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PARAMETRIC OPTIMIZATION IN TURNING OF AISI 8620 ALLOY STEEL USING COATED INSERTS USING TAGUCHI.

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ABSTRACT

The aim of this research is to investigate the optimization of cutting parameters (cutting speed, feed rate and depth of cut) for surface roughness in turning of AISI 8620 alloy steel using coated cemented carbide insert. Experiments have been carried out based on Taguchi L27 standard orthogonal array design with three process parameters namely cutting speed, feed rate and depth of cut for surface roughness. The objective function has been chosen in relation to surface roughness for quality target. Optimal parameters contribution of the PSG-A141 Lathe machine turning operation was obtained. The analysis of variance is applied to identify the most significant factor.

KEYWORDS : *Surface roughness, Taguchi orthogonal array.*

1.INTRODUCTION :

Lathe machine was used for conducting the experiments. A combination of AISI 8620 was used as the work material and CVD coated cemented cermets' tool was used as the cutting tool. The average surface roughness on the work piece was measured using Mitutoyo surface finish measuring instrument. The experimentation for this work was based on Taguchi's design of experiments (DOE) and orthogonal array. A large number of experiments have to be carried out when the number of the process parameters increases. To solve this task, the Taguchi method uses a special design of orthogonal arrays to study the entire parameter space with a small number of experiments only. In this work, three cutting parameters namely, cutting speed, depth of cut and feed rate were considered for experimentation. Accordingly there are three input parameters and for each parameter three levels were assumed. For a three factors, three level experiment, Taguchi had specified L27 (33) orthogonal array for experimentation (Table 3). The response obtained from the trials conducted as per L27 array experimentation was recorded and further analyzed. The parameters and their levels considered for the experiments.

2. SCHEME OF EXPERMENT FOR INVESTIGATION:

In order to achieve the desired aim, the investigations were planned to be carried out in the following steps:

I.Identifying the machining parameters
II.Selection of the useful limits of the cutting parameters, namely speed(v), feed(f), and depth of cut(d).
III.Developing the design matrix.
IV.Conducting the experiment as per Taguchi design matrix.
V.Testing the significance of regression co-efficient and arriving at the final form of the mathematical models.
VI.Presenting the main effects and the significant interactions between different parameters in graphical forms.
VII.Analysis of results and conclusions

3. TAGUCHI APPROACH:

The objective of the robust design is to find the controllable process parameter settings for which noise or variation has a minimal effect on the product's or processes functional characteristics. It is to be noted that the aim is not to find the parameter settings for the uncontrollable noise variables, but the controllable design variables. To attain this objective, the control parameters, also known as inner array variables, are systematically varied as stipulated by the inner orthogonal array. For each experiment of the inner array, a series of new experiments are conducted by varying the level settings of the uncontrollable noise variables. The level combinations of noise variables are done using the outer orthogonal array. The influence of noise on the performance characteristics can be found using the ratio. Where S is the standard deviation of the performance parameters for each inner array experiment and N is the total number of experiment in the outer orthogonal array.

a) Signal-To-Noise ratio b)Orthogonal arrays.

3.1 Introduction to Signal-To-Noise Ratio:

The signal-to-noise concept is closely related to the robustness of a product design. A Robust Design or product delivers strong 'signal'. It performs its expected function and can cope with variations ("noise"), both internal and external. In signal-to-Noise Ratio, signal represents the desirable value and noise represents the undesirable value.

Advantages:

1.S/N ratios can be used to get closer to a given target value, or to reduce variation in the product's quality characteristic(s).
2.Signal-To-Noise ratio is used to measure controllable factors that can have such a negative effect on the performance of design.
3.They lead to optimum through monotonic function
4.They help improve additives of the effects.

There are 3 Signal-to-Noise ratios of common interest for optimization of Static Problems. The formulae for signal to noise ratio are designed so that an experimenter can always select the largest factor level setting to optimize the quality characteristic of an experiment. Therefore a method of calculating the Signal-To-Noise ratio we had gone for quality characteristic. They are

a) Smaller-The-Better, b) Larger-The-Better, c) Nominal-The-Best.

The Smaller-The-Better

The Signal-To-Noise ratio for the Smaller-The-Better is:
S/N = -10 *log (mean square of the response)

$$S/N = -10\log_{10}\left(\frac{\sum y^2}{n}\right)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(a).$$

The Larger-The-Better

The Signal-To-Noise ratio for the bigger-the-better is:
S/N = -10*log (mean square of the inverse of the response)

$$S/N = -10\log_{10}\left(\frac{1}{n}\sum\frac{1}{y^2}\right)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(b)$$

Nominal-the-Best

The S/N equation for the Nominal-The-Best is:
S/N = 10 * log (the square of the mean divided by the variance)

$$S/N = 10\log_{10}\left(\frac{y^2}{s^2}\right)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(C)$$

3.2 Determine the Quality Characteristic to be optimized

The first step in the Taguchi method is to determine the quality characteristic to be optimized. The quality characteristic is a parameter whose variation has a critical effect on

4. EXPERIMENTAL DETAILS:

4.1. Work Piece Material:

In the present study AISI 8620 steel rods are used for turning on PSG-A141 Lathe machine. The diameter of steel rods was taken 50 mm and length was 300 mm during experiments shown in Fig 2. The work piece material is chosen because of its wide use in automotive industry for ring gears, pinions, helical gears, bearing races, Arbors, bushes, camshafts, kingpins, ratchets, gears, splined shafts etc. Chemical composition of the material is shown in Table 1. The cutting tool selected for machining the AISI 8620 steel is CVD coated carbide inserts designed as CNMG- 120408.

Table 1: chemical composition of AISI 8620

Element	Composition
Fe	96.89-98.02%
C	0.18-0.23%
Si	0.15-0.35%
Mn	0.70-0.90%
S	0.040%
P	0.035%
Cr	0.40-0.60%
Ni	0.40-0.70%
Mo	0.15-0.25%

4.2. Selection of Parameters and Their Levels: In the present study, the experiments plan has three variables of machining, named as cutting speed, feed and depth of cut. The process parameters and their levels are shown in Table.

Table 2: Process parameters and their levels

Level	Speed (s) (rpm)	Feed rate(f) (mm/rev)	Depth of cut(d) (mm)
1	450	0.05	0.10
2	580	0.07	0.20
3	740	0.09	0.30

5.DESIGN OF EXPERIMENT:

Experimental design by full factorial design with three factors and three levels involves 27 numbers of experiments. The degree of freedom is defined as the numbers of comparisons between machining parameters that need to be made to determine, which level is better and specifically how much better it is. As per Taguchi experimental design philosophy a set of three levels assigned to each process parameter has two degrees of freedom (DOF) and OA (Orthogonal Array) to be selected must satisfy the following conditions: D.O.F. of O.A. selected ≥D.O.F. required. The experiment under consideration has 6 D.O.F. and therefore requires an O.A with 8 or more D.O.F.

Table 3. L_{27} orthogonal array

	Column no.												
Trial no.	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	2	2	2	2	2	2	2	2	2
3	1	1	1	1	3	3	3	3	3	3	3	3	3
4	1	2	2	2	1	1	1	2	2	2	3	3	3
5	1	2	2	2	2	2	2	3	3	3	1	1	1
6	1	2	2	2	3	3	3	1	1	1	2	2	2
7	1	3	3	3	1	1	1	3	3	3	2	2	2
8	1	3	3	3	2	2	2	1	1	1	3	3	3
9	1	3	3	3	3	3	3	2	2	2	1	1	1
10	2	1	2	3	1	2	3	1	2	3	1	2	3
11	2	1	2	3	2	3	1	2	3	1	2	3	1
12	2	1	2	3	3	1	2	3	1	2	3	1	2
13	2	2	3	1	1	2	3	2	3	1	3	1	2
14	2	2	3	1	2	3	1	3	1	2	1	2	3
15	2	2	3	1	3	1	2	1	2	3	2	3	1
16	2	3	1	2	1	2	3	3	1	2	2	3	1
17	2	3	1	2	2	3	1	1	2	3	3	1	2
18	2	3	1	2	3	1	2	2	3	1	1	2	3
19	3	1	3	2	1	3	2	1	3	2	1	3	2
20	3	1	3	2	2	1	3	2	1	3	2	1	3
21	3	1	3	2	3	2	1	3	2	1	3	2	1
22	3	2	1	3	1	3	2	2	1	3	3	2	1
23	3	2	1	3	2	1	3	3	2	1	1	3	2
24	3	2	1	3	3	2	1	1	3	2	2	1	3
25	3	3	2	1	1	3	2	3	2	1	2	1	3
26	3	3	2	1	2	1	3	1	3	2	3	2	1
27	3	3	2	1	3	2	1	2	1	3	1	3	2

6. EXPERIMENTAL RESULTS

All the analysis was made by using statistical software. Table 4 displays the Experimental results in terms of process parameters and measured values of surface roughness.

Table 4: Orthogonal array with process parameters

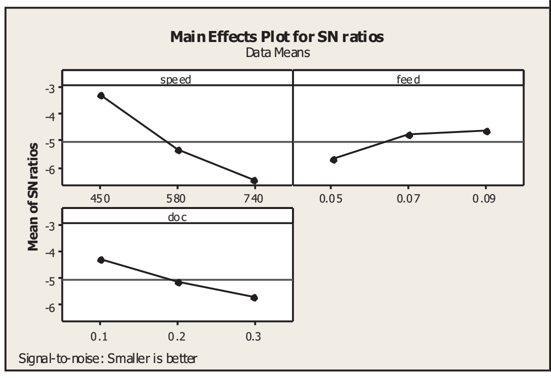
S.No	Speed, s (rpm)	Feed, f (mm/rev)	Depth of cut, d(mm)
1	450	0.05	0.10
2	450	0.05	0.20
3	450	0.05	0.30
4	450	0.07	0.10
5	450	0.07	0.20
6	450	0.07	0.30
7	450	0.09	0.10
8	450	0.09	0.20
9	450	0.09	0.30
10	580	0.05	0.10
11	580	0.05	0.20
12	580	0.05	0.30
13	580	0.07	0.10
14	580	0.07	0.20
15	580	0.07	0.30
16	580	0.09	0.10
17	580	0.09	0.20
18	580	0.09	0.30
19	740	0.05	0.10
20	740	0.05	0.20
21	740	0.05	0.30
22	740	0.07	0.10
23	740	0.07	0.20
24	740	0.07	0.30
25	740	0.09	0.10
26	740	0.09	0.20
27	740	0.09	0.30

Tabl 5: Response table for signal- to –noise ratio for CVD tool [Ra]

Level	Speed(S)	Feed(f)	Depth of Cut(d)
1	-3.277	-5.697	-4.276
2	-5.345	-4.754	-5.092
3	-6.438	-4.608	-5.691
Delta(max-min)	3.161	1.090	1.415
Rank	1	3	2

Table 6: Response Table for means for CVD tool [Ra]

Level	Speed(S)	Feed(f)	Depth of Cut(d)
1	1.473	1.951	1.665
2	1869	1.757	1.825
3	2.116	1.749	1.967
Delta(max-min)	0.643	0.201	0.301
Rank	**1**	**3**	**2**



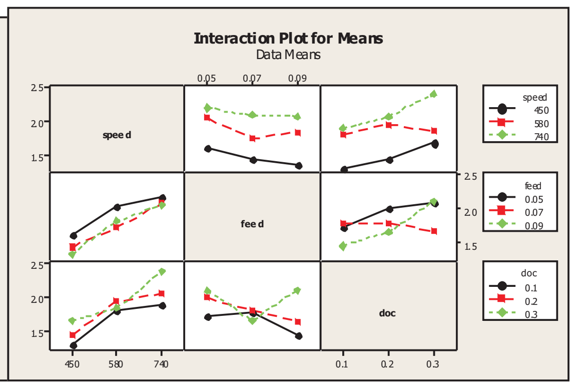
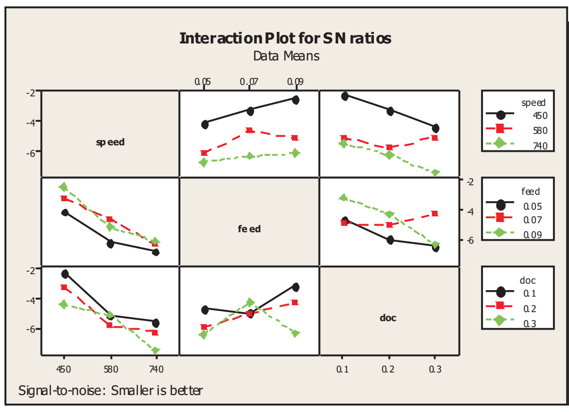


Figure 1: S/N ratio for Surface roughness (Ra) on CVD toolFigure 2: Interaction data means for Surface roughness (Ra) on CVD tool



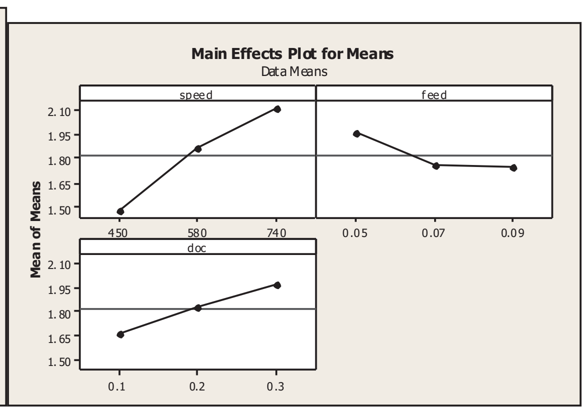


Figure 3: Interaction S/N ratios for Surface Roughness (Ra) on CVD toolFigure

fig 4: Plots of main effects for means for Surface roughness (Ra) on CVD tool

7. RESULT AND DISCUSSION

After identifying the most influential parameters, the last phase is to verify the surface roughness by conducting the confirmation experiments. The S1-F3-D1 is an optimal parameter combination for turning operation. Therefore, from the Fig. the condition [S1-F3-D1] of the optimal process parameters of the turning operation was treated as a confirmation test. If the optimal setting for AISI 8620 steel with cutting speed 450 (m/min), feed rate 0 .09 (mm/rev) and depth of cut 0.10(mm) is used then the final work piece gives the surface roughness 1.128 (µm) is minimum.

8. CONCLUSION:

In the present study, Taguchi optimization technique has been adopted for evaluating parametric complex to carry out acceptable surface roughness the AISI 8620 steel during turning on a PSG-A141 Lathe machine. After identify the optimal process parameters setting for turning operation, in this study it is concluded that the speed is the most significant factor than the feed rate and depth of cut for the surface roughness.

REFERENCES:

[1] Nian C.Y., et al "Optimization of turning operations with multiple performance characteristics", Journal of Materials Processing Technology, Volume 95, 1999, pp. 90-96.

[2] Noordin M.Y., et al "Application of response surface methodology in describing the performance of coated carbide tools when turning AISI 1045 steel", Journal of Materials Processing Technology, Volume 145, 2004, pp. 46−58.

[3] Kirby E. D., et al "Development of a fuzzy-nets-based in-process surface roughness adaptive control system in turning operations", Expert Systems with Applications, Volume 30, 2006, pp. 592−604.

[4] Nalbant M., et al "Application of Taguchi method in the optimization of cutting parameters for surface roughness in turning", Materials and Design, Volume 28, 2007, pp. 1379−1385.

[5] Arya D.M., et al "Parametric optimization of mig process parameters using taguchi and grey taguchi analysis" IJREAS, Volume 3, Issue 6, 2013, pp.1-17.

[6] Ross P.J, Taguchi Techniques for quality engineering second edition, 2005, TMH Publishing, New Delhi.

[7] Lalwani D.I., et al "Experimental investigations of cutting parameters influence on cutting forces and surface roughness in finish hard turning of MDN250 steel", Journal of materials processing technology, Volume 206, 2008, pp. 167−179.

[8] Davim J.P., et al "Investigations into the effect of cutting conditions on surface roughness in turning of free machining steel by ANN models", Journal of materials processing technology, Volume 205, 2008, pp. 16−23.

[9] Asilturk I. and Akkus H., "Determining the effect of cutting parameters on surface roughness in hard turning using the Taguchi method", Measurement, Volume 44, 2011, pp. 1697−1704.

[10] Bartarya G. and Choudhury S.K., "Effect of cutting parameters on cutting force and surface roughness during finish hard turning AISI52100 grade steel", Procedia CIRP, Volume 1, 2012, pp. 651 − 656.

[11] Kumar N. S., et al "Effect of spindle speed and feed rate on surface roughness of Carbon Steels in CNC turning", Procedia Engineering, Volume 38, 2012, pp.691 − 697.