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Experimental investigation of Machining Parameters in dry turning Using CNMG Insert.

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ABSTRACT

Increasing productivity and quality of the machined parts in terms of surface finishing are the main challenges in metal cutting industries. In this experiment we use Response Surface Methodology (RSM) is used for experimental investigation of surface roughness (Ra) in dry single point turning of high carbon high chromium (D2) steel using CNMG120408 PVD Coated carbide insert is selected based on recommendation from industry experts. Three different cutting parameters are used in this experiment such as Speed, Feed rate and Depth of cut where each of the other parameter was taken as a constant. To designed the experiment RSM method is to carried out. Analysis of variance (ANOVA) was performed to identify to significant parameters for formability.

Keywords: ***Analysis of variance (ANOVA),D2 steel,Response Surface Methodology (RSM),Surface Roughness.***

1. INTRODUCTION

In industry machining is one of the most important processes, it consists of separating a layer of material from the workpiece to obtain a machined part in required geometry (shape, size and dimension) the required thing is quality of surface finish by having a relative motion between tool and workpiece. Machining is known as semi-finishing, finishing process or roughening depends on requirement, surface finish and accuracy. In this study the Surface Roughnesswas selected as an output parameter in the turning operation. As we have discussed about mashing process, there are two main points, such as high production rate and minimize the surface roughness. The production rate is increases it can help to reduce the production costs and time consumption. Therefore, the machine tool operators would not push the cutting tool its limit, but the high production rate may increase the surface roughness. So, it will be important to explain the relationship between Surface Roughness. In the present research paper, High Carbon High Chromium (HCHC) material is use due to its popularity in the industry. HCHC material contain high tensile strength and high wear resistance which are mostly used for drawing dies, blanking dies, forming dies and different gauges, etc. for the machining of HCHC steels the cutting tool

materials must be harden than workpiece materials. This material can be machined with carbide tool. Few works have been done on this material on minimum quality lubrication as well as dry turning and flooded. In this paper we work on dry turning to find out the best possible regression equation for this hard material to reduce the value surface roughness as per the customer satisfaction. Surface roughness affect functional performance of mechanical parts (wear resistance fatigue strength, heat generation, and corrosion resistance). To achieve perfect surface quality in turning could not be possible even in the absence of irregularities and deficiencies of the cutting process.

Fig.1: CNC Lathe

2. LITERATURE REVIEW

A. Mohanty,(1) has done experimental investigation with MRR, Ra and microstructure in electrochemical machining on Inconel 825. For calculating the optimal value of Ra and MRR Taguchi method was used and also compare the result to ANOVA. A Thakur, (2) Investigated the machining performance of chip morphology, chip thickness ratio, tool wear, surface and sub surface integrity in dry turning of Inconel 825 material. For that the machining parameter can be selected as speed, feed and depth of cut. R.R Deshmukh, (3) attempt has been done to optimize input parameter cutting velocity, feed rate, and depth of cut. And the output parameter is surface roughness. The genetic algorithm was use in this research to get the optimum solution. N. G. Phafat (4) the researcher has studied effect of minimum quantity lubrication (MQL) on cutting velocity, feed rate and depth of cut. For this research AISI H-13 material was used. The Genetic algorithm was used to optimize the surface roughness in MQL. The aerosol spray gun is used to apply the lubrication during the machining. R.R. Deshmukh, (5) in this research the author discuss problem aboutsurface roughness while machining of hard material by using Taguchi L9orthogonal array approach. The result also compares to regression analysis and ANOVA. from the result the researcher was conclude that the speed has maximum effect and feed has minimum. V.R. Kagade (6) main objective of this research was to discuss the effect of machining parameter (Speed, Feed, Depth of cut) on surface roughness. From this parameter author conclude that the speed has

maximum effect and depth of cut has minimum effect at high speed surface roughness is least affected. For this research the author approaches the Taguchi orthogonal aaray was used to perform the experiment. V. Bushlya, (7) objective of this paper to identification and characteristics of white layer generated in turning of super alloy like Inconel718. the author concludes that the three possible reasons for formation of white layer; phase transformation due to rapid heating and cooling, grain refinement due to sever plastic deformation and reaction of the surface with environment, the study also clear that the white layer was registered only for worn out tools. During dry machining, white layer was not found under new tool conditions. Increases in the cutting speed under semi worm conditions lead to transformation of white layer.Jinming Zhou (8),has studied the surface quality in high speed turning of Inconel 718 alloy with uncoated and coated CBNInsert. In this paper the machining parameter was consider are cutting speed, feed rate and depth of cut and output parameter is surface quality, tool wear rate and metalab graphic analysis of surface layer. Form the result the author was conclude that the coated insert life was increases 20% than uncoated insert. M. Kaladhar (9), this paper deals with the machining parameter in turning of AISI 202 austenitic stainless-steel using CVD coated cemented carbide insert. The above experiment author able to conclude that to obtain a good surface finish of AISI 202 steel higher cutting speed, lower feed rate and depth of cut and higher nose radius are preferred. R.R. Deshmukh (10), this paper deals with performance of the tool in the turning with minimum fluid application by keeping speed, feed and depth of cut are constant and varying the MQL parameter like coolant pressure, angle of impingement and spot distance for supplying lubrication aerosol spray was used. The experiment was designed by central composite method and result obtain which can be analyzed by ANOVA.R.T. Coetho (11) the objective of this paper to evaluate the performance of same insert subjected to modifications on the edge geometry. During turning at high speed, a nickel-based alloy, like Inconel 718. For that research the author compares the three different tools are used and compare its result with output parameter.

3. EXPERIMENTAL DETAILS

3.1 Workpiece

HCHC steel having a size of 40mm in diameter and length is 70mm is use for this research. The following table shows the chemical composition of HCHC steel.

Table1

Chemical Content	C	Mn	Cr	Ni	Mo	S	P	Si	V
Composition in %	1.40	0.25	11.80	-	0.90	0.020	0.022	0.20	0.80

3.2 Cutting insert

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CNMG 120408:C- Insert Shape (Rhombus), N- Clearance or relief angle, M- Tolerance, G- insert type**,** 12-Insert size, 04-Insert thickness, 08-Nose radius.

Table2:Technical Specification of insert CNMG 120408 (Make - Sandvik)

Insert thickness	Nose radius	No of cutting edges	Coating	Substrate	Insert shape & size	Mounting circle diameter
0.188 inch	0.8mm	4	CVD	Carbide hard cutting	12mm Rhombus	0.5 inch

3.3 Measurement Procedure

In fig 2, Surface Roughness (Ra) tester is shown. To be good predictor of the performance of mechanical components after mating. It can be measures average roughness as irregularities exist on the surface by comparing all the peaks and valleys from the mean line and then averaging them all over the entire cut-off length. Cut-off length is the length that stylus is dragged across the surface. The longer cut-off length will be able to give a more average value and a shorter cut-off length will be able to give a less accurate result over a shorter stretch of surface.

Fig.2: Mitutoyo SURFTEST SJ410

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3.4 Experimental Design:

Response Surface methodology is used to design experimentation. RSM experimentation method used two or more factors each with discrete possible values or "levels" and whose experimental units take on all possible combinations of these levels across all such factors. Such an experiment allows the investigator to study the effect of each factor on the response variables, and the effects of interactions between input parameters on the output parameters.

4.RESULTS AND DISCUSSION

The results of performance measures surface roughnessfor 20 experimental trials of CNC lathe machine show in Table 4. Response Surface Methodology (RSM) is use to study the effect of input parameters (Speed, feed and depth of cut) on output parameter (Surface Roughness).

Analysis of variance (ANOVA) was used to identify the significant parameters so as to reduce process variability by using minitab-18 software which is shown in table 3.Table 4 shows the ANOVA for Surface Roughness. From ANOVA table it is clear that the Depth of cut has the most significant factor. The value of P for significant factor was less than 0.005 for 95% confidence level. So, the small variation in depth of cut will be of great influence on process performance.

Table 3 Experimentation Layout of RSM and measured values

Run Order	Speed	Feed	DOC	Ra	Run Order	Speed	Feed	DOC	Ra
1	2000	0.2	0.8	2.2	11	2000	0.15	0.8	1.9
2	2500	0.1	0.4	1.1	12	1500	0.1	1.2	3.2
3	1500	0.1	0.4	1.3	13	2000	0.15	1.2	2.9
4	2500	0.1	1.2	3	14	2000	0.1	0.8	1.8
5	1500	0.2	0.4	1.2	15	2000	0.15	0.4	1.3
6	2500	0.15	0.8	1.6	16	2000	0.15	0.8	1.9
7	2000	0.15	0.8	2.2	17	1500	0.15	0.8	1.6
8	2000	0.15	0.8	2.1	18	2500	0.2	0.4	1.4
9	2000	0.15	0.8	2.1	19	2000	0.15	0.8	2.3
10	1500	0.2	1.2	3.4	20	2500	0.2	1.2	3.3

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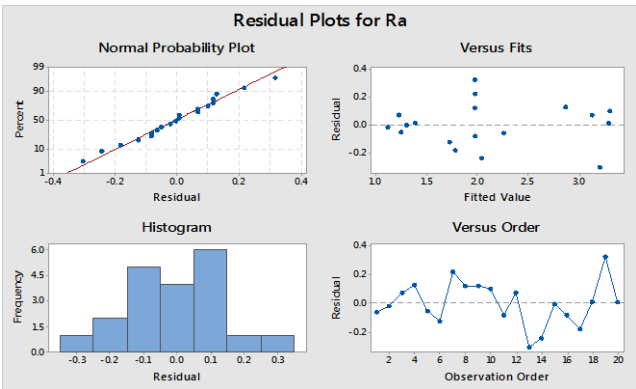
Table 4: Analysis of variance for Surface Roughness

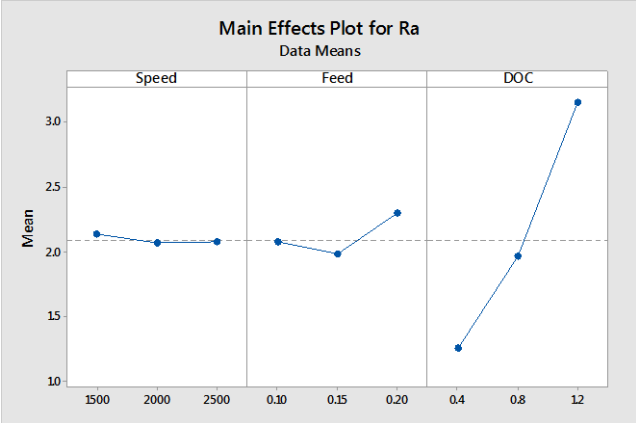
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Speed	1	0.0090	0.00900	0.21	0.659
Feed	1	0.1210	0.12100	2.78	0.126
DOC	1	9.0250	9.02500	207.61	0.000
Speed*Speed	1	0.1420	0.14205	3.27	0.101
Feed*Feed	1	0.0820	0.08205	1.89	0.200
DOC*DOC	1	0.2045	0.20455	4.71	0.055
Speed*Feed	1	0.0312	0.03125	0.72	0.416
Speed*DOC	1	0.0112	0.01125	0.26	0.622
Feed*DOC	1	0.0112	0.01125	0.26	0.622
Error	10	0.4347	0.04347		
Total	19	10.0980			



Graph 1 Residual Plots for Surface Roughness (Ra)

The four-in-one residual plot for formability is shown in graph 1. Normal probability plot shows that the points approximately form a straight line and so the residuals are normally distributed.The histogram of residuals is to determine whether the data are skewed or whether outliers exist in the data.

Graph 2 shows the experimental results using MINITAB18, signifies that surface roughness increases with increases in depth of cut. Surface roughness first increases and then decreases with increases in speed.



Graph 2 Main effect plot for Surface Roughness

The values of R-sq 95.70%, R-sq(adj) 91.81%, R-sq(pred) 80.76% are obtained.

Regression equation for Surface Roughness

Regression coefficients of the second order equation are obtained by using experimental data. The regression equation for the Surface Roughness as function of three input parameters (speed, feed and depth of cut) was developed and is shown below.

Ra = -0.44 + 0.00335 Speed - 25.0 Feed - 0.26 DOC - 0.000001 Speed*Speed + 69.1 Feed*Feed

+ 1.705 DOC*DOC + 0.00250 Speed*Feed - 0.000187 Speed*DOC + 1.87 Feed*DOC

5.CONCLUSION

In the present research the machining characteristics on surface roughness during turning of high carbon high chromium steel were studied. From the above result following conclusion can be found from that study,
The cutting parameter affecting the surface roughness for D2 steel, speed has maximum effect than depth of cut. At high speed surface roughness is least affected where at low speed surface roughness is more affected.

The future scope for future development of this experimental investigation is: -

1) Scope available for Cryogenic Treatment can be apply on the same insert to mashing of hard material and compare it.

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