International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org Volume 3 Issue 8 ǁ August 2014 ǁ PP.59-63

"Analysis and Optimization Of Boring Process Parameters By Using Taguchi Method On SAE 1541"

[1,]Mayuresh P Vaishnav , [2,]S A Sonawane
[1,] (Research Scholar Post graduate Student, Mechanical Engineering Department, Government College of Engineering, Aurangabad,Maharashtra,431005)
[2] (Asst. Professor, Mechanical Engineering,Department, Government College of Engineering, Aurangabad,Maharashtra,431005)
Dr. Babasaheb Ambedkar Marathwada University Aurangabad, India

ABSTRACT : *In order to produce any product with desired quality by machining , proper selection of parameter is essential surface an indicator of surface quality is one of the prime customer requirement for machined parts. In this paper Taguchi parameter optimization methodology is applied to optimize cutting parameter as speed, feed and coolant flow for medium carbon steel SAE1541 using regression analysis method. The surface roughness were selected as the quality targets.In this paper two level three factors have selected. The result analysis show that feed rate and cutting speed have present significant contribution on the surface roughness and coolant flow rate have less significant contribution on surface roughness.*

KEYWORDS : *Boring, optimization, Orthogonal L8Array, Cutting speed, feed, coolant flow rate, ANOVA ,Surface Roughness Taguchi Method,*

I. INTRODUCTION

Metal based industry are focused to increase productivity and quality of the machined parts. For these purpose all aspects of every process need to be monitored. Certain desired parameter of a machined parts are chosen and checked against desired degree of a quality.Surface finish is one of these important parameter in a manufacturing. It directly affects performing efficiency of a mechanical parts as well as their production cost. The ratio between cost and quality of a products n each production stage has t be monitored and immediate corrective action have to be taken in case of a deviation from a desired trend.

BORING: For internal machining, Boring is a precision operation. It increases whole diameter and also it gives desired degree of a surface roughness provided that parameters affecting are maintained under control conditions as observed in experimental analysis. This process used after drilling or cast. Boring is a unit process in manufacturing as a mass reduction step, used for enlarging and accurately sized existing hole by means of a single point of a cutting tool with multiple cutting edges Boring is used to achieve greater accuracy of the diameter of the hole and can be used to a cut tapered hole. Boring is done with the conjunction with turning, facing or other machined operation. Because of the limitation on tooling design imposed by the fact the work piece mostly surrounded the tool ,boring is inherently somewhat more challenging than turning. Boring Can be viewed as the internal diameter counterpart to turning ,which cuts external diameter.

II. LITERATURE REVIEW

1) Hardeep Singh, Rajesh Khanna, M.P. Garg [1] (1Dec. 2011) investigated the effects of cutting parameters like spindle speed, feed and depth of cut on surface finish and material removal rate on EN-8. Taguchi methodology wer applied to optimize cutting parameters.In that work, four levels, three factors and sixteen experiments are identified .they used L16 array in that experiment.The results showed that the spindle speed (the most significant factor) contributed 63.90%, depth of cut (second most significant factor) contributed only 11.32% and feed rate contribution was least with 8.33% for Ra. The contribution for feed and RPM was 60.91% and 29.83%.whereas the depth of cut contributed only 7.82% for material removal rate. The experimental results were analyzed using analysis of variance (ANOVA) for identifying the significant factors affecting the performance measures.

2) Y. Zheng H. Li, W. W. Olson, J. W. Sutherland [2](200) Investigated the Sets of dry and wet boring were conducted to estimate the amount of heat transferred into the workpiece and the cutting fluid heat convection coefficient in a boring operation by an inverse heat transfer method. The temperature distribution in that bore is predicted using a heat transfer model that includes heat convection on the inner and outer bore walls. The

developed model was solved by an integral transform approach. The thermal expansion of the bore was calculated using the finite element method (FEM). Surface error due to the cutting forces is also predicted using FEM and added to the thermally induced surface error to give the total surface error. The actual surface error of bores machined under dry and wet cutting conditions are measured and compared with the predicted surface error. Very good agreement between measured and predicted surface errors was observed in that experiment

3) Show-shynlin (2009) investigated the optimization of 6061T6 CNC boring process using the Taguchi method and grey relation analysis. the surface properties of a roughness average roughness and maximum roughness as well as the roundness were selected as to quality targets. Analysis of variance (ANOVA) is also used to analyze the influence of the cutting parameter during machining. The result related that the feed rate is the most influence factor on the average roughness and maximum roughness and the cutting speed is the most influential factor to the roundness. [1]

4) Adel H.Suhail et.al [2010](2) conducted experimental study to optimize the cutting parameter using two performance measure work piece, surface temperature and surface roughness. He has used carbon steel AISI 1020 and its dimension were 250mm long with 50 mm dia. Optimal cutting parameter for each performance were obtained using Taguchi techniques. The orthogonal array, signal to noise ratio and ANOVA were employed to study the performance characteristics in operation. The experimental result showed that the work piece surface temperature can be sensed and used effectively as an indicator to control the cutting performance and improves the optimization process.

III. EXPERIMENTAL SETUP

Medium carbon low alloy steel ASI1541is nothing but the mild steel. It was used as work piece material (Hardness,51-59 HRC).

Table 1: Chemical composition of work-piece component

C	Mn	Si	Cr	Al	Cu	HRC
0.39	1.52	0.205	0.103	0.255	0.155	52-59

Taguchi Method

Taguchi method based design of experiment has been used to study effect of three machining parameters like speed, feed, coolant flow on one important parameter like surface roughness. for selecting appropriate orthogonal arrays, degree of freedom of array is calculated. There are seven degree of freedom owing to three machining input parameters and two levels, so Taguchi based L8 arrays is selected. Accordingly,8 experiment were carried out the study the effect of machining input parameters. Each experiment was repeated three times in order to reduce experimental errors. In all tests, roughness was measured using surface roughness tester made by MITITOYO model no.SJ400.The roughness tester having measuring force 075mN-4mN and Diamond tip 5μm stylus having accuracy ±0.03μm.The probe comes in and out holes while traveling on the surface. The probe is made up of diamond nip which very high in cost

Experimental Conditions

A series of experiments were carried out on Hyundai WIA F500DI (VMC) (Sanjeev Auto). From OVAT analysis three input controlling parameters selected having two levels. Details of parameters and their levels used shown in the table:

Table 2. Machining parameters and their levels

Parameter	Level 1	Level 2
Speed (rpm)	1700	2100
Feed (mm/min)	90	130
Coolant flow (lit/min)	20	60

Experimental Procedure

High performance HYNDAI WIA f 500D CNC Milling machine (working space, X, Y and Z movements being 600×460×570 mm) variable spindle speeds, optimum 8000 rpm; main spindle power,14.7 kw having table size 700×500mm was employed to perform experiments for boring rough bar.cutting fluid IPOL cut 140AS has density 0.88 at15°C

IV. RESULTS AND ANALYSIS

Experimental design matrix of L8 Orthogonal Array by Minitab 14 A table is got after actual experimentation, showing Ra values and S/N ratios for each trials. Table is given below:

Table 3 Response table for Ra

SPEED	FEED	COOLANT FLOW RATE	Ra	S/N Ratio
1700	90	20	0.77	2.2710
1700	90	60	0.87	1.2096
1700	130	20	0.98	0.1754
1700	130	60	1.36	-2.6707
2100	90	20	0.54	5.3521
2100	90	60	0.62	4.1521
2100	130	20	0.78	2.1581
2100	130	60	0.89	1.0121

Table 4 & 5 Analysis of Variance for Means and S/N ratio

Source	DF	Seq SS	Adj SS	F	P	Source	DF	Seq SS	Adj SS	F	P
Speed	1	17.706	17.706	69.00	0.001	Speed	**1**	**0.17111**	**0.17111**	**23.34**	**0.011**
Feed	1	18.294	18.294	71.29	0.001	Feed	**1**	**0.17701**	**0.17701**	**21.04**	**0.010**
CF	1	5.223	5.223	20.35	0.011	CF	**1**	**0.05951**	**0.05951**	**7.07**	**0.056**
Error	4	1.026	1.026			Error	**4**	**0.03365**	**0.03365**		
Total	7	42.249				Total	7	0.44129			

S = 0.506560 R-Sq = 97.57% R-Sq(adj) = 95.75% S = 0.0917197 R-Sq = 92.37% R- Sq(adj) = 86.6

In table 5 Analysis of Variances had been done (ANOVA) and it reflects that the value P is less than 0.05 in all three parametric sources. Therefore it is clear that all three parameters have significant effect on the surface roughness while boring.

Table 6&7 Response Table for Means (smaller is better) for Ra and S/N ratio

Level	Speed	Feed	CF	Level	Speed	Feed	CF
1	0.9975	0.7025	0.7650	1	02213	3.2212	2.5170
2	0.7050	1.000	0.9375	2	3.1967	0.1968	0.9010
Delta	0.2925	0.2975	0.1725	Delta	2.9754	3.0244	1.6160
Rank	2	1	3	Rank	2	1	3

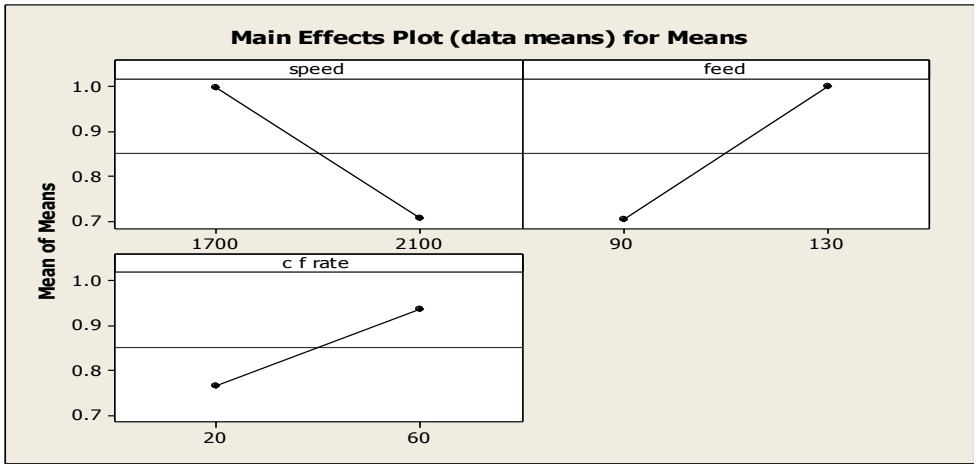

Fig1.main effect plot for Ra

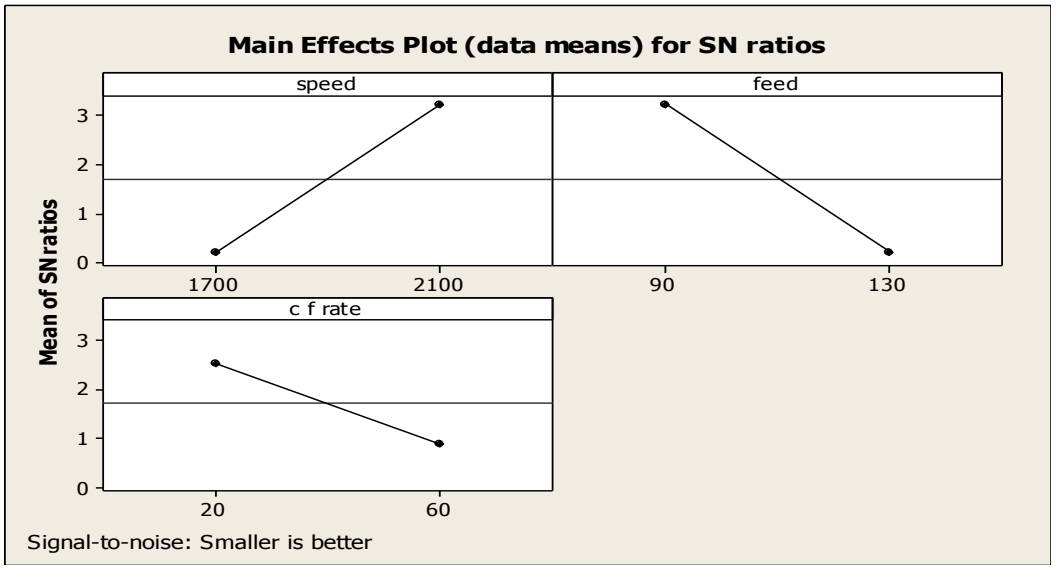

Fig.2 Main effects plot for S/N ratios

It is clear form main effect plot as shown in figure 1 that surface roughness is increasing with increasing in speed from 1700 rpm to 2100 rpm. Similarly in the case of feed rate we will get the minimum surface roughness value at 90mm/min. Minimum value of surface roughness lies at 20 liter/min.

Taguchi statics for Ra : Firstly data has checked for its normality by probability plot (see figure). As data points are distributed all along the normal line and having negligible outliers, so data can be concluded as normally distributed. The second plot doesn't show any trend while plotting residual verses fitted value of data which implies Taguchi model chosen is well fitted with given data set. Third plot is frequency histogram showing data distribution and at last residue verses order plot highlights the random data points which signifies non-significance of experimental order as far as first response (Ra) is concerned.

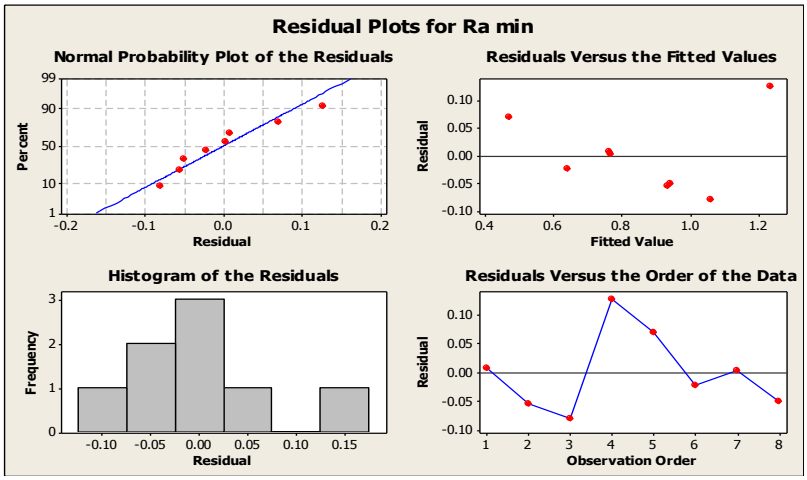

Fig.3 Residual plot for Ra mean

Confirmation Test

Table 8 Confirmation Test

Sr no.	Pre. Ra mean	Exp. Trial 1	Exp. Trial 2	Exp. Trial 3	Exp. Ra mean	% Error
1	0.762	0.77	0.79	0.78	0.776	1.84

V. CONCLUSION

This study discussed an application of the Taguchi method of optimizing the cutting parameters of boring operation. from this research, following conclusion could be reached with a fair amount of confidence.

[1] It is observed that cutting speed, feed has significant effect on surface roughness.
[2] Coolant flow rate is the least significant parameter on surface roughness.
[3] Feed is the most significant parameter on surface roughness.
[4] The result of present investigation is valid within specified range of process parameters.
[5] Also the prediction made by Regression Analysis is in good agreement with Confirmation results.
[6] For better surface finish i.e low roughness value (Ra), higher cutting speed, lower feed rate and low coolant flow rate is essential for work piece of SAE 1541or medium carbon steel.

REFERENCES

[1] Hardeep Singh, Rajesh Khanna, M.P. Garg, Effect of Cutting Parameters on MRR and Surface Roughness in Turning EN-8, Research Article Current Trends in Engineering Research Vol.1, No.1 (Dec. 2011)
[2] Y. Zheng H. Li, W.W.Olson, J. W. Sutherland, Evaluating Cutting Fluid Effects on Cylinder Boring Surface Errors by Inverse Heat Transfer and Finite Element Methods, Journal of Manufacturing Science and Engineering AUGUST 2000, Vol. 122 Õ 377
[3] Show-Shyn Lin, Ming-Tsan Chaung, Jeoung-Lian Wen, and Yung-Kaung Yang "Optimization of 6061T6 CNC Boring Process Using the Taguchi Method and Grey Relation Analysis' The Open Industrial and Manufacturing Engineering, Journal,2009, 2, 14-20
[4] Adeel H. Suhail, N. Ismail, S.V.Wong and N.A. Abdul Jalil "Optimization of Cutting Parameters Based on Surface Roughness and Assistance ofWorkpiece Surface Temperature in turning process" American Journal of Engineering and Applied Sciences 3 (1),pp 102-108,2010
[5] Harimansinghsodhi, DhirajPrakashDhiman, Ramesh Kumar Gupta, Raminder Singh Bhatia " Investigation of Cutting Parameters For Surface Roughness of Mild Steel In Boring Process Using Taguchi Method" International Journal OF Applied Engineering Research, ISSN 0973-4562 Vol.7 No.119 (2012)
[6] GauravVohra, Palwinder Singh, Harimansinghsodhi " Analysis and Optimization of Boring Parameters By Using Taguchi Method" International Journal of Computer Science and Communication Engineering, ISSN 2319-7080, NCRAET-2013
[7] Parvesh Kumar Rajvanshi, Dr. R.M. Belokar "Improving the Process Capability of a Boring Operation by Application of Statistical Techniques' International Journal of Scientific and Engineering Research Volume 3, ISSN 2223-5518, 5 May-2012.
[8] M G Mehrabi, G O Neal, B-K Min, Z.Pasek and Y.Koren "Improving Machining Accuracy in Precision Line Boring" Journal of Intelligent Manufacturing,13, 379-389, 2002
[9] Rang-Tai Yang, Hsin-Te-Ligo, Yung-Kaung Yang, Show-Shyn Lin " Modeling and Optimization in Precise Boring Processes For Aluminum Alloy 6061T6 Component "International Journal of Precision Engineering and Manufacturing, Vol 13, No.1, PP 11-16, Jan 2012