Heat Analysis of PTFE Plates on Drilling Process by ANOVA Methodology

Desikan.S [1] Kalaiyarasan.V [2] Kannan. Ttm [3] Vijayakumar P [4]

Abstract: *Nowadays Teflon (PTFE) plates and cylindrical rods play an important role in modern manufacturing trends,PTFE plates are suitable for corrosive environment like marine, automobile applications. In this experimental work ,the drilling process conducted on Teflon plates with various process parameters like spindle speed ,feed rate and drilling diameter and response parameter as heat generation is analyzed, in this experimental work L27 orthogonal array is used as DOE to optimize the parameters specifically signal to noise ratio curves and ANOVA techniques. It indicates spindle speed play an important role for achieving lower heat generation in PTFE Plates in drilling process.*

Index Terms— Drilling, PTFE, Process parameters, Heat generation, ANOVA

I. INTRODUCTION

Drilling is basic material removal processes, familiar over the years. The cutting temperature directly influences the hole accuracy hole diameter, perpendicularity, and cylindricity, surface roughness, and tool wear. The experimental investigation of the material removal rate changes that occur on the cutting tool during the material removal processes is a traditional concern. In automotive industry depending on the application hole quality is very important and response process variable outputs. A statistical technique, using orthogonal arrays and analysis of variance, has been employed to investigate the influence of cutting parameters in machining. The Cutting speed, feed rate, drill and work piece material, drilling nomenclature which highly affect the performance measures, the main concepts to determine thrust force, torque, metal removal rate

II. LITERATURE SURVEY

1. CATALINFETECAU, Felicia Stan (2012) – Measurement- Study of cutting force and surface roughness in the turning ofpolytetrafluoroethylene composites with a polycrystalline diamond tool

2. Francisco Mata, V.N. Gaitonde, S.R. Karnik and J. Paulo Davim (2009)- Journal of materials processing technology-Influence of cutting conditions on machinability aspectsof PEEK, PEEK CF30 and PEEK GF 30 composites using PCD tools.

3. Rama Rao. S, Padmanabhan (2012) - International Journal of Engineering Research and Applications (IJERA*)* - Application of Taguchi methods and ANOVA in optimization of process parameters for metal removal rate in electrochemical machining of Al/5%SiC composites.

4. G. Petropoulos, F. Mata, J. Paulo Davim (2008) - Materials and Design - Statistical study of surface roughness in turning of peek composites.

5. Palanikumar, J. Paulo Davim (2007) – Materials and Design -Mathematical model to predict tool wear on the machining of glassfibre reinforced plastic composites.

III. POLYTETRAFLUOROETHYLENE(PTFE)

PTFE is a strong, tough, waxy , nonflammable synthetic resin produced by the polymerization of tetrafluoroethylene known by such a trademark of Teflon . PTFE is distinguished by its slippery surface,high melting point and resistant to attack of almost all chemicals.these properties have made familiar to all by coating on non stick cookware and also it is used to fabricate industrial products like pipe liners ,valves and pumps
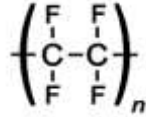
The chemical formula for PTFE

Table 1 specific properties of PTFE

Density	Melting point	Yield strength	Youngs modulus	Thermal diffiusivity
2200 kg/m^3	600 K	23 Mpa	0.5 Gpa	0.124 mm^2/s

IV. PROBLEM IDENTIFICATION

The identification of Drilling problem for PTFE flat plates which cannot be tackled using conventional technique because of following problems occurs in Drilling process.
1. Difficult to drill
2. Low coefficient of friction
3. High surface Roughness.
4. Poor Chip Breaking.

The above problems are to overcome during Drilling process and achieve good surface finish.

V. EXPERIMENTAL SETUP

Fig 1 Radial drilling machine

Fig 2 drills used

Fig 3 PTFE Drilled plates

VI. METHODOLOGY

➢ State the problem
➢ State the objectives of experiments
➢ Select the factors that may influence the selected quality characteristics
➢ Identify quality and noise factors
➢ Select levels for the factors
➢ Select appropriate orthogonal array
➢ Select interactions that may influence the selected quality characteristics
➢ Conduct the tests described by trails in orthogonal array
➢ Analyze and interpret results of the experimental trails
➢ Conduct confirmation experiment

VII. TAGUCHI DESIGN OF EXPERIMENTS

Taguchi method is a powerful tool in quality Optimization makes use of a special design of orthogonal array (OA) to examine. Number of experiments used to design the orthogonal array for 3 parameters and 3 levels of Drilling parameters

Table 2. L 27 Taguchi's Design of Experiments

Test No.	Spindle speed(Rpm)	Feed rate(mm/rev)	Dia of drill (mm)
1	1	1	1
2	1	1	1
3	1	1	1
4	1	2	2
5	1	2	2
6	1	2	2
7	1	3	3
8	1	3	3
9	1	3	3
10	2	1	2
11	2	1	2
12	2	1	2
13	2	2	3
14	2	2	3
15	2	2	3
16	2	3	1
17	2	3	1
18	2	3	1
19	3	1	3
20	3	1	3
21	3	1	3
22	3	2	1
23	3	2	1
24	3	2	1
25	3	3	2
26	3	3	2
27	3	3	2

VIII. RESULT AND DISCUSSION

Heat Generation
After conducting the experiments of Drilling operation on PTFE Plates (75x75x15mm) of heat generation values are given.
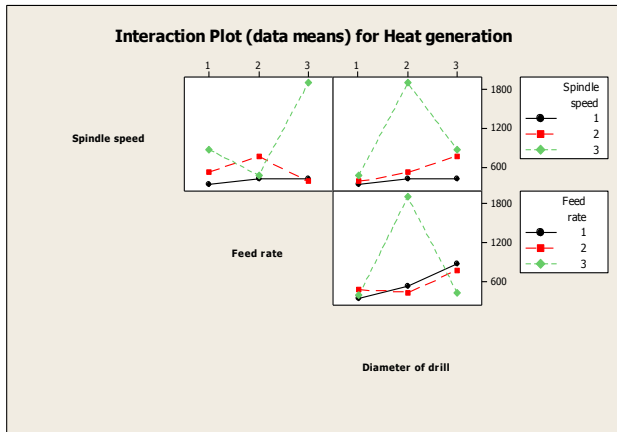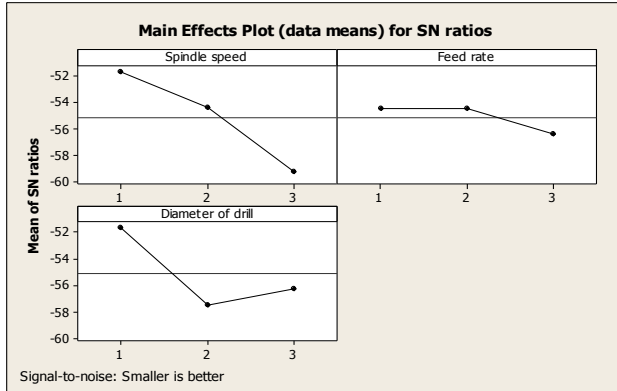
1. Cutting speed is a dominating parameter of Drilling process for achieving lower heat generation of PTFE plates.
2. The optimum parameter of Drilling operation of PTFE plates were 1000RPM of spindle speed,0.015 mm/rev of Feed and 8 mm diameter of drill.
3. However PTFE plate having reasonable Machinability.
4. During drilling processes all parameters are interact and dependant able the drilling operation.

Response Table for Signal to Noise Ratios of heat generation values (Smaller is better)

Table 4 S/N ratio of Drilling parameters of heat generation

Level	Spindle speed	Feed rate	Dia of drill
1	-51.73	-54.45	-51.70
2	-54.42	-54.52	-57.46
3	-59.27	-56.43	-56.27
Delta	7.54	1.95	5.76
Rank	1	3	2

The table 4 shows that spindle speed is an influencing process parameter of drilling operation for achieving lower heat generation

Main Effects Plot (data means) for SN ratios

Interaction Plot (data means) for Heat generation

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IX. CONCLUSION

By taking input parameters like spindle speed,feed rate and diameter of drill for the output parameter heat generation the experiment is conducted by using DOE concepts the optimsed parameter which give minimum heat generation of PTFE Teflon plates is as follows

1.Spindle Speed is 1000 rpm
2.Feed rate is 0.0015 mm/rev
3.Diameter of drill is 8 mm

X. REFERENCES

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