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An Experimental Analysis of Turning Operation in EN 31ALLOY

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ABSTRACT

Turning is a form of machining process which is used to create a cylindrical part by cutting away unwanted materials. Today the most common type of automation is computer numerical control, better known as CNC. Components such as axles, shafts can be manufactured by turning process. In that manufacturing unit mainly focuses on high quality with increased production rate and profit level of the firm and so it's important to determine the optimal machining parameters such as speed, feed and depth of cut. This works deals with the selecting the optimal parameters that plays a critical role in increasing the productivity with desired product quality at minimum cost and reduced lead time. The experiments were conducted with Taguchi's L 9 mixed orthogonal array. Coated insert was used to machine the EN 31 alloy steel work pieces on computer numerical controlled (CNC) lathe. The optical parameters were found using Taguchi's approach individually for minimum surface roughness and maximum material removal rate (MRR) and were compared with the results obtained from Grey relation analysis.

1. INTRODUCTION

Sunil dambhare[1] Is attempt to solve the sustainability issues in turning process. This process was optimized from power consumption point of view. In this process surface roughness, material removal rate and energy consumption were considered as sustainability factors. The effect of surface roughness and material removal rate were analyzed. Rosa [2] is investigating the influence of cutting parameters on longitudinal turning of high silicon alloy using PCO tools. The result will be analyzed on machining parameters such as geometric and cutting forces and there effects. Robert kowalcz[3] is analyzed the input parameters such as cutting speed, feed and nose radius. By using the classical method the output variables such as main cutting force and feed force can be evaluate. Supriya sahu[4] is analyze input parameters such ad cutting speed, feed rate and depth of cut. By the taguchi method the output values can be calculated such as tool wear surface roughness, tool geometry and cutting fluid.Thus the result will be the machining of hard materials at higher speeds and lower feeds is improved by using coated tools. Meenu gupta[5] analyzed the machining parameters by the single crystal diamond tools and poly crystal diamond tool. By using the taguchi method the Result is analyzed such as the surface roughness increases as feed rate increases. It is found that feed rate is more significant factor followed by depth of cut and cutting speed. Amol thakare[6] is investigate steady state temperature distribution on coated carbide tool by the finite analysis method. Cutting tool temperatures are strongly influenced due to edge deformation and the progressive development of flank land.

2. Experimental Set Up

The specimen material is in cylindrical form which has 100mm length and 20mm diameter with the help of coated insert. For this method L9 orthogonal array can be used. For the present experiment work the two process parameters at three levels and one parameter at two levels have been decided. Computer Numerical Controlled lathe with a variable speed of 50 to 50,000 rpm and a power rating of AC motor can be preferred.

Figure 1-Computer Numerical Controlled Lathe

2.1 Work piece Material – EN 31 Alloy Steel

Cylindrical bars of 20mm diameter and 100 mm long were used for this experimentation process. The chemical composition of the material is Carbon-0.101%, Silicon-0.30%, Sulphur-0.24%, Chromium-0.76%, Phosphorous-0.028%, Manganese-0.78%.

2.2 Process variables and their limits

In this experimental study, spindle speed, feed and depth of cut have been considered in this process. The process variable and the limits were shown in table 1.

Table 1 – Process variables and their limits

Parameters	Level 1	Level 2	Level 3
Cutting speed(m/min)	1250	1350	1450
Feed(mm/rev)	0.25	0.30	0.35
Depth of cut(mm)	0.5	0.75	1

2.3 Selection of experimental designs

Based on Taguchi's orthogonal array design L9 array can be selected and it is mentioned in the table 2. The experiments were designed with help of design of experiments [7 to 10].

Table 2 – Process variables and their limits

Experiment no	Speed	Feed	Depth of cut
1	1250	0.25	0.5
2	1350	0.3	0.5
3	1450	0.35	0.5
4	1350	0.25	0.75
5	1450	0.3	0.75
6	1250	0.35	0.75
7	1450	0.25	1
8	1250	0.3	1
9	1350	0.35	1

2.4 Material Removal Rate

Initial and final weights of work piece were noted. Machining time was also recorded. Following equation is used to determine the response Material Removal Rate (MRR).

MRR=(Initial weight – final weight)/(density× machining time)

2.5 Surface Roughness

Surface roughness generally can be described as the geometric features of the surface. The roughness measurement, in the transverse direction, on the work pieces has been repeated three times and average of three measurements of surface roughness parameter values has been noted in table.

3. Analysis of Results

The Material Removal Rate and Surface Roughness were shown in table 3. The analysis were carried out Taguchi optimization method [11 to 18].

Table 3- Material Removal Rate and Surface Roughness

S.NO	MRR	SR(µm)
1	78.39	2.27
2	50.95	1.54
3	95.54	1.46
4	69.48	2.5
5	84.92	2.36
6	84.92	1.28
7	101.91	1.62
8	101.91	1.74
9	113.23	1.71

4. Material removal rate analysis

SN ratios are used to determine the optical design conditions to obtain the optimum material removal rate. The plot below represents the main effect plot of SN ratio for the MRR

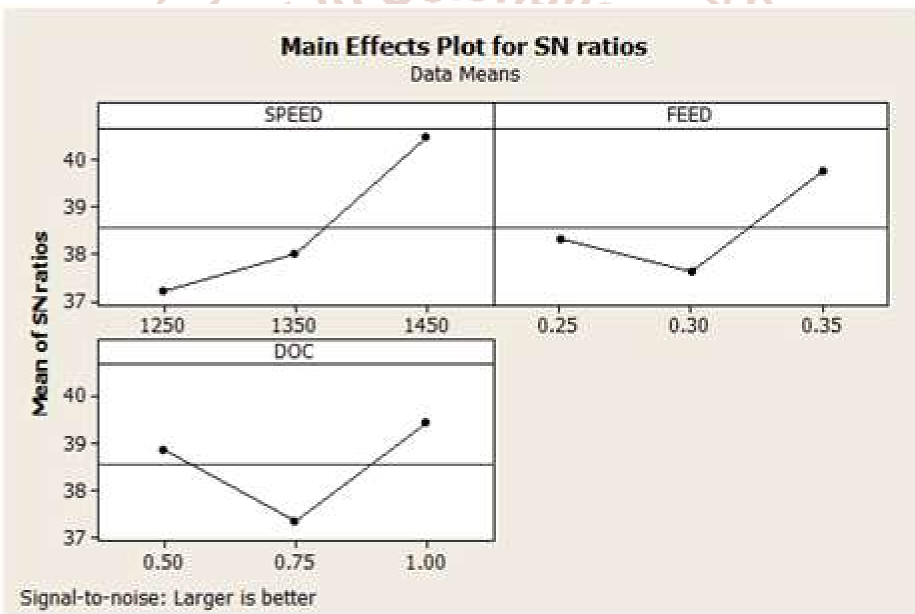

Figure 2 – Main Effects plots of SN ratio for MRR in coated insert

According to this main effect plot of SN ratio (figure 1), the optical conditions for maximum MRR in coated insert.

1. Cutting speed at 1450rpm (level 3).
2. Feed rate at 0.35 mm/rev (level 3).
3. Depth of cut 0.50 mm(level 1)

4.1.1 Surface Roughness Analysis

The main effects plots are used to determine the optimal deign conditions to obtain the optimum surface roughness. The plot shows the main effect plot of SN ratio for the surface roughness.

According to this main effect plot of SN ratio (figure 3) , the optical conditions for minimum surface roughness are:

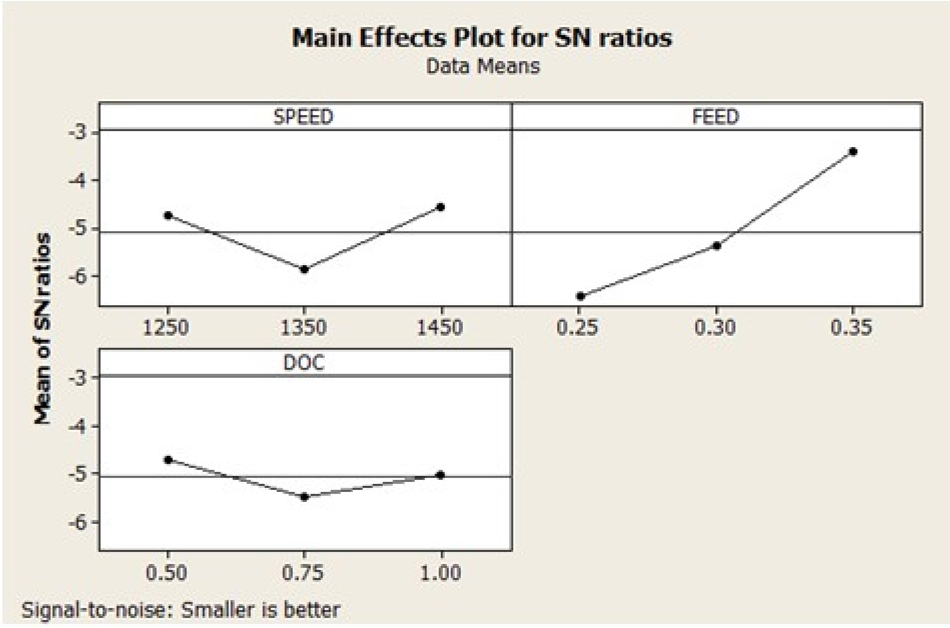

Figure3 – Main effect plots of SN ratio for SR in coated insert

CONCLUSION

The experiments were designed with the help of design of experiments based on the input parameters and their corresponding levels, L9 orthogonal array was selected.

1. Experimentation was carried out with coated insert and the material removal rate and surface roughness was recorded based on the input
2. The best feasible combination of parameters was identified using the signal to noise ratio individually for both MRR and SR.
3. The feasible properties of MRR are
   i. Cutting speed at 1450rpm (level 3)
   ii. Feed rate at 0.35 mm/rev (level 3).
   iii. Depth of cut 0.50 mm (level 1).
4. The feasible properties of SR are
   i. Cutting speed at 1350 m/min (level 1).
   ii. Feed rate at 0.25 mm/rev (level 1).
   iii. Depth of cut at 0.75 mm (level 2).

REFERENCES

1. Sunil Dambhare, Samir Deshmukh, Atul Borade,(2015), 'Sustainability issues in turning process: a study in Indian machining industry .
2. T.fraga oa selva, R.B. Soares ,A.M.P Jesus, P.A.R.Rosa (2015) 'Simulation studies of turning of aluminum cast alloy using pcd tools
3. Robert kowalcz (2015) , 'Development of three-dimensional finite element model to calculate the turning processing parameters in turning operations'.
4. Masao Murakana , Supriya sahu (2015) ' Application of brazed diamond film as intrest for turning aluminum alloys' .
5. Meenu Gupta, Surinder Kumar, (2015),'Investigation of surface roughness and MRR for turning of UD-GFRP using PCA and taguchi method'.
6. Amol thakare , Shivakumar Raman (2015) , ' Observations of tool-chip boundary conditions in turning of aluminium alloys' .
7. Radhakrishnan.K, Godwin Antony.K, Rajaguru.K, Dinesh.S, Experimental Investigation on Machining of Aluminum Metal Matrix using Electrical Discharge Machining , Advances in Natural and Applied Sciences, Vol. 11. No 7, pp.no 809-816.
8. Dinesh S, Godwin Antony A, K.Rajaguru, V.Vijayan," Investigation and Prediction of Material Removal Rate and Surface Roughness in CNC Turning of En24 Alloy Steel", Mechanics and Mechanical Engineering 20 (4), 451-466.
9. Dinesh S, Godwin Antony A, K.Rajaguru, V.Vijayan," Experimental Investigation and Optimization of Material Removal Rate and Surface Roughness in Center less grinding of Magnesium Alloy using Grey Relational Analysis", Mechanics and Mechanical Engineering, Vol 21, No 1 (2017), pp.no 17-28.

10. Kannan.S, Suresh Kumar.B, Baskar. N, Varatharajalu.M, (2015),' Investigation on optimum cutting condition in face milling of copper with HSS cutter using response surface methodology and genetic algorithm', International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.57, 243-248.
11. Deepan Bharthi Kannan.T,Rajesh Kannan.G, Suresh Kumar. B, Baskar.N (2014),' Application of Artificial Neural Network for Machining parameters optimization in drilling operation', Procedia Material sciences, Vol. 5, 2242-2249.
12. B. Suresh kumar, V. Vijayan, N. Baskar (2016), 'Comparison of coated and uncoated carbide drill bits for drilling titanium grade 2 material', Mechanika, Vol. 22 no 6, 571-576.
13. Godwin Antony A, Aravind S, Dinesh S, K.Rajaguru, V.Vijayan," Analysis and Optimization of Performance Parameters in Computerized IC Engine Using Diesel Blended with Linseed Oil and Leishmaan's Solution", Mechanics and Mechanical Engineering, Vol 21 issue 2, pp.no 193-205.
14. Dinesh S, Godwin Antony A, K.Rajaguru, V.Vijayan," Experimental Investigation and Optimization of Machining Parameters in CNC Turning Operation of Duplex Stainless Steel", Asian Journal of Research in Social Sciences and Humanities, Vol. 6, No. 10, October 2016, pp. 179-195.
15. Dinesh S, Prabhakaran M, Godwin Antony A, K.Rajaguru, V.Vijayan,"Investigation and Optimization of Machining Parameters in Processing AISI 4340 Alloy Steel with Electric Discharge Machining", International Journal of Pure and Applied Mathematics, Vol 117 No. 16 2017, 385-391.
16. Dinesh S, Godwin Antony A, K.Rajaguru, V.Vijayan,"Comprehensive Analysis of Wire Electric Discharge Machining Process in Machining High Chromium High Carbon Steel", International Journal of Mechanical and Production Engineering Research and Development Vol. 8, No 1, Feb 2018, 65-74.
17. Suresh kumar. B, Baskar. N, ' Integration of fuzzy logic with response surface methodology for thrust force and surface roughness modeling of drilling on titanium alloy', International Journal of Advanced Manufacturing Technology 65 (2013) 1501–1514.
18. Kannan.S, Varatharajalu.M, Baskar.N, Suresh Kumar. B, Modeling and optimization of face milling parameters on brass component using response surface methodology and genetic algorithm, International Journal of Applied Engineering Research, Vol. 10 No.76 (2015) 219 - 224.