5	1.67
8	20.5	230	0.03	5	1.94
9	16.0	230	0.02	1	1.72
10	25.0	230	0.02	1	1.50
11	16.0	230	0.02	5	1.54
12	25.0	230	0.02	5	1.80
13	20.5	180	0.01	3	1.82
14	20.5	280	0.01	3	2.20
15	20.5	180	0.03	3	1.25
16	20.5	280	0.03	3	2.00
17	16.0	230	0.01	3	1.65
18	25.0	230	0.01	3	1.27
19	16.0	230	0.03	3	1.85
20	25.0	230	0.03	3	1.97
21	20.5	180	0.02	1	1.83
22	20.5	280	0.02	1	1.85
23	20.5	180	0.02	5	1.05
24	20.5	280	0.02	5	1.45
25	20.5	230	0.02	3	1.69
26	20.5	230	0.02	3	1.23
27	20.5	230	0.02	3	0.79

ISSN- 2394-5125 VOL 6, ISSUE 06, 2019

RESULTS ANDDISCUSSION

The influences of the cutting parameters like speed (S), Feed (F), depth of cut (d) and number of plates (n) on the response variables selected are assessed for 3 different secondary bed materials by conducting experiments. The results are put into the Minitab 15 software for further analysis Influence on surface roughness (SR).Figure 1, 2 & 3 surface plots of roughness shows graphical representation of cutting speed, feed rate and depth of cut Vs surface roughness at cutting speeds of 180, 230 and 280 m/min,with feed rates of 16, 20 and 25 mm/min, depth of cut of 0.01, 0.02 and 0.03 mm andnumbersofplates1,3,and5.duringthis figure is clearly indicates the when the feed is increase in 16 to 20 then the surface roughness in increasing and if the feed is increase in above the 20 min/min the Ra value is decreasing. So, it is often seen that the upper value of feed given the great surface finish of this experiments. If the speed is increased within the roughness value is decreasing up to maximum level then they start to increasing. The optimum value of the speed in 230rpm permanently surface finish. Depth of cut is slightly increasing so there's not significantly effect on surface roughness that also are described within the ANOVA analysis of surface roughness. The number of platesis increasing the roughness value in decreasing. So, it is often shown that the amount of composite plate in increasing the surface finish in increasing. Table 4is the ANOVA for before elimination of non-significant terms and after eliminations the insignificant terms the ANOVA shown in Table 5.

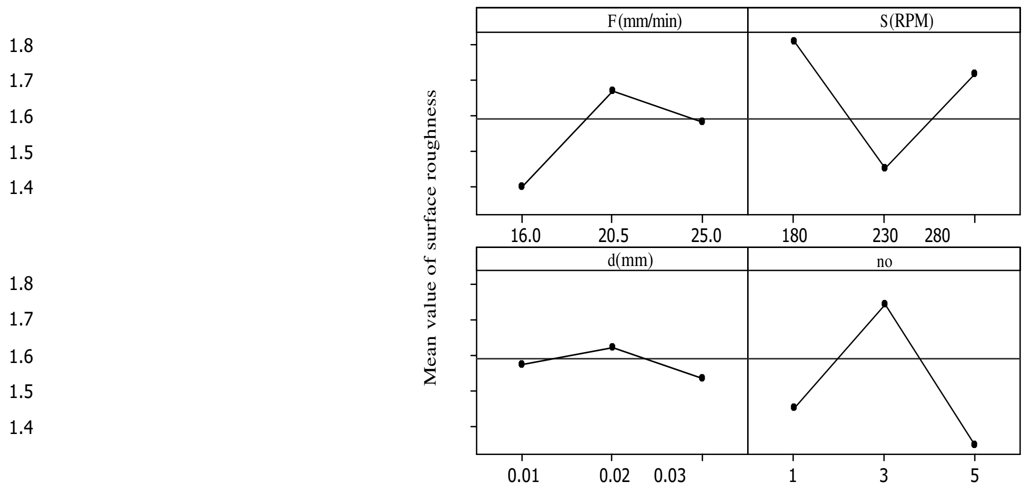

Figure 1: Main effect plots for surface roughness

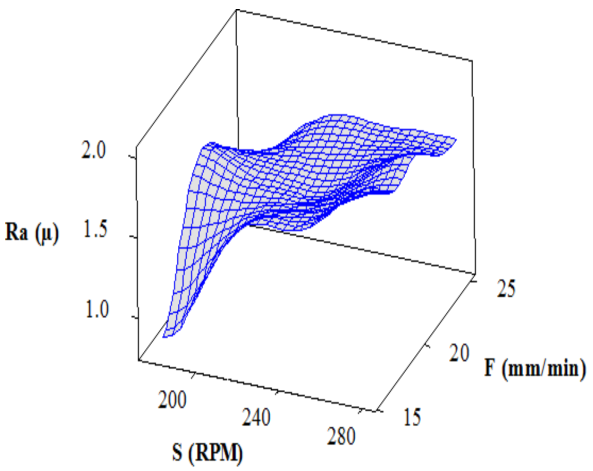

Figure 2: Surface Plot of Ra vsF,S

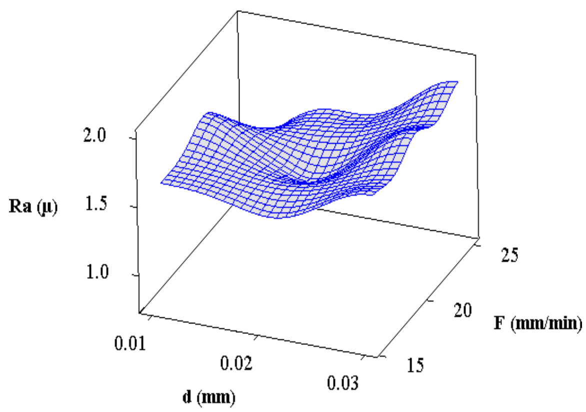

Figure 3 :Surface Plot of Ra vs F,d

Table4: Analysis of Variance for (Ra) before eliminations of non-significant terms

Source	DF	Seq SS	Adj SS	F	P
Regression	14	3.04612	3.04612	16.85	0.000
Linear	4	0.16028	0.16028	3.10	0.057
F	1	0.09901	0.09901	7.67	0.017
S	1	0.02521	0.02521	1.95	0.188
d	1	0.00403	0.00403	0.31	0.587
no	1	0.03203	0.03203	2.48	0.141
Square	4	1.58332	1.58332	30.66	0.000
F*F	1	0.21004	0.36750	28.46	0.000
S*S	1	0.51756	0.10830	8.39	0.013
d*d	1	0.00770	0.15187	11.76	0.005
no*no	1	0.84801	0.84801	65.68	0.000
Interaction	6	1.30252	1.30252	16.81	0.000
F*S	1	0.12602	0.12602	9.76	0.009
F*d	1	0.16000	0.16000	12.39	0.004
F*no	1	0.00000	0.00000	0.00	1.000
S*d	1	0.03240	0.03240	2.51	0.139
S*no	1	0.06250	0.06250	4.84	0.048
d*no	1	0.92160	0.92160	71.38	0.000
Residual Error	12	0.15494	0.15494		
Lack-of-Fit	10	0.13488	0.13488		0.500
Pure Error	2	0.02007	0.02007	1.34	
Total	26	3.20107			

Table5: Analysis of Variance for (Ra) after eliminations the insignificant terms

Source	DF	Seq	Adj	F	P
Regression	12	3.01372	0.251144	18.77	0.000
Linear	4	0.16028	0.040071	2.99	0.056
F	1	0.09901	0.099008	7.40	0.017
S	1	0.02521	0.025208	1.88	0.191
d	1	0.00403	0.004033	0.30	0.592
no	1	0.03203	0.032033	2.39	0.144
Square	4	1.58332	0.395829	29.58	0.000
F*F	1	0.21004	0.367500	27.46	0.000
S*S	1	0.51756	0.108300	8.09	0.013
d*d	1	0.00770	0.151875	11.35	0.005
no*no	1	0.84801	0.848008	63.37	0.000
Interaction	4	1.27012	0.317531	23.73	0.000
F*S	1	0.12602	0.126025	9.42	0.008
F*d	1	0.16000	0.160000	11.96	0.004
S*no	1	0.06250	0.062500	4.67	0.048
d*no	1	0.92160	0.921600	68.87	0.000
Residual Error	14	0.18734	0.013382		
Lack-of-Fit	12	0.16728	0.013940	1.39	0.493
Pure Error	2	0.02007	0.010033		
Total	26	3.20107			
S=0.115679 R-Sq=94.15% R-Sq(adj) =89.13%					

CONCLUSION

Based on the experimental results, the subsequent conclusions are often drawn:

1. Response surface methodology is found to be a successful technique to perform analysis of surface roughness in milling operation with reference to various combinations of design variables (cutting speed, feed rate, depth of cut and numbers of plates).
2. The upper value of feed gives the great surface finish of this experiment.
3. Speed is increased within the roughness value is decreasing up to maximum level then they start to increase. The optimum value of the speed is 230 rpm permanently surface finish.
4. The amount of plate is increasing the roughness value in decreasing. So, it is often shown that the amount of composite plate is increasing the surface finish.2nd order response model for Ra is more precise significant results during machining operations

REFERENCES

1. Akhyar, G., Haran, C. H., &Ghani, J. A., (2008). Application of Taguchi method in the Optimization of turning parameters for Surface Roughness. *International Journal of Science Engineering and Technology,1*(3),60 –66.
2. Trivedi, N. M., &Mevada, J. R., (2014). Improvement of surface finish by vibration control in machine tool using composite material. *International Journal of Engineering Research and Applications, 4*(4), 17- 23.
3. Wankhede, O., Awchat, P., & Parishiwnikar, T., (2016). Computer Aided Analysis of vibration in machine tool and Design of damping system. *Journal of Information Knowledge and Research in mechanical Engineering, 4*(1), 753 – 756.
4. Bhagat, K., Kumar, D., &Verma, A., (2014). Effectiveness of milling parameter on surface roughness and metal removal rate. *International Journal of Engineering and Technology Research (IJETR), 2*(6),189 – 198.
5. Davim, P. J., (2003). Design of Optimization of cutting parameters for milling metal matrix composite based upon orthogonal array.*Journal of material science and technology, 132*, 340 – 344.
6. Ghani, J.A., Choudhury, I.A., & Hasssan, H.H., (2004). Application of Taguchi method in the optimization of end milling parameters. *Journal of Material Processing Technology, 145*(1), 84 –92.
7. Kopac, J., &Krajnik, P. (2007). Robust design of flank milling parameters based on Grey Taguchi method*Journal of material processing technology, 191*(1 – 3), 400 – 403.
8. Kumar, R., Pradhan, M. K., &Kumar, R., (2014). Modeling and Optimization of milling parameters on Al6061 alloy using Multi Objective Genetic Algorithm.*5th International Technology, Design and Research conference,*891 – 897.
9. Rao, HK. G., Ansari, M. M. M., &Begum, S., (2013). Effect of cutting parameters on the surface roughness of MWCNT Reinforced Epoxy composite using

CNC End milling process. *International Journal of Science and Research (IJSR),* 51 – 55.

10. Singh. B., Khanna, R., Goyal, K., & Kumar,P., (2014). Optimization of input process parameters in CNC milling machine of EN24 steel. *International Journal of Research in Mechanical Engineering and Technology*.

11. Suresh, P.V.S., Rao, V. P.,& Deshmukh, S.G., (2002). A genetic algorithmic approach for optimization of surface roughness prediction model .*International Journal of machine tool & manufacturing, 42*, 675 –680.