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Analysis of Cutting Process Parameter during Turning of EN 31 for minimum Surface Roughness Using Taguchi Method

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Abstract - *In machining operation, choice of cutting parameters is very important to control the required surface quality. The focus of the present paper is to analyze the cutting process parameter for minimum surface roughness in turning of EN 31 at different levels. The cutting parameter cutting speed, tool nose radius and feed rate were considered for performing the experiment while carbide tool was selected as cutting tool. For performing the experimental work L9 orthogonal array taguchi design of experiments were employed & the surface roughness is measured using Surtronic 3+ measuring instrument.*

Key Words: **CNC Lathe, EN 31, Coated carbide tool, Surface roughness, Taguchi etc**.

1. INTRODUCTION

In machining operation, the quality of surface finish is an important requirement of many turned work pieces and parameter in manufacturing engineering. It is characteristic that could influence the performance of mechanical parts and the production cost. Various failure, some time catastrophic, leading to high cost, have been attribute to the surface finish of the component in question. For these reasons there have been research developments with the objective of optimizing the cutting condition to obtain a surface finish.

1.1 Machining Operation

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters.

Turning is the machining operation that produces cylindrical parts. In its basic form, it can be defined as the machining of an external surface:

- With the work piece rotating.
- With a single-point cutting tool, and
- With the cutting tool feeding parallel to the axis of the work piece and at a distance that will remove the outer surface of the work.

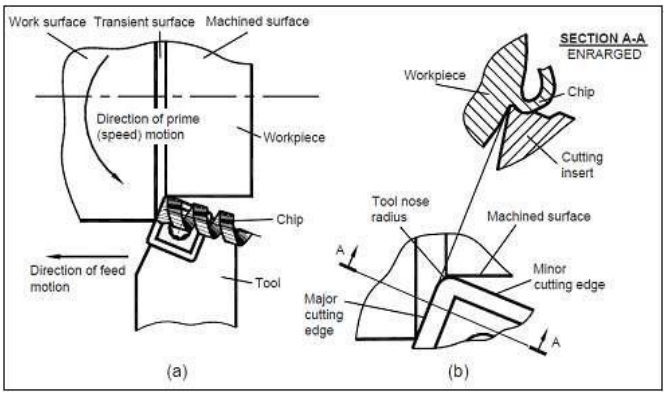

Fig. -1: Turning terminologies

2. METHODOLOGY

The experiments were carried out on a CNC lathe using coated carbide insert . EN 31 alloy steel of 150 mm length and 32 mm diameter was used as work material for experimentation on CNC lathe machine. The chemical composition and mechanical properties of the selected work piece is shown as in table 1 and table 2 respectively.

Table -1: Chemical composition of EN 31 Alloy Steel

C	Mn	Si	Cr	S	P
0.9-1.20	0.3-0.75	0.10-0.35	1.0-1.6	0.04	0.04

Table -2: Mechanical Properties of EN 31 Alloy Steel

Bulk Modulus	Shear Modulus	Elastic modulus	Possion's ratio	Hardness Rockwell
140 GPa	80GPa	190GPa	0.30	20

In this study L9 Taguchi orthogonal array was employed to design the experiments with three factors and three levels. Three input parameters, cutting speed, nose radius and feed rate were considered in the study. Table 3 shows the design factors along with their levels.

Table -3: Factors and Levels

SN	Parameter	Code	Level 1	Level 2	Level 3
1	Cutting Speed(m/min)	A	110	160	210
2	Feed Rate(mm/rev)	B	0.025	0.050	0.075
3	Nose radius(mm)	C	0.4	0.8	1.2

Taguchi's methodology uses signal to noise ratios (S/N ratios) giving the observations and gives information about mean and standard deviation of parameters for finding data from a robust design view point. Depending on the desired output parameter, there are three types of signal to noise ratio the lower-the better, the higher-the-better and the nominal-the-better.

For smaller-the-better type problems:

$$S/N\ Ratio = -10 \log\left\{\frac{1}{n}\Sigma_{1}^{n} Yij^{2}\right\}$$

Here, the main objective of the problem is to minimize the surface roughness. So, the criterion of Smaller-The-Better is adopted for the optimization. A Portable Surface Roughness Tester measuring instrument was used to measure the surface roughness.

Statistical analysis was performed by applying MINITAB 18 software. Table 4 represents Taguchi's L9 orthogonal array along with the results obtained from the experiments corresponding S/N ratios. Main effect plots for S/N ratio means of Surface Roughness have been drawn using Minitab 18 for optimization of parameters.

Table 4: Taguchi's L9 Orthogonal Array with Response Parameters & Respective S/N Ratios

S.N0	A (m/min)	B (mm/rev)	C (mm)	SR (µm)	S/N
1	110	.025	0.4	1.954	-5.81849
2	110	.050	0.8	1.720	-4.71057
3	110	.075	1.2	1.853	-5.35751
4	160	.025	0.8	1.653	-4.36546
5	160	.050	1.2	1.673	-4.46992
6	160	.075	0.4	2.184	-6.78505
7	210	.025	1.2	1.958	-5.83625
8	21O	.050	0.4	1.651	-4.35494
9	210	.075	0.8	2.051	-6.23931

Table 5: Response Table for S/N Ratio (Surface Roughness)

SN	Code	Level 1	Level 2	Level 3	Delta (Max-Min)	Rank
1	A	-5.296	-5.207	-5.477	0.270	3
2	B	-5.340	-4.512	-6.127	1.615	1
3	C	-5.653	-5.105	-5.221	0.548	2

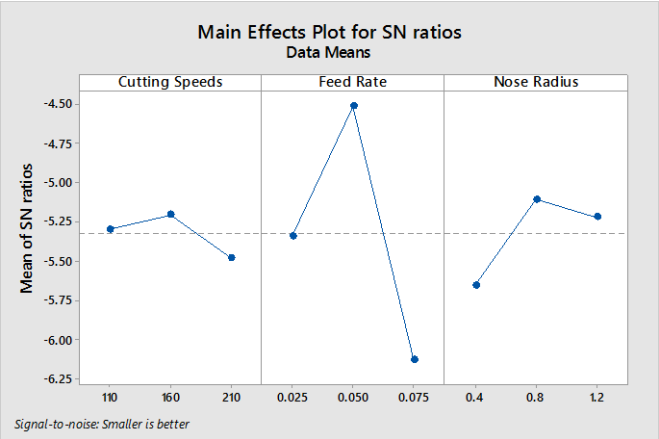

Fig. -2: Main Effect Plot for S/N ratio

The main effects plot is plotted between the S/N ratio and the various considered values of the input parameters hence if the line for a particular parameter is near horizontal, it indicates that the parameter has no significant effect in the selected range of values. This also indicates that the parameter for which the line has the highest inclination will have the most significant effect. In this work, it is very much clear from the main effects plot that the Feed rate and then nose radius had the most significant influence on Surface roughness while parameter A (Cutting Speed) has some or negligible effect.

3. CONCLUSIONS

EN31 high carbon steel has been machined under different cutting conditions to investigate cutting parameter effects of surface roughness in turning operation. The three independent variables (cutting speed, feed rate and tool nose radius) was used to investigate the interaction using taguchi design of experiments.The experimental results show that the feed rate and nose radius are the main parameters that influence the surface roughness in turning of EN31.The optimum combination parameter for the minimum surface roughness is 0.025(mm/rev) feed rate, 0.8(mm) Tool Nose radius and 210(m/min) cutting speed.

REFERENCES

[1] Harsh Y Valera, Sanket N Bhavsar "Experimental Investigation of Surface Roughness and Power Consumption in Turning Operation of EN 31 Alloy Steel" 2nd International Conference on Innovations in Automation and Mechatronics Engineering, ICIAME 2014.

[2] Sayak Mukherjeea, Anurag Kamala, Kaushik Kumar "Optimization of Material Removal Rate During Turning of SAE 1020 Material in CNC Lathe using Taguchi Technique" 12th GLOBAL CONGRESS ON MANUFACTURING AND MANAGEMENT, GCMM 2014.

[3] Deepak D, Rajendra B "Optimization of Machining Parameters for Turning of Al6061 using Robust Design Principle to minimize the surface roughness" International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST- 2015)

[4] P. Jayaraman, L.Mahesh kumar "Multi-response Optimization of Machining Parameters of Turning AA6063 T6 Aluminium Alloy using Grey Relational Analysis in Taguchi Method" 12th GLOBAl CONGRESS ON MANUFACTURING AND MANAGEMENT, GCMM 2014.

[5] Carmita Camposeco-Negrete"Optimization of cutting parameters using Response Surface Method for minimizing energy consumption and maximizing cutting quality in turning of AISI 6061 T6 aluminum" Journal of Cleaner Production xxx (2014).

[6] Md.Maksudul Islam, Sayed Shafayat Hossain "Optimization of Metal Removal Rate for ASTM A48 Grey Cast Iron in Turning Operation Using Taguchi Method" international journal of material science and engineering 2015.

[7] G.M.Sayeed Ahmed, S. Sibghatullah Hussaini Quadri,Md Sadiq Mohiuddin "Optimization of Feed and Radial Force in Turning Process by using Taguchi Design Approach" 4th International Conference on Materials Processing and Characterisation (ICMPC 2015)

[8] R. Deepak Joel Johnson, K. Leo Dev Wins, Anil Raj, B. Anuja Beatrice "Optimization of Cutting Parameters and Fluid Application Parameters during Turning of OHNS Steel" 12th GLOBAL CONGRESS ON MANUFACTURING AND MANAGEMENT, GCMM 2014

[9] Puneet Bansal, Lokesh Upadhyay "Effect of Turning Parameters on Tool Wear, Surface Roughness and Metal Removal Rate of Alumina Reinforced Aluminum Composite" 3rd International Conference on Innovations in Automation and Mechatronics Engineering,ICIAME 2016.

[10] Shreemoy Kumar Nayak, Jatin Kumar Patro, Shailesh Dewangan, Soumya Gangopadhyay "Multi-Objective Optimization of Machining Parameters During DryTurning of AISI 304 Austenitic Stainless Steel Using Grey Relational Analysis" 3rd International Conference on Materials Processing and Characterisation (ICMPC 2014).

[11] Suleyman Neseli, Suleyman Yaldız, Erol Turkes, Optimization of tool geometry parameters for turning operations based on the response surface methodology. Measurement 44 (2011).

[12] S.J. Raykara*, D.M. D'Addonab, A.M. Mane "Multi-objective optimization of high speed turning of Al 7075 using grey relational analysis" 9th CIRP Conference on Intelligent Computation in Manufacturing Engineering.

[13] Sachin C Borse " Analysis of Process Parametrs in Dry Machining of EN-31 steel by Grey Relation Analysis INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING 2015.

[14] M. Kaladhar, Optimization of process parameters in turning of AISI202 austenitic stainless steel. ARPN Journal of Engineering and Applied Sciences VOL. 5, NO. 9, Sep. (2010).

[15] G. Akhyar, Application of Taguchi Method in the Optimization of Turning Parameters for Surface Roughness. International Journal of Science Engineering and Technology Vol. 1, No. 3, (2008).