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Research Paper

Investigating the Effect of Machining Parameters On Tool Life For Turning of En 08

Engineering

KEYWORDS : Taguchi Method, ANOVA, Regression, EN08

Vishal Francis Assistant Professor, Department of Mechanical Engineering, SSET, SHIATS, Allahabad

Sumit k Singh UG Student Mechanical Engineering, SSET, SHIATS, Allahabad

ABSTRACT

The present work focuses on the application of Taguchi technique and Analysis of Variance for investigating the effect of machining parameters such as Depth of cut, Feed and spindle speed on Tool life for machining of EN08. The results obtained were used to find out the main factors affecting the Tool life. Linear regression equation was developed to establish a correlation between the machining parameters and Tool life. Spindle speed was found to be the most influencing factor.

1 Introduction:

Turning is one of the common metal cutting operations used for manufacturing of products. It is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. Turning is used to produce rotational, typically axi-symmetric, parts that have many features, such as holes, grooves, threads, tapers, various diameter steps, and even contoured surfaces. Parts that are fabricated completely through turning often include components that are used in limited quantities, perhaps for prototypes, such as custom designed shafts and fasteners. Turning is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process [1]. Tool life is one of the important issues to be studied as the tool is subjected to wear continuously while it is operating. Obviously after some time when the tool wear is increased considerably, the tool loses its ability to enter efficiently and must be reground. If not, it will totally fail, the tool life can be effectively used as the basis to evaluate the performance of the tool material, assess machinability of the work piece material and know the cutting conditions. In the present work an experimental investigation on turning of EN 08 with a HSS tool is carried out and the effect of cutting parameters on the Tool life is studied.

2 Literature Review:

Selvaraj and Chandramohan (2010) [2] presented the influence of cutting parameters like cutting speed, feed rate and depth of cut on the surface roughness of austenitic stainless steel during dry turning. The present work is concentrated with the dry turning of AISI 304 Austenitic Stainless Steel (ASS). A plan of experiments based on Taguchi's technique has been used to acquire the data. An orthogonal array, the signal to noise (S/N) ratio and the analysis of variance (ANOVA) are employed to investigate the cutting characteristics of AISI 304 austenitic stainless steel bars using TiC and TiCN coated tungsten carbide cutting tool. Finally the confirmation tests that have been carried out to compare the predicted values with the experimental values confirm its effectiveness in the analysis of surface roughness. Kirby (2006) [3] discussed an investigation into optimizing a quality characteristic, while considering productivity, through the use of Taguchi Parameter Design. A turning operation is the subject of this study, and the output parameter selected is surface roughness. today's manufacturers hope to quickly and effectively set up and optimize processes associated with new and existing processes to remain competitive. Engineers and production personnel may utilize various methods and industrial technologies to achieve the optimization of a process to meet the company's needs. Ideally, this takes into consideration productivity, quality, and safety. Previously published studies show the tendency to seek the lowest surface roughness, which usually requires the lowest possible feed rate and therefore a long cutting time. It is demonstrated here that Taguchi Parameter Design can be used to determine the optimal levels of controlled parameters to meet a quality target without sacrificing productivity.

3 Methodology:

Taguchi method uses a special design of orthogonal arrays to study the entire parameter space with only a small number of experiments. This method uses a special set of arrays called orthogonal array. This standard array gives a way of conducting the minimum number of experiments which could give the full information of all the factors that affect the response parameter instead of doing all experiments.

Analysis of variance was invented by Sir Ronald Fisher, who was a Statistician and Geneticist. It is a statistical method of comparing means between groups [4]. It computes the F-statistics, named after the inventor Fisher. The computed F value is compared with the critical F value to determine the significance of the parameters on the response. Variation observed (total) in an experimental attributed to each significant factor or interaction is reflected in percent contribution (P), which shows relative power of factor or interaction to reduce variation

3.1 Materials and Method

A 25 x 150 mm rod of EN 08 was used for the experimental work. Table 1 shows the composition of En08.

Table 1: Composition of En08

EN08	C%	Mn%	Si%	S%	P%	Ni%	Co%
	0.37	0.50	.17	0.04	0.04	0.25	0.25

Turning operation was carried out on lathe machine at Students Workshop of Department of Mechanical Engineering, SHIATS, Allahabad. A HSS tool was used for the experiment. The three process parameters, viz. depth of cut, feed and spindle speeds were varied as shown in table 2.

Table 2: Process parameters and their levels

Process Parameters	Level 1	Level 2	Level 3
Depth of cut (mm)	0.5	0.8	1.0
Feed (mm/rev)	0.015	0.022	0.450
Spindle speed (rpm)	200	328	523

4 Results and Analysis of Experiment

Table 3 shows the values of the responses obtained from the experimental runs, designed by Taguchi method, the corresponding value of S/N Ratio is mentioned for each run. L9 orthogonal array was employed for the experiment.

Table 3: Results for experimental trial runs

Exp. No.	Depth of Cut(mm)	Feed Rate (mm/rev)	Spindle Speed(rpm)	Tool Life (min)	SNR (Signal/ Noise Ratio)
1	0.5	0.015	200	26.55	28.4813
2	0.5	0.022	328	12.38	21.8544
3	0.5	0.450	523	23.10	27.2722
4	0.8	0.015	328	17.45	24.8359
5	0.8	0.022	523	11.85	21.4744
6	0.8	0.450	200	19.45	25.7784
7	1.0	0.015	523	9.30	19.3697
8	1.0	0.022	200	57.88	35.2506
9	1.0	0.450	328	11.53	21.2366

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4.1 Analysis of the S/N Ratio

The S/N Ratio is calculated using larger the better characteristics for Tool life.

$$\frac{S}{N}_{(bigger)} = -10 \log\left(\frac{\Sigma\left(1/y_i^2\right)}{n}\right)$$

Where n is the number of measurement in a trail/row and Yi is the measured value in the run/row.

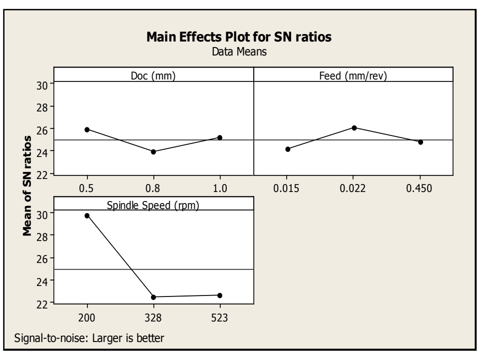
Table 4: Response Table for Signal to Noise Ratios Larger is better

Level	Doc (mm)	Feed (mm/rev)	Spindle Speed (rpm)
1	25.87	24.14	29.77
2	23.89	26.06	22.52
3	25.18	24.74	22.65
Delta	1.98	1.92	7.24
Rank	2	3	1

Table 4 shows the Responses for Signal to Noise ratios of larger the better for each level of the parameters. The difference of S/N Ratio between level 1 and level 3 indicates the effect of the process parameters on the response, greater the difference, greater will be the effect. It indicates that for Tool life the parameter that had the most influence is spindle speed with delta value of (7.24). The optimal cutting parameters found are Depth of cut of 0.5mm, Feed rate of 0.022mm/rev and spindle speed of 200 rpm.

Figure 1 shows the main effect plot for S/N ratio for Tool life.

Figure1 Effect of depth of cut, feed and spindle speed on



Tool life

4.2 Analysis of Variance (ANOVA)

The response data obtained via experimental runs for Tool life were subjected to ANOVA for finding out the significant parameters, at above 95% confidence level and the results of ANOVA thus obtained for the response parameters are illustrated in table 5.

Table 5: ANOVA table for S/N Ratios for Tool life

Source	DF	SS	MS	F	P
Doc (mm)	2	6.08	3.04	0.08	0.930
Feed (mm/rev)	2	5.77	2.89	0.07	0.933
Spindle Speed (rpm)	2	103.23	51.61	1.28	0.438
Error	2	80.35	40.18		
Total	8	195.43			

From table 5 one can observe that spindle speed is the only factor influencing the Tool life, whereas depth of cut and feed rate contributes less towards the Tool life. On comparing the F value obtained in table 5 with the theoretical F value, it was found that none of the factors were significant.

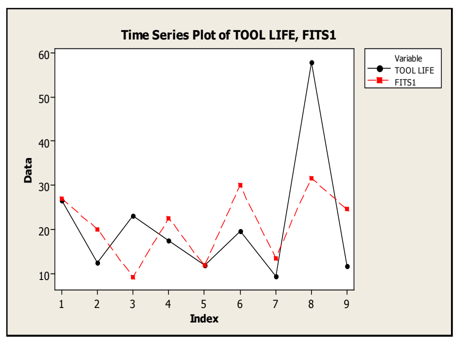
4.3 Regression Analysis

The spindle speed, feed and depth of cut are considered in the development of mathematical model for Tool life. The correlation between the cutting parameters and Tool life is obtained by linear regression; equation 1 shows the developed model.

TOOL LIFE = 33.6 + 9.1 DOC + 14 FEED - 0.0561 SPINDLE SPEED (1)

The predicted and the experimental values of Tool life are shown in figure 2. It is clear from the figure that most of the predicted values (fits 1) are in close agreement with the experimental values for Tool life.

Figure 2: Time series Plot of Tool Life, FITS1



5 Conclusions

The study discusses about the application of Taguchi method and ANOVA to investigate the effect of process parameters on Tool life. From the analysis of the results obtained following conclusion can be drawn: -

- Statistically designed experiments based on Taguchi method are performed using L9 orthogonal array to analyze Tool life. The results obtained from analysis of S/N Ratio and ANOVA were in close agreement.
- Optimal parameters for Tool life are Depth of cut of 0.5mm, Feed rate of 0.022mm/rev and spindle speed of 200 rpm
- Linear regression equation is developed to predict the values of Tool life, and the predicted values are compared with the measured value.

REFERENCE

1 http://www.custompartnet.com/wu/turning. | 2 D. Philip Selvaraj1, P. Chandramohan (2010), optimization of surface roughness of aisi 304 austenitic stainless steel in dry turning operation using Taguchi design method Journal of Engineering Science and Technology,Vol. 5, no. 3 293 – 301, © school of engineering, Taylor's university college. | 3 E. Daniel Kirby (2006), Optimizing surface finish in a turning operation using the Taguchi parameter design method Int J Adv Manuf Technol: 1021–1029. | 4http://www.informatics-review .com/wiki/index.php/ANOVA. | 5 Gulhane U.D., et. al. (2013), "Investigating the effect of machining parameters on surface roughness of 6061 Aluminum Alloy in end milling", International journal of Mechanical Engineering and Technology. Vol.4, issue 2, pp. 134-140. | 6 J.Pradeep Kumar and P.Packiaraj (2012), "Effect of drilling parameters on surface roughness, Tool wear, Material removal Rate and hole diameter error in drilling of OHNS", International Journal of Advanced Engineering Research and Studies. Vol. I/ Issue III/April-June, 2012/150-154. | |