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Influence Of Cutting Parameters In Milling Of Ss304 And Glass Epoxy Composite Material parameters

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ABSTRACT
The main purpose of this project is to analyze the comparative study of Surface Roughness and Material Removal Rate (MRR) of SS304 and Glass Epoxy composite materials. In the present paper three parameters were taken to check whether quality lies within desired tolerance level. Surface Roughness and MRR were taken using three different parameters of milling machining including spindle speed, feed rate and depth of cut. Taguchi L9 orthogonal array is used to gather information regarding the process with less number of experimental runs. Traditional Taguchi approach is insufficient to solve a multi response optimization problem. In order to overcome this limitation, a multi criteria decision making method, Techniques for Order Preference by Similarity to Ideal Solution (TOPSIS) is applied in this project. The weight for each criterion (response) is obtained by Analytical Hierarchy Process (AHP) instead of using intuition and judgment of the decision maker. This project aims to obtain an optimal setting of three milling parameters by using Carbide cutting tool in end milling operation of SS304 and Glass Epoxy composite materials taken as specimen. *Keywords* - About five key words in alphabetical order, separated by comma.

I. INTRODUCTION

Traditional metal removal processes continue to dominate the manufacturing landscape in third world countries where modern technologies such as CNC machining, additive manufacturing (3D printing) and computer integrated manufacturing (CIM) etc. is slow to establish for reasons such as capital costs and lack of adequate training of personnel. One such indispensable and versatile metal removal process is milling.Metal Removal by milling can be aptly defined as: Milling is the process of machining flat, curved, or irregular surfaces by feeding the work piece against a rotating cutter containing a number of cutting edges.To achieve these surfaces various milling operations exist that can be performed on distinct milling machines. The focus of this project is on end milling using a universal milling machine.The US Army training department considers the end-mill as a type of milling cutting tool used in industrial milling applications. A milling bit can generally cut in all directions, though some cannot cut axially. End mills are used in milling applications such as profile milling, tracer milling, and face milling, and plunging.

II. Design of Experiments

Design of experiments (DOE) is considered for the optimization of the surface roughness of the end milling operation when considering three factors at three different levels. The input parameters or control factors selected are outlined in the Table 4.1 below.

Table :Factors and levels of the experiments

Factors	Levels		
	1	2	3
Spindle Speed (RPM)	125	225	310
Feed (mm/min)	18	29	45
Depth of Cut (mm)	0.3	0.6	0.9

III. Orthogonal Array

The standardized Taguchi-based experimental design L9 orthogonal array is used in this study. For this purpose software Minitab 15 is used. A total of 9 runs are conducted, using the combination of levels for each control factor as indicated in table 4.2 below.

Table : L9 Taguchi orthogonal array

Run	Speed	Feed	Depth of cut
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

After the orthogonal array is selected, the second step is conducting the experiments and recording the necessary data. The Table below lists the results from experiments.

Table : MRR and Surface roughness results for SS304

Run	Speed (RPM)	Feed (mm/min)	Depth of cut (mm)	MRR (mm^3/min)	Surface Roughness (µm)
1	125	18	0.3	25.68493	1.47
2	125	29	0.6	68.18182	1.29
3	125	45	0.9	91.46341	1.49
4	225	18	0.6	120.9677	0.57
5	225	29	0.9	245.9008	1.01
6	225	45	0.3	119.0476	1.19
7	310	18	0.9	214.2857	0.39
8	310	29	0.3	70.75472	0.72
9	310	45	0.6	184.4262	1.28

Table: MRR and Surface roughness results for Glass Epoxy composite material

Run	Speed (RPM)	Feed (mm/min)	Depth of cut (mm)	MRR (mm^3/min)	Surface Roughness (µm)
1	125	18	0.3	197.3684	2.35
2	125	29	0.6	206.3983	2.09
3	125	45	0.9	227.1867	1.99
4	225	18	0.6	267.6182	1.87
5	225	29	0.9	367.1971	1.22
6	225	45	0.3	225.5639	1.43
7	310	18	0.9	358.8517	1.09
8	310	29	0.3	343.2494	2.49
9	310	45	0.6	250.6266	1.55

6	0.1831897	0.1188597
7	0.3783907	0.0574572
8	0.1088769	0.0713262
9	0.2837939	0.1268021

Table : Values of Weighted Normalized Matrix for Glass Epoxy Composite Material

Exp No	MRR	SR
1	0.1573558	0.1413006
2	0.164555	0.1256673
3	0.181129	0.1196545
4	0.2133638	0.1124392
5	0.292755	0.073356
6	0.1798352	0.0859829
7	0.2861014	0.0655394
8	0.2736622	0.1497185

Step 5: The positive-ideal (best) and negative-ideal (worst) solutions are determined using equation 7 and 8

Step 6: The separation of each alternative from the positive-ideal solution and negative-ideal solution is calculated given by using equations 9 and 10.

Table :Values of Separation Measures for SS304

Exp No	S^+	S^-
1	0.3556224	0.001997641
2	0.2878686	0.068377099
3	0.2618162	0.101219537
4	0.1930852	0.173036525
5	0.0619269	0.342241629
6	0.2109226	0.146757544
7	0.0486491	0.310318904
8	0.2715218	0.103561
9	0.1298109	0.245169037

Table :Values of Separation Measures for Glass Epoxy Composite Material

Exp No	S^+	S^-
1	0.1551538	0.157355766
2	0.1416001	0.017211275
3	0.1240516	0.032151469
4	0.0922093	0.063006959
5	0.0078166	0.151490607
6	0.1147555	0.059710701
7	0.0066535	0.149382735
8	0.0863171	0.116610676
9	0.0969665	0.064162141

Step 7: The relative closeness to the ideal solution C_i^* is calculated and the corresponding rank of the alternatives by using equation 11.

Table 4.15 Relative Closeness and Ranking of Alternatives for SS304

Exp No	Relative Closeness	Rank
1	0.0055859	9
2	0.191938	8
3	0.2788142	6
4	0.4726202	4
5	0.8467795	2
6	0.4103039	5
7	0.864475	1
8	0.2761017	7
9	0.653819	3

Table 4.16 Relative Closeness and Ranking of Alternatives for Glass Epoxy Composite Material

Exp No	Relative Closeness	Rank
1	0.5035231	4
2	0.1083756	9
3	0.2058312	8
4	0.4059302	5
5	0.9509336	2
6	0.342248	7
7	0.9573591	1
8	0.5746412	3
9	0.3982045	6

In this project work, the experiment is performed with different combination values of input parameter. Equal weighted is assigned to all input parameter and a (Multi attribute decision making) MADM approach then performed to find out the best result. The results shown that Speed 310 (rpm), Feed 18 (mm/min.), and D.O.C (mm) 0.9 is the best input parameters setting for both SS304 and Glass Epoxy Composite material.

IV. Discussion:

The individual effects of various factors as well as their interactions can be discussed from the graphs shown in below.Increasing the spindle speed improves the surface finish. It is generally well known that an increase in cutting speed improves machine ability. This may be due to the continuous reduction in the buildup edge formation as the cutting speed increases.The surface finish deteriorated with increasing the cutting feed. This is due to the increase in distance between the successive grooves made by the tool during the cutting action, as the cutting feed increases.The interaction between the cutting feed and spindle speed is significantly affecting the surface roughness as shown in Figure 4.1. The figure shows that increasing the spindle speed improves the surface finish as the cutting feed decreases. This supports the earlier discussion about the effect of decreasing cutting speed on the surface roughness of the machined workpieces.

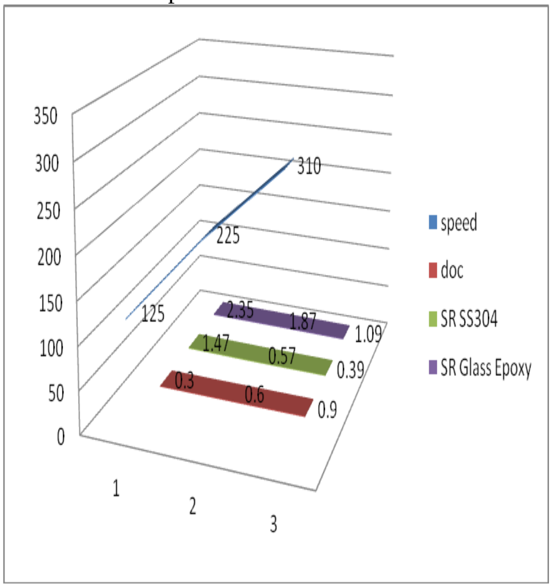

Figure Speed, Depth of Cut vs Surface Roughness for SS304 and Glass Epoxy Composite Material

The depth of cut which indicates that increasing the depth of cut improves the surface finish. The effect of the depth of cut is less significant on the surface finish.The interaction between the depth of cut and spindle speed is less significant as shown in Figure 4.2. The interaction reveals that increasing the spindle speed and increasing the depth of cut deteriorates the surface finish. The interaction between the cutting feed and depth of cut significantly affects the surface roughness as shown in Figure 4.3. The interaction also suggests that to get a certain surface finish and maximum metal removal it is preferable to use a high cutting feed associated with depth of cut.As the depth of cut influences the surface roughness considerably for a given feed rate, the increase in feed rate causes the surface roughness to increase. For lower depth of cut, feed rate increases with surface roughness. During finish milling, the depth of cut is small

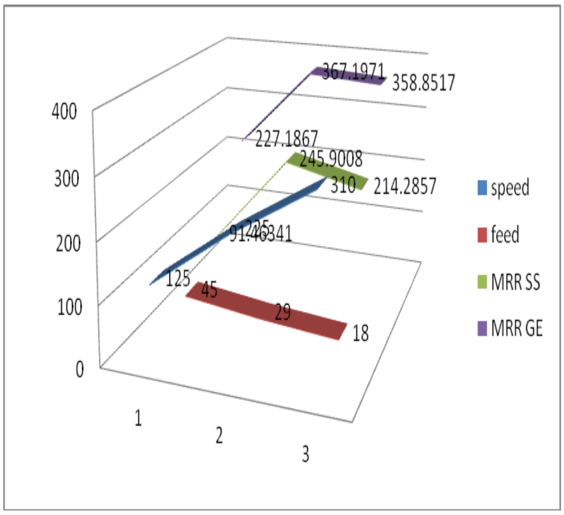

Figure 4.4 Speed, Feed vs MRR for SS304 and Glass Epoxy Composite Material

The interaction between the speed and feed is less significant as shown in Figure 4.4 as the speed influences the material removal rate considerably for a given feed rate.The depth of cut is the most dominant factor for material removal rate out of others two factors i.e., spindle speed & feed rate. The interaction between the speed and depth of cut is shown in Figure 4.5. The depth of cut which indicates that increasing the depth of cut improves the material removal rate. The effect of the depth of cut is high significant on the material removal rate.

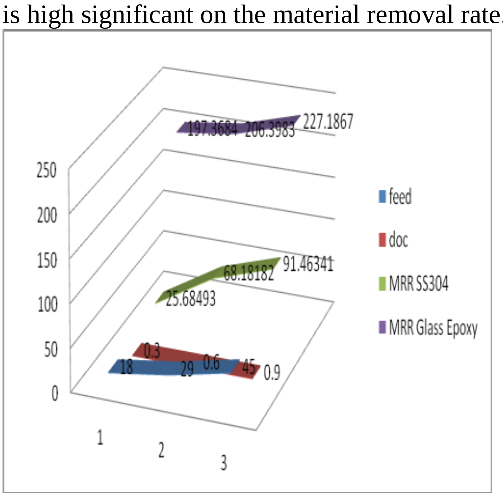

Figure Feed, doc vs MRR for SS304 and Glass Epoxy Composite material

The interaction between the cutting feed and depth of cut significantly affects the material removal rate. The interaction also suggests that to get a certain surface finish and maximum metal removal it is preferable to use a high cutting feed associated with depth of cut.

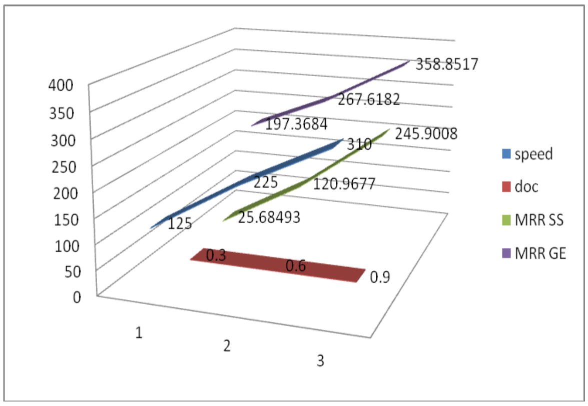

Figure :Speed, doc vs MRR for SS304 and Glass Epoxy Composite material

V. Conclusions

In the present project the parameters that are controlled by the milling machine operator when performing the end milling process is investigated with the aim of selecting the combination of values for these parameters that will generate the optimum surface roughness. Based on extensive literature survey and consultation with experienced personnel three factors; spindle speed, feed and depth of cut were selected as the control parameters of the end milling process. Three levels or values for each of the parameters were then selected for the optimization of surface roughness and the material removal rate.

The following are the conclusions drawn from the work done in this investigation.In this work two MADM approach is implemented on experimental data to optimize the result. The AHP is implemented to compute the weight and TOPSIS so implemented to rank out the results.

1. The results of the performed research show that feed is the most dominant factor and the depth of cut has a negligible influence on the surface roughness. The minimum surface roughness achieved by setting the feed as low as possible and the cutting speed as high as possible.
2. The depth of cut is the most dominant factor for material removal rate out of others two factors i.e., spindle speed and feed rate. In this experimental work it is concluded that use of medium value of spindle speed, higher value of depth of cut and higher value of feed rate are recommended to obtain the maximum MRR in milling process.
3. The smoothest surface and the maximum material removal rate are found at the speed of 310rpm, feed 18mm/min and 0.9mm depth of cut for both SS304 and Glass Epoxy Composite material.

REFERENCES

[1] Yung-Cheng Wang & Chi-Hsiang Chen & Bean-Yin Lee (2013) Analysis model of parameters affecting cutting performance in high-speed machining. Int J AdvManufTechnol DOI 10.1007/s00170-013-5505-9

[2] N.V. Prajina (2013) Multi Response Optimization of CNC End Milling Using Response Surface Methodology and Desirability Function, International Journal of Engineering Research and Technology. ISSN 0974-3154 Volume 6, Number 6

[3] Thanongsak Thepsonthi & Tuğrul Özel (2012) Multi-objective process optimization for micro-end milling of Ti-6Al-4V titanium alloy. Int J AdvManufTechnol 63:903–914

[4] V V K Lakshmi, Dr K Venkata Subbaiah (2012) Modelling and Optimization of Process Parameters during End Milling of Hardened Steel, International Journal of Engineering Research, ISSN: 2248-9622, Vol. 2, Issue 2

[5] Hedi Yangui, Bacem Zghal, Amir Kessentini, Gaël Chevallier, Alain Rivière2, Mohamed Haddar, Chafik Karra (2010) Influence of Cutting and Geometrical Parameters on the Cutting Force in Milling doi:10.4236/eng.2010.210097

[6] Doriana M. , Roberto Teti (2013) Genetic algorithm-based optimization of cutting parameters Forty Sixth CIRP Conference on Manufacturing Systems, Procedia CIRP 7 (2013) 323 – 328

[7] P. Chockalingam, Lee Hong Wee (2012) Surface Roughness and Tool Wear Study on Milling of AISI304 Stainless Steel. International Journal of Engineering and Technology, ISSN:2049-3444 Volume 2 No. 8

[8] Anna Carla Araujo, Guillaume Fromentin, Ge´ rard Poulachon (2013) Analytical and experimental investigations on thread milling forces in titanium alloy, International Journal of Machine Tools & Manufacture 67 28–34