iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VII **Month of publication:** July 2020

DOI: https://doi.org/10.22214/ijraset.2020.30489

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VII July 2020- Available at www.ijraset.com

Milling Operation on Nickel Alloy Inconel-625 and Optimization of Machining Parameters Using Taguchi Method

Hemantha Kumar Injarapu[1], Attili. Narendra Kumar[2], S. Roopa[3]
[1] M.Tech Student CAD/CAM, [2, 3]Asst. Prof, Mechanical Department, VIET Engg College Visakhapatnam.

Abstract: Metal cutting is one of the most important production processes in the field of material removal. Black defines metal cutting as the removal of metal shavings on one side to obtain a finished product with the desired attributes of size, shape and surface roughness. In this thesis, experiments are conducted to improve the surface finish quality of a piece of Inconel 625 in nickel alloy using carbide tips. The boy has the tip of a bull. A series of experiments is carried out by varying the milling parameters of the spindle speed, the feed speed and the cutting depth using the orthogonal matrix L_9 in the Taguchi technique. The spindle speeds are 1800 rpm, 2000 rpm and 2500 rpm. The feed speeds are 200 mm / min, 300 mm / min and 400 mm / min. The cutting depth is 0.2mm, 0.3mm and 0.6mm. The process parameters are optimized for a better surface finish using the Taguchi technique in the Minitab software.

Keywords: Inconel-625, Spindle speed, feed ratio, Depth of cut, Taguchi, MINITAB

I. INTRODUCTION

Milling is the most common form of processing, a material removal process, which can create a variety of functions in one piece by cutting unwanted material. The milling process requires a milling machine, a work-piece, a device and a milling cutter. The work-piece is a piece of preformed material that is attached to the device, which in turn is attached to a platform in the milling machine. The cutter is a cutting tool with sharp teeth that also attaches to the router and rotates at high speed. By inserting the part into the rotating blade, the material is cut from that part into small shavings to create the desired shape.

A. Cutting parameters

During milling, the speed and movement of the cutting tool are specified by various parameters. These parameters are selected for each function based on the part material, tool material, tool size, etc.

1) Power failure
2) Cutting speed
3) Speed axis
4) Feed rate
5) Axial cutting depth
6) Radial cutting depth

II. LITERATURE SURVEY

Dražen Bajić's work [1] examines the influence of three cutting parameters on surface roughness, tool wear and cutting force components on the surface as part of offline process control. Two modeling methodologies were studied, namely regression analysis and neural networks applied to experimentally determined data. The results obtained from the models were compared. Both models have a relative forecast error of less than 10%. Research has shown that when the training dataset is a small neural network, the modeling methodologies are comparable to the regression analysis methodology and may even offer better results, in which case an average relative error of 3.35%. The benefits of offline process control using process models that use these two modeling methodologies are explained in theory. The work carried out by K. Adarsh Kumar [2], presents an experimental study to study the effects of the cutting parameters, such as the spindle speed, the feed and the cutting depth on the surface finish. EN-8. Multiple regression (RA) analysis is performed which uses variance analysis to determine the performance of experimental measurements and shows the effect of cutting parameters on surface roughness. The treatment was carried out using a carbide insert. The goal was to establish a correlation between cutting speed, feed speed and cutting depth and to optimize the turning conditions based on the surface roughness. These correlations are obtained by multiple regression analysis (RA).

III. EXPERIMENTAL SETUP AND PROCEEDURE

Experiments have been conducted to study the effects of one or more factors of the process parameters (spindle speed, feed speed and depth of cut) on the finish of the worked surface. The main objective of the project is to determine the influence of carbide tips on metallurgy. The study is based on the surface roughness when milling the Inconel 625 nickel alloy with a carbide tool. The cutting parameters considered are feed, spindle speed and depth of cut.

This experiment used a CNC vertical milling machine. A carbide cutting tool is used. The experiment was conducted under spindle speed conditions of 1800 rpm, 2000 rpm and 2500 rpm. The feed speeds are 200 mm / min, 300 mm / min and 400 mm / min. The cutting depth is 0.2mm, 0.3mm and 0.6mm. Square pieces of Inconel 718 material are taken for processing.

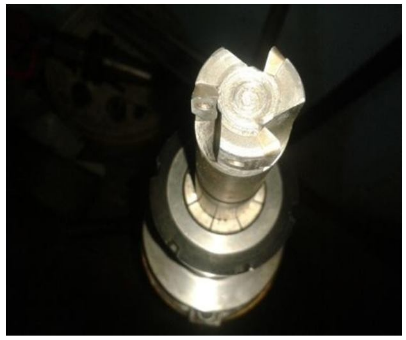


Fig. 1 High Carbide Tool

A. *Taguchi parameter design for optimizing parameters using Minitab software - Selection of Orthogonal Array*

The process parameters and their values are given in table. It was also decided to study the three factor interaction effects of process parameters on the selected characteristics.

TABLE I

Input Process Parameters For Taguchi Method

Factors	Process Parameters	Level-1	Level-2	Level-3
A	Spindle Speed (Rpm)	1800	2000	2500
B	Feed Rate (Mm/Min	200	300	400
C	Depth of Cut (Mm)	0.2	0.3	0.6

B. *Results*

Using randomization technique, analysis is done by varying the input parameters. The values have been reported in Tables. The values being ‘smaller the better’ type of machining quality characteristics, the S/N ratio for this type of response was and is given below:

$$S/N\ Ratio = -10 \log \left[\frac{1}{n}(Y_1^{\,2} + Y_2^{\,2} + \ldots\ldots + Y_n^{\,2}) \right] \quad \ldots..(1)$$

Where $Y_1, Y_2, \ldots.., Y_n$ are the responses of the machining characteristics for each parameter at different levels.

TABLE II

Arrangement Of Process Parameters As Per L9 Orthogonal Array

Job No.	Spindle Speed (Rpm)	Feed Rate (Mm/Min	Depth of Cut (Mm)
1	1800	200	0.2
2	1800	300	0.3
3	1800	400	0.6
4	2000	200	0.3
5	2000	300	0.6
6	2000	400	0.2
7	2500	200	0.6
8	2500	300	0.2
9	2500	400	0.3

C. Surface Finish Results

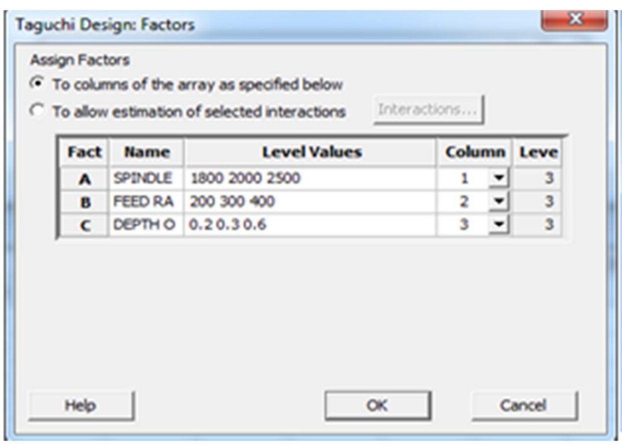
In this project most important output performances in milling such as Surface Roughness (Ra) is considered for optimizing machining parameters. The surface finish value (in µm) was obtained by measuring the mean absolute deviation, Ra (surface roughness) from the average surface level using a Computer controlled surface roughness tester.

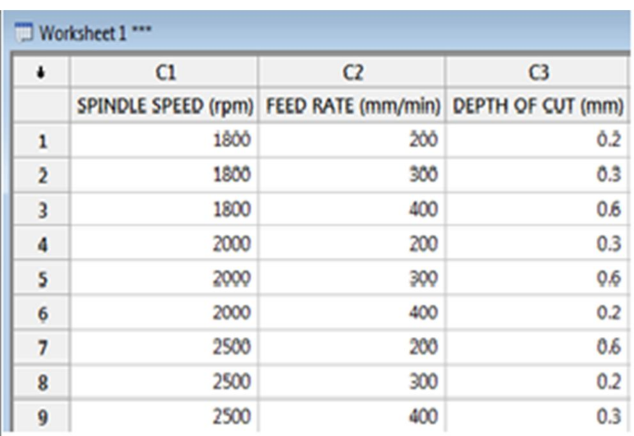
TABLE III
MEASURED ROUGHSURFACE VALUES

Job No.	Spindle Speed (Rpm)	Feed Rate (Mm/Min	Depth of Cut (Mm)	Surface Roughness(R_a)
1	1800	200	0.2	1.72
2	1800	300	0.3	1.13
3	1800	400	0.6	0.95
4	2000	200	0.3	0.83
5	2000	300	0.6	1.53
6	2000	400	0.2	1.21
7	2500	200	0.6	1.23
8	2500	300	0.2	1.34
9	2500	400	0.3	1.97

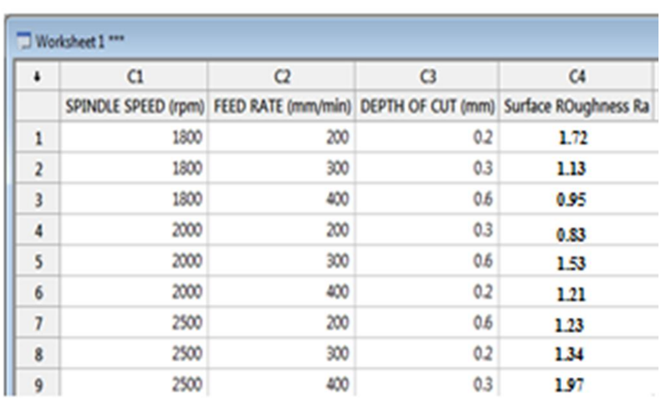
IV. OPTIMIZATION OF MACHINING PARAMETERS USING MINITAB SOFTWARE FOR MINIMUM SURFACE ROUGHNESS

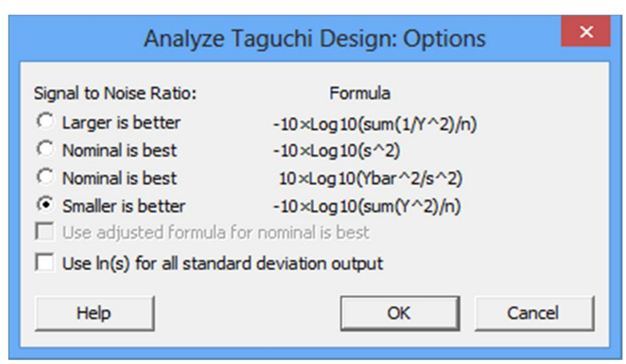
A. Taguchi Design Select Factors





B. Enter Surface Roughness Values in the table and Options

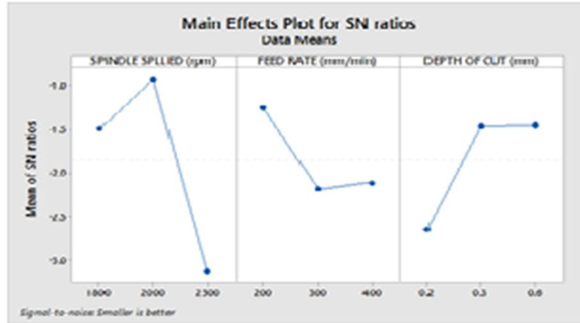




C. S/N Results Table and Effect of milling parameters on surface finish for S/N ratio

Worksheet 1 ***

↓	C1	C2	C3	C4	C5
	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)	Surface ROughness Ra	SNRA1
1	1800	200	0.2	1.72	-4.71
2	1800	300	0.3	1.13	-1.06
3	1800	400	0.6	0.95	0.44
4	2000	200	0.3	0.83	1.62
5	2000	300	0.6	1.53	-3.69
6	2000	400	0.2	1.21	-1.65
7	2500	200	0.6	1.23	-1.79
8	2500	300	0.2	1.34	-2.54
9	2500	400	0.3	1.97	-5.88



D. Analysis and Discussion

Regardless of the category of performance characteristics, a higher S / N value corresponds to better performance. Therefore, the optimal level of parameter processing is the level with the highest value.

1) *Spindle Speed:* The effect of the spindle speed settings on the surface finish is shown above the S / N ratio figure. Therefore, the optimal spindle speed is 2000 rpm.
2) *Feed Speed:* The effect of the feed speed of the parameters on the surface finish is indicated above the S / N ratio. Therefore, the optimal feed speed is 200 mm / min.
3) *Depth of Cut:* The effect of the depth of cut of the parameters on the surface finish is shown above the figure of the S / N ratio. Therefore, the optimal depth of cut is 0.3 mm.

V. RESULTS AND DISCUSSION

The parameters are optimized using the Taguchi technique in Minitab 17. Observing the signal-to-noise ratio, the optimal parameters are the spindle speed 2000 rpm, the feeding 200 mm / min and the cutting depth 0.3 mm for the values of roughness on the underside. From this it can be concluded that the processing of Inconel 625 with a spindle speed of 2000 rpm, a feed speed of 200 mm / min and a cutting depth of 0.3 mm ensures better quality. Surface finish

REFERENCES

[1] Modeling of the Influence of Cutting Parameters on the Surface Roughness, Tool Wear and Cutting Force in Face Milling in Off-Line Process Control by DraženBajić, Luka Celent, Sonja Jozić, University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia
[2] Optimization of surface roughness in face turning operation in machining of EN-8 by K. Adarsh Kumar, Ch.Ratnam, BSN Murthy, B.Satish Ben, K. Raghu Ram Mohan Reddy
[3] Effect of machining conditions on MRR and surface roughness during CNC Turning of different Materials Using TiN Coated Cutting Tools – A Taguchi approach by H. K. Dave, L.S. Patel, H. K. Raval
[4] Optimization of surface roughness in CNC end milling using response surface methodology and genetic algorithm by B. Sidda Reddy, J. Suresh Kumar, and K. Vijaya Kumar Reddy
[5] Prediction of surface roughness in end milling with gene expression programming by Yang Yang, Xinyu Li, Ping Jiang, Liping Zhang
[6] Furness, R.J., Ulsoy, A.G., Wu, C.L. (1996). Feed, speed, and torque controllers for drilling. ASME Journal for Manufacturing Scientists and Engineers, vol. 118, p. 2–9.
[7] Landers, R.G., Usloy, A.G., Furness, R.J. (2002). Process monitoring and control of machining operations. Mechanical Systems Design Handbook. CRC Press LLC, p. 85-119.
[8] Lu, C. (2008). Study on prediction of surface quality in machining process. Journal of Materials Processing Technology, vol. 205, no. 1-3, p. 439-450, DOI:10.1016/j.jmatprotec.2007.11.270.
[9] Bajić, D., Belaić, A. (2006). Mathematical modelling of surface roughness in milling process. Proceedings of the 1st International Scientific Conference on Production Engineering (ISC), p. 109-115.
[10] Oktem, H., Erzurumlu, T., Kurtaran, H. (2005). Application of response surface methodology in the optimization of cutting conditions for surface roughness. Journal of Materials Processing Technology, vol. 170, p. 11-16, OI:10.1016/j.jmatprotec.2005.04.096.