International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 8, Issue 4, July 2021 ||

Effects of Magnetic Field and Variation of Viscosity and Thermal Conductivity on Separation of a Binary Fluid Mixture over a Continuously Moving Surface

B.R Sharma, Kabita Nath

Department of Mechanical Engineering, Swarnandhra College of Engineering & Technology, Narsapur, West Godavari, Andhra Pradesh, India[1]

ABSTRACT: Surface roughness is an important measure of the technological quality of a product and a factor that greatly influences manufacturing cost. Decreasing the surface roughness value in the manufacturing field improves end products quality. The optimization of high speed milling process parameters with respect to the surface roughness of samples and the study of the Taguchi design application to surface quality was experimented by using CNC end milling operation. The Taguchi design is an efficient and effective experimental method in which a response variable can be optimized by giving various control factors. An orthogonal array of L9 was used to carry out and to identify the significant factors affecting surface roughness. In the present investigation, the straight flute end-milling cutter was used for machining of 6463 Aluminium alloy and brass work pieces. The factors related to surface roughness are cutting speed, feed rate and depth of cuts. Confirmation test with optimal levels of machining parameters were carried out in order to illustrate the effectives of Taguchi's optimization method.

KEYWORDS: Optimization, Surface Roughness, Taguchi, Milling.

I. INTRODUCTION

One of the most common metal removal operations used in industry is the end milling process. It is common manufacturing process widely used in a variety of sectors, such as the aerospace, die, machinery design and automobile as well as manufacturing industries. In order to ensure the machining quality and to reduce cost and time, it is indispensable to develop research on milling process including the prediction of cutting forces, form errors and surface quality. The machined surface topography and the geometric shape and texture of the machined surface is essential because the latter directly affects the surface quality. Surface roughness is an important measure of the technological quality of a product and a factor that greatly influences manufacturing cost. The mechanism behind the formation of surface roughness is very dynamic, complicated and process dependent; it is very difficult to calculate its value through theoretical analysis. The dynamic nature and widespread usage of milling operations in practice have raised a need for seeking a systematic approach that can help to set-up milling operations in a timely manner and also to help achieve the desired surface roughness quality. Under periodically varying milling forces, the cutting tool experiences both static and dynamic deformations, which are passed as dimensional, and surface finish errors to the product. The conditions that affect the surface finish are feed, speed, material, and tool geometry.

Traditional experimental design procedures are too complicated and not easy to use. A large number of experimental works have to be carried out when the number of process parameters increases. To solve this problem, the Taguchi method uses a special design of orthogonal arrays to study the entire parameter space with only a small number of experiments. Taguchi is the developer of the Taguchi method. Taguchi methods have been widely utilized in engineering analysis and consist of a plan of experiments with the objective of acquiring data in a controlled way, in order to obtain information about the behaviour of a given process. The greatest advantage of this method is the saving of effort in conducting experiments; saving experimental time, reducing the cost, and discovering significant factors quickly. Taguchi's robust design method is a powerful tool for the design of a high quality system. He considered three steps in a process and product development; system design, parameter design, and tolerance design. In system design, the engineer uses scientific and engineering principles to determine the fundamental configuration. In the parameter design step, specific values for the system parameters are determined. Tolerance design is used to determine the best tolerance for the parameters. In addition to the S/N ratio a statistical analysis of variance can be employed to indicate

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|| Volume 8, Issue 4, July 2021 ||

the impact of process parameters on surface finish values. In this way the optimal levels of process parameters can be estimated.. The analysis results of related subjects discussed above are given in the following sections.

II. RELATED WORK

Design of Experiment: DOE is a powerful analysis tool for modelling and Analysing the influence of control factors on performance output. The traditional experimental design is difficult to be used especially when dealing with large number of experiments and when the number of machining parameter is increasing. Taguchi method, which is developed by Dr. Genichi Taguchi, is introduced as an experimental technique which provides the reduction of experimental number by using orthogonal arrays and minimizing the effects out of control factors. Taguchi is a method which includes a plan of experiments with the objective of acquiring data in a controlled way, executing these experiments and analysis data in order to obtain the information about behaviour. This technique has been applied in the manufacturing processes to solve the most confusing problems especially to observe the degree of influence of the control factors and in the determination of optimal set of conditions. The Taguchi method could decrease the experimental or product cycle time, reduce the cost while increasing the profit and determines the significant factors in a shorter time period as it can ensure the quality in the design phase. The first step in Taguchi's parameter design is selecting the proper orthogonal array (OA) according to the controllable factors (parameters). Then, experiments are run according to the OA set earlier and the experimental data are analysed to identify the optimum condition. Once the optimum conditions are identified, then confirmation runs are conducted with the identified optimum levels of all the parameters. The use of parameter design in Taguchi's technique is an engineering method of focusing on determining the parameter settings producing the best levels of a quality characteristic with minimum variation for a product or process. In the Taguchi method the term signal represent the desirable value (mean) for the output characteristic and the term noise represent the undesirable value for the output characteristic. Taguchi uses the S/N ratios to measure the quality characteristic deviating from the desired value. There are several S/N ratios available depending on types of characteristics. Smaller is better S/N ratio used here because the quality characteristic is Surface Roughness (Ra).

Working Machine: For the experiments XL CNC Machine is used

Figure 1: Working Machine XL Mill

High performance XL MILL is used which having working space X,Y,Z movements being 225×150×115MM variable spindle speed. Optimum 150-4000 rpm main spindle power 14.7 K.W. having table size 360 ×132 mm was employed to perform experiments.

Work piece material: The experiment is carried out on 6463aluminum alloy and brass materials (100 x 95 x 10 mm) and (160×75×10mm) 9 blocks.

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Figure 2 Work piece 6463 Aluminium Alloy

Figure 3 Work piece Brass

Surface Roughness Tester: Taylor Hobson Surface tester is used for taking Ra values. It contains a probe which is movable. By some force this probe is moved on surface of work piece.

Figure 4: Surface roughness tester (Talysurf)

Experimental Conditions The following experimental data is obtained by conducting milling operation on 6463 aluminium alloy and brass materials using CNC end milling.

Control parameters and levels:

Parameters	Symbols	Level-1	Level-2	Level-3
Cutting speed, rpm	N	600	1200	1800
Feed rate, mm/min	F	1000	3000	5000
Depth of cut, mm	D	0.2	0.4	0.6

Table 1: Selected Process Parameter levels

The following table represents the 9 levels of working parameters. In levels speed, feed and depth of cut are varied.

S.NO	Speed (rpm)	Feed (mm/rev)	D.O.C (mm)
L1	600	1000	0.2

L2	600	3000	0.4
L3	600	5000	0.6
L4	1200	1000	0.4
L5	1200	3000	0.6
L6	1200	5000	0.2
L7	1800	1000	0.6
L8	1800	3000	0.2
L9	1800	5000	0.4

Table 2: L9 Orthogonal Array by Minitab 17

III. RESULTS AND ANALYSIS

After all 9 experiments are carried out a table is generated by Minitab 17 which contains Ra value in 6463 aluminium alloy

S.NO	Speed (rpm)	Feed (mm/rev)	D.O.C (mm)	R act (µm)
L1	600	1000	0.2	1.75
L2	600	3000	0.4	2.87
L3	600	5000	0.6	3.82
L4	1200	1000	0.4	1.99
L5	1200	3000	0.6	1.99
L6	1200	5000	0.2	1.70
L7	1800	1000	0.6	1.72
L8	1800	3000	0.2	1.52
L9	1800	5000	0.4	1.14

Table 3 Results obtained from L9 orthogonal array for 6463 Aluminium alloy

Analysis of Data

a) S/N Ratio analysis: The following table shows ranking for the operating conditions i.e.. L9 orthogonal array for 6463 Aluminium alloy. From the table larger is better.

Levels	Cutting speed	Feed rate	Depth of cut
1	13.12	12.01	10.93
2	12.43	12.33	12.59
3	12.08	13.39	14.11
Delta	1.04	1.29	3.17
Rank	3	2	1

Table 4: Response Table for Signal to Noise Ratio

b) Response Table for Means: The following table shows ranking for the operating conditions i.e... L9 orthogonal array for 6463 Aluminium alloy. From the table larger is better.

Level	Cutting speed	Feed rate	Depth of cut
1	4.58	4.003	3.540
2	4.233	4.237	4.283
3	4.093	4.673	5.090
Delta	0.493	0.670	1.550
Rank	3	2	1

Table 5: Response Table for Means

Above tables clearly indicates the optimal condition of process parameters. Optimal value levels for better surface finish Ra are at cutting speed 1800 m/min, feed is at 1000mm/min and depth of cut is 0.2mm.The delta is the highest minus the lowest average for each factor. Minitab assigns rank based on Delta value.

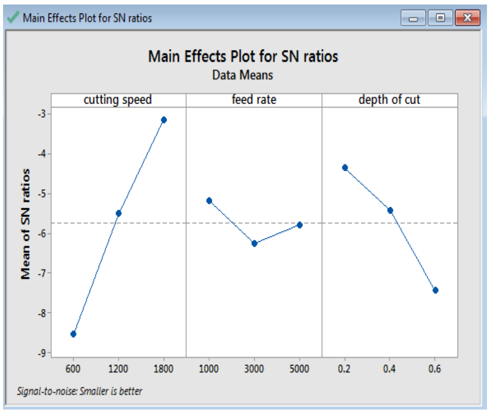

Figure 5: Effect of process

From the plots S/N ratio increases with the increase in speed. Higher S/N ratio represents the better surface roughness value. In DOC mode the S/N ratio is decreases with the increasing depth of cut. Then better surface finish is obtained at lower rate of depth of cut.

After all 9 experiments are carried out a table is generated by Minitab 17 which contains Ra value in Brass. The following table consists Ra values for the brass at different operating conditions

Analysis of Data

a) S/N Ratio: S/N ratio is a measure used in science and engineering that compares the level of background noise. It is defined as the ratio of signal power to the noise power. A ratio higher than 1:1 indicates more signal than noise.

S.NO	SPEED (rpm)	FEED (mm/rev)	D.O.C (mm)	R act (µm)
L1	600	1000	0.2	0.76
L2	600	3000	0.4	0.67
L3	600	5000	0.6	0.60
L4	1200	1000	0.4	0.48
L5	1200	3000	0.6	0.72
L6	1200	5000	0.2	1.09

Table 7 Response table brass

b) Response table for means: The following table represents the response table for means and smaller is better.

Level	Cutting speed	Feed	Depth of cut
1	0.6767	0.5933	1.0400
2	0.7633	0.8867	0.5367
3	0.7567	0.7167	0.6200
Delta	0.0867	0.2933	0.5033
Rank	3	2	1

Table 8: Response Table for Means

Tables clearly indicate the optimal condition of process parameters. Optimal value levels for better surface finish Ra are at cutting speed 600 m/min, feed is at 1000mm/min and depth of cut is 0.4mm.The delta is the highest minus the lowest average for each factor. Minitab assigns rank based on Delta value.

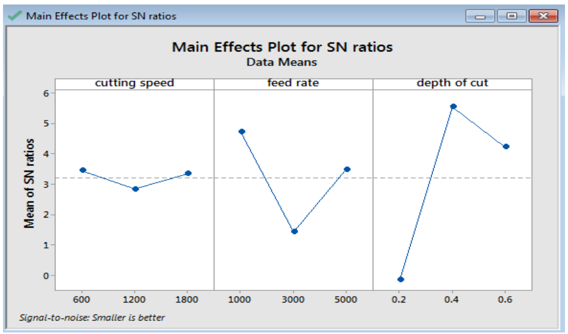

Figure 6: Effect of process parameter on S/N Ratios

From the plots Surface roughness decreases with an increase feed rate and decrease cutting speed and depth of cut.

IV. CONCLUSION

- Using Taguchi method in the experiment, the machining parameters cutting speed, feed rate, depth of cut which are influencing the surface roughness on the CNC end mill machining of 6463 aluminium alloy and brass.
- The optimized results were obtained by using Taguchi method from means and SN ratio results
- For (i) Brass cutting speed 600m/min, feed rate 1000mm/min, depth of cut 0.4mm.
  (ii) Aluminium cutting speed 1800m/min, feed rate 1000mm/min, depth of cut 0.2mm.

- The optimized surface roughness value of 6463 aluminium alloy is 1.69µm and brass is 0.70µm. In the Analysis of 6463 aluminium alloy surface roughness decreases with an increase in the cutting speed and, increases with increase in feed rate and depth of cut.
- In the analysis of brass Surface roughness decreases with an increase feed rate and decrease cutting speed and depth of cut.

REFERENCES

[1] Taguchi G. Introduction to quality engineering. New York: McGrawHill: 1990

[2] Mohammed T. Hayajneh a, Montasser S. Tahat b, Joachim Bluhm c, A Study of the Effects of Machining Parameters on the Surface Roughness in the End- Milling Process." , JJMIE, vol 1, sep.2007

[3] Dr. Mike S. Lou, Dr. Joseph C. Chen & Dr. Caleb M. Li. Surface Roughness Prediction Technique For CNC End-Milling, journal of INDUSTRIAL TECHNOLOGY, vol15, NOV 1998 to JAN 1999

[4] Dhole N.S. 1, Prof. Naik G.R 2, Mr. Prabhawalkar M.S. 3." OPTIMIZATION OF MILLING PROCESS PARAMETERSOF EN33 USING TAGUCHI PARAMETER DESIGN APPROACH" JERS/vol.III/Issue I/January-march,2012/70-74

[5] B. Sidda Reddy1, J. Suresh Kumar and K. Vijaya Kumar Reddy "Optimization of surface roughness in CNC end milling using response surface methodology and genetic algorithm." ,IJEST,Vol3, NO8(2011)

[6] R.AROKIADASS and K. PALANIRADJA "EFFECT OF PROCESS PARAMETERS ON SURFACE ROUGHNESS IN END MILLING OF Al/SiCp MMC , IJEST, Vol3 NO 1 jan2011

[7] Arshad Noor Siddiqueea, Zahid A. Khana, Pankul Goelb, Mukesh Kumarb, Gaurav Agarwalb, Noor Zaman Khana "Optimization of Deep Drilling Process Parameters of AISI 321 Steel using Taguchi Method, Elsevier, procedia material science 6(2014) 1217-1225

[8] Lohithaksha M Maiyara*, Dr.R.Ramanujamb, K.Venkatesanc, Dr.J.Jerald "Optimization of Machining Parameters for End Milling of Inconel 718 Super Alloy Using Taguchi Based Grey Relational Analysis", Elsevier, procedia engineering 64(2013) 1276-1282