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Optimization of Machining Parameters in Turning Operation of Bronze Metal for Surface Temperature

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Abstract

In most of the production industries mostly the numbers of components are manufactured by the metal removal turning. Now due to this metal removal a high temperature at the surface of the metal occurs due to which it affects the properties of the material. So the objective of the paper is to optimization of machining parameters in turning operation of bronze metal for surface temperature. On the basis of observations from the pilot experiments three values of Cutting speed 220,330,440, three values of feed 1, 1.5, 2 and three values of Depth of cut 1, 2, 3 were chosen. L9 orthogonal array performed using these values. It is concluded that for Temperature to be minimum Cutting speed has to be at high level 3, Feed has to be at high level 3 & D.O.C has to be at level 1.

Keywords: *Turning, Surface Temperature, Taguchi, Orthogonal Array, Signal to noise ratio*

1. Introduction

In most of the production industries mostly the numbers of components are manufactured by the metal removal turning. Now due to this metal removal a high temperature at the surface of the metal occurs due to which it affects the properties of the material. So the objective of the paper is to optimization of machining parameters in turning operation of bronze metal for surface temperature.

1.1 Factors In turning process

The primary main parameters in any basic turning operation are: Speed, Feed, and Depth of cut.

There are numbers of other factors which are responsible for the surface temperature. But due to number of limitation we are here optimizing with three primary parameters to control or minimize the surface temperature while machining the bronze metal. So that there will not be much reduction in the mechanical properties of the material.

Kirby et al. (2004) [1] developed the gauge appear for the surface cruelty in turning task. The backslide indicate was made by a singular parameter court and vibration along three tomahawks were chosen for the system desire of surface brutality. Using distinctive backslide examination of contrast and a strong direct association between the parameters (sustain speed and vibration) response (surface disagreeableness) was found. The makers gathered that the speed and significance of cut of the head that does not by any stretch of the imagination should be made due with fruitful estimate model of surface cruelty. Luo et al. (2005) [02] drove speculative and exploratory examinations to look into the common association between instrument flank wear and working conditions in metal cutting methods using carbide cutting supplements. Mate and Chakraborty (2005) [03] concentrated to develop a model of neural framework back-causing for gauge of surface brutality in turning activity and is used smooth steel workpieces with fast steel as the evacuating gadget to pass on different tests. Sing and Kumar (2006) [04] considered the streamlining of the support oblige through perfect change of process parameters to be particular speed, reinforce and significance of cut in steel getting ready with carbide implants EN24 TiC secured tungsten. Ahmed (2006) [05] developed the logic for getting the perfect system parameters for desire of surface obnoxiousness in turning.

Al. Kumanan et al. (2006) [06] proposed an approach for anticipating the machining powers using multilayer perceptron arranged by inherited computation (GA). The data obtained from test eventual outcomes of a turning strategy is explored to get ready fake neural frameworks proposed (RNAs) with three commitments for yield machining powers. ANN perfect weights were gotten using GA look. This creamer limit supplanting made of GA and ANN found computationally successful and correct to foresee the forces of machining for the machining conditions of section. Mahmoud and Abdelkarim (2006) [07] considered in turning activity using quick steel (HSS) cutting contraption 450 at an edge of approach. This instrument showed he could finish the cutting task at higher rates and longer organization life of the standard gadget with a rake purpose of 90 degrees. The examination in the long run chooses the perfect cutting rate for high creation speed and minimum cost and instrument, age time and working costs. Kassab and Khoshnaw (2007) [08] assessed the association between's surface obnoxiousness and vibration cutting instrument for turning activities. The strategy parameters were cutting pace, significance of cut, empower rate and remarkable contraption. The trials were finished on the machine turning using dry (without cutting fluid) task of medium carbon steel with different levels of process parameters determined already.Harjit Singh, Harish Garg and Ajay Kumar(2016)[09] Turning of Hybrid aluminium Metal matrix composites (HMMC) CNC lathe using response surface methodology (RSM).When tool insert directly affect our response variable, tool insert has a maximum material removal rate (MRR) and minimum surface roughness (SR).

3. Methodology

The steps covered in Methodology are as follows:

Determine the quality characteristic to be Identify the noise factors and test conditions.

Identify the control parameters and their concerned levels.

Design the matrix designing as per the Taguchi Orthogonal array.

Conducting the experiments as per the matrix

Analyze the observations and determine the optimum levels for control factors.

4. Results and Discussions

4.1 Calculation of Temperature

Table 4.1: Calculation of Temperature

Sr. No.	Cutting Speed (RPM)	Feed	Depth of Cut (mm)	Temp.	SNRA1	MEAN1
1	440	1	1	30.9	-29.7992	30.9
2	440	1.5	2	31.5	-29.9662	31.5
3	440	2	3	30.3	-29.6289	30.3
4	220	1	2	32.7	-30.291	32.7
5	220	1.5	3	37.8	-31.5498	37.8
6	220	2	1	31.1	-29.8552	31.1
7	330	1	3	44.7	-33.0062	44.7
8	330	1.5	1	32.6	-30.2644	32.6
9	330	2	2	36.3	-31.1981	36.3

4.2 Linear Model Analysis for Surface Temp

Table 4.2: Surface Temp. Response Table for Signal to Noise Ratios

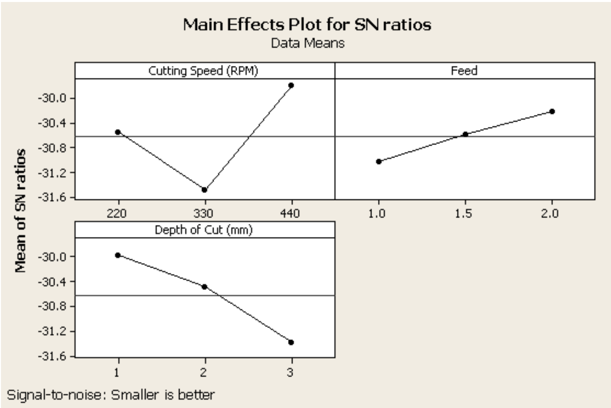
Smaller is better

Level	Cutting Speed(RPM)	Feed	Depth Of Cut(mm)
1	-30.57	-31.30	-29.97
2	-31.49	-30.59	-30.49
3	-29.80	-30.23	-31.39
Delta	1.69	0.80	1.42
Rank	1	3	2

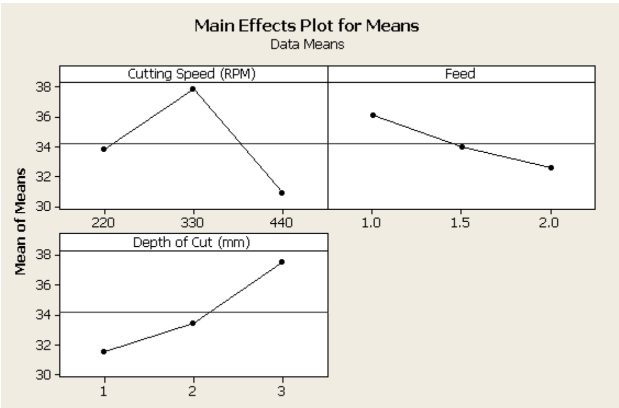
Table 4.3: Surface Temp. Response Table for Means

Level	Cutting Speed(RPM)	Feed	Depth Of Cut(mm)
1	33.87	36.10	31.53
2	37.87	33.97	33.50
3	30.90	32.57	37.60
Delta	6.97	3.53	6.07
Rank	1	3	2

The main effects plots are used to determine the optimal design conditions to obtain the optimum Surface Temp. Main effects plots for Surface Temp. here are plotted between 1 Surface Temp. V/s Cutting speed. 2. Surface Temp V/s Feed. 3. Surface Temp V/s Depth of cut.



Graph 4.1 Main effects of Plot for S/N Ratio Surface Temperature



Graph 4.2 Main effects of Plot for Means of Surface Temperature

The effect of each parameter on the Surface Temp. is plotted on the graph in form of lines from the figure 4.3 main effects plot for S/N ratios it can be clearly seen that the temperature is minimum at the second level of cutting speed, third level of Depth of cut & at first level of feed.

Table 4.3: Analysis of Variance of Surface Temp. for SN ratios

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Cutting Speed (RPM)	2	4.3039	4.3039	2.1520	3.06	0.246
Feed	2	0.9739	0.9739	0.4870	0.69	0.591
Depth of Cut (mm)	2	3.1123	3.1123	1.5562	2.21	0.311
Residual Error	2	1.4055	1.4055	0.7028		
Total	8	9.7957				

Table 4.4: Analysis of Variance of Surface Temp. for Means

Source	DF	Seq SS	Adj	MS	F	P
Cutting Speed (RPM)	2	73.34	73.34	36.668	2.86	0.259
Feed	2	19.00	19.00	9.498	0.74	0.574
Depth of Cut (mm)	2	57.48	57.48	28.741	2.24	0.308
Residual Error	2	25.62	25.62	12.808		
Total	8	175.43				

Conclusions

It is concluded that for Temperature to be minimum Cutting speed has to be at high level 3, Feed has to be at high level 3 & D.O.C has to be at level 1. As shown in table below.

Table Optimal combination for Temperature

Physical	Optimal Combination		
Requirements	C.S	F	D.O.C
Minimum. Temp.	440	2	1
	Level-3	Level-3	Level-1

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