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EVALUATION THE EFFECT OF MACHINING PARAMETERS ON SURFACE TEMPERATURE OF MILD STEEL

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Abstract

Turning is the removal of metal outside diameter of a rotating cylindrical workpiece. As it is used to reduce the diameter of the work piece in the form of chips formation. The optimization problem that seeks to identify the best process conditions or parametric combination to the manufacturing process, so in this study, the effects of different cutting parameters are studied in the cutting temperature of mild steel. In the beginning of D.O.E phase, pilot experiments will be performed for preliminary study. The various parameters, their ranges and levels will be selected based on results of the pilot study. Suitable Technique for orthogonal arrays will be used for design of experiments after the pilot experiments. Based on the findings study, experimentation work are designed and input machining parameters and their values finalized. The results are expected to show that the response variables (output parameters) strongly influenced by the control factors (input parameters). So, the results which are obtained after experimentation analyzed and modeled for their application in manufacturing industry. It is concluded that for Temperature to be minimum Cutting speed has to be at high level, Feed has to be at high level 3 & D.O.C has to be at high level.

Key Words: Taguchi Design, Orthogonal Array, Turning, cutting speed, feed.

1. Introduction

The first lathe machine that was developed was the two-person lathe machine which was designed by the Egypt in about 1300 BC. Primarily, there are two things that are achieved in this lathe machine tool. The first is the turning of the wood working piece manually by a rope; and the second is the cutting of shapes in the wood by the use of a sharp cutting tool., there have been constant modifications and improvements over the two-person lathe machine, most importantly on the production of the rotary motion. **P. Zhou et al. (1995) [1]** investigated in tool life in turning raw. A new criterion-life of the tool based on a pattern recognition technique was proposed and neural network techniques were used to make the new criteria. The experimental results showed that this approach was applied to condition monitoring of the tool in a wide range of cutting conditions. **Lin et al. (2001) [2]** abdicative adopted a network to build a model of surface roughness and shear force. Once the process parameters: cutting speed, feed rate and cutting depth are given; surface roughness and cutting force could be predicted by the network. Regression analysis was also adopted as a second predictive model for the surface roughness and the cutting force. The comparison was made on the findings of both models. **Feng and Wang (2002) [3]** investigated for predicting surface roughness in finish turning operation by developing an empirical model by considering parameters: I piecework hardness (materials), food, cutting tip angle tool, cutting depth and cutting time. Data mining techniques were used with logarithmic transformation of data to develop an empirical model to predict surface roughness. **Suresh et al. (2002) [4]** focused on the machining of mild steel cutting tools tungsten carbide coated with TiN to develop a prediction model of surface roughness It was observed that GA program provided maximum values of surface roughness conditions of minimum and optimal machining. **Lee and Chen (2003) [5]** highlighted in artificial neural networks using a detection technique to control the effect of the vibration produced by the movement of the workpiece and cutting tool during the cutting process developed a recognition system Online surface. The authors use triaxial accelerometer to determine the direction of vibration significantly affecting surface roughness then analyzed using a statistical method and accuracy compared both ANN and SMR. **Choudhury and Bartarya (2003) [6]** focused on the design of experiments and the neural network for prediction of tool wear. The input parameters were cutting speed, feed and depth of cut; flank wear, surface finish and temperature were selected as outputs. Empirical relationship between different answers and the input variables and also through neural network program helped predictions for the three response variables and the method was best for the prediction is compared. **Chien and Tsai (2003) [7]** developed a model for predicting the tool flank wear followed by an optimization model for the determination of optimum cutting conditions PH stainless steel machining. The back-propagation neural network was used to build the predictive model. The genetic algorithm was used to optimize the model. **Kirby et al. (2004) [8]** developed the prediction model for the surface roughness in turning operation. The authors concluded that the speed and depth of cut of the head that does not necessarily have to be fixed for effective prediction model of surface roughness. **Ozel and Karpat (2005) [9]** studied for prediction of surface roughness and tool flank wear by using the neural network model compared to the regression model. Established measurement data of the surface roughness and tool flank wear to train the neural network models were used. Predictive neural network models to be able to better predictions of surface roughness and tool flank wear within the range of each were trained found. **Luo et al. (2005) [10]** conducted theoretical and experimental studies to investigate the intrinsic relationship between tool flank wear and operating conditions in metal cutting processes using carbide cutting inserts. The authors developed a model for predicting the wear land width combines mechanical cutting and an empirical model simulation tool flank. The study revealed that the rate cut was more dramatic effect on the life of the tool feed rate.

2. Experiments

2.1 Design of Experiments

Taguchi method developed by Dr. Genichi Taguchi, referring to the technique of quality engineering. Taguchi method is best used when there are a number of variables, medium (3-50) interaction between a few variables and parameters on a few significant share Taguchi arrays can be acquired or looked up. Small arrays can be pulled out manually. It has a large array of algorithms to determine. Generally, the array can be found. The array will be chosen by a number of parameters (variable) and the number of levels (state), this will be discussed further later in this chapter.

2.2 PROCESS VARIABLES AND THEIR LIMITS

First pilot experiments were done on the work piece using random values and then from those pilot experiments the suitable values of these parameters were selected. On the basis of observations from the pilot experiments these levels were found suitable for the experimentation.

Process variables and their limits

Factors	Units	Level-1	Level-2	Level-3
Spindle speed (N)	RPM	220	330	440
Feed (F)	mm/rev.	0.2	0.3	0.4
Depth of cut (DOC)	mm	0.5	1	1.5

2.3 Taguchi's L9 Orthogonal Array

Run	C.S	Feed	D.O.C
1	440	0.4	0.5
2	440	0.3	1
3	440	0.2	1.5
4	330	0.4	1
5	330	0.3	1.5
6	330	0.2	0.5
7	220	0.4	1.5
8	220	0.3	0.5
9	220	0.2	1

2.4 Calculation of Temperature

C.S	Feed	D.O.C	Max T
440	0.4	0.5	47.73
440	0.3	1	47.64
440	0.2	1.5	49.84
330	0.4	1	48.18
330	0.3	1.5	53.82
330	0.2	0.5	49.07
220	0.4	1.5	50.84
220	0.3	0.5	48.98
220	0.2	1	49.82

C.S	Feed	D.O.C	Max T	SNRA1	MEAN1
440	0.4	0.5	47.73	-33.5764	47.73333
440	0.3	1	47.64	-33.5602	47.64444
440	0.2	1.5	49.84	-33.9523	49.84444
330	0.4	1	48.18	-33.6569	48.17778
330	0.3	1.5	53.82	-34.6192	53.82222
330	0.2	0.5	49.07	-33.8157	49.06667
220	0.4	1.5	50.84	-34.1249	50.84444
220	0.3	0.5	48.98	-33.8	48.97778
220	0.2	1	49.82	-33.9485	49.82222

2.5 Response Table for Signal to Noise Ratios
Smaller is better

Level	C.S	Feed	D.O.C
1	-33.96	-33.91	-33.73
2	-34.03	-33.99	-33.72
3	-33.70	-33.79	-34.23
Delta	0.33	0.21	0.51
Rank	2	3	1

Response Table for Means

Level	C.S	Feed	D.O.C
1	49.88	49.58	48.59
2	50.36	50.15	48.55
3	48.41	48.92	51.50
Delta	1.95	1.23	2.96
Rank	2	3	1

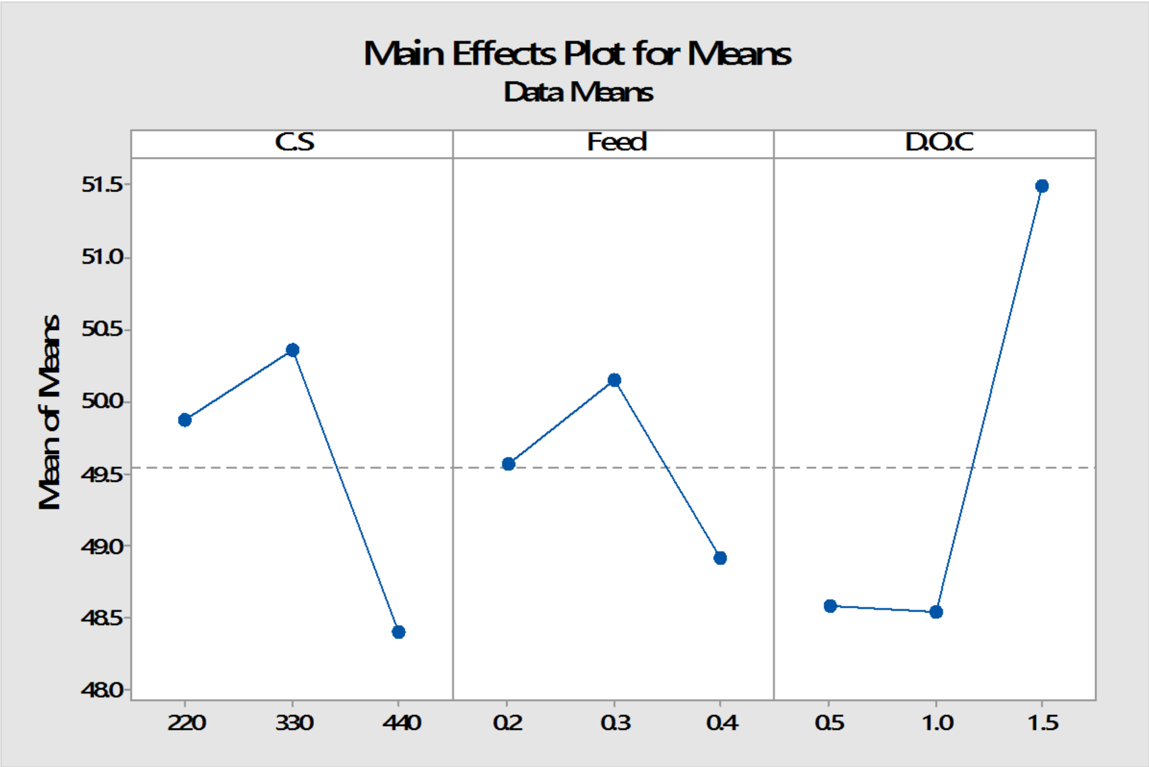

Fig shows the effect of different parameters on MRR

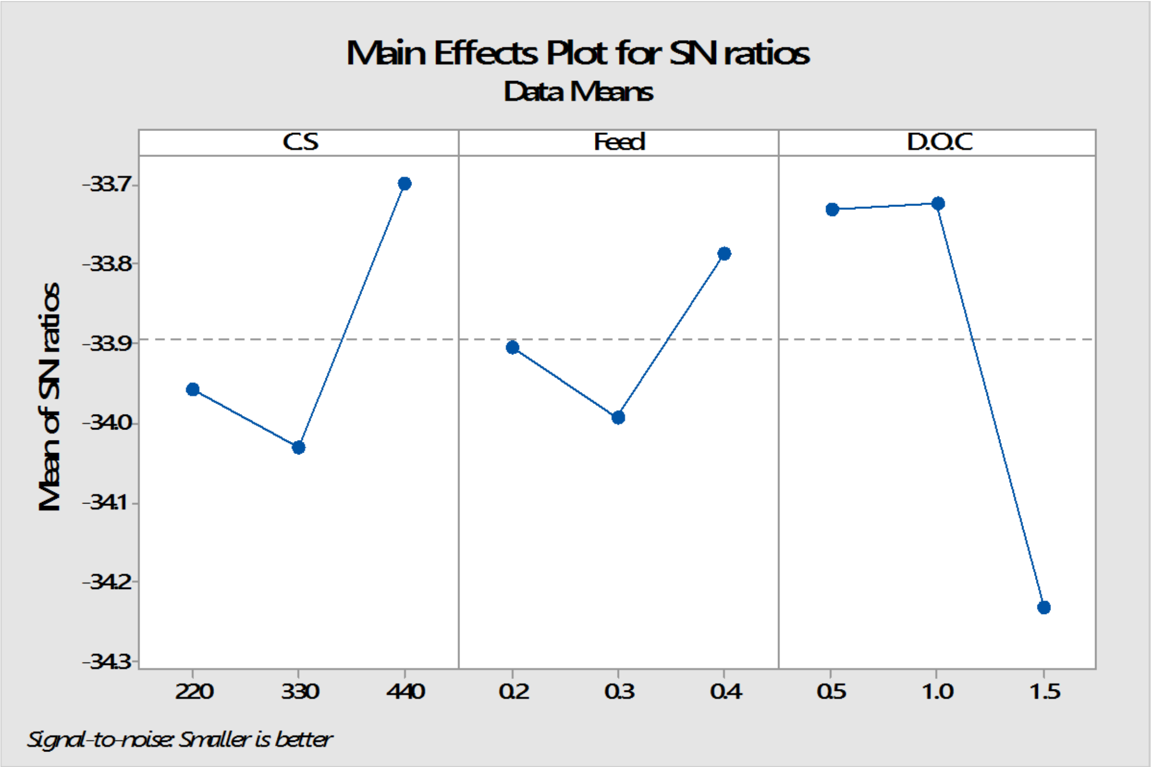

Fig shows the effect of different parameters on Signal o noise ratio

2.6 Analysis of Variance for SN ratios

Source	DF	Seq SS	Adj SS	Adj MS	F	P
C.S	2	0.18541	0.18541	0.09270	1.73	0.366
Feed	2	0.06482	0.06482	0.03241	0.61	0.623
D.O.C	2	0.51188	0.51188	0.25594	4.79	0.173
Residual						
Error	2	0.10692	0.10692	0.05346		
Total	8	0.86903				

Analysis of Variance for Means

Source	DF	Seq SS	Adj SS	Adj MS	F	P
C.S	2	6.193	6.193	3.096	1.64	0.379
Feed	2	2.272	2.272	1.136	0.60	0.625
D.O.C	2	17.212	17.212	8.606	4.54	0.180
Residual Error	2	3.787	3.787	1.893		
Total	8	29.464				

. 3. Conclusion

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 high level 3. As shown in table below.

Optimal combination for Temp.

Physical	**Optimal Combination**		
Requirements	C.S	F	D.O.C
Min. Temp.	440	0.4	1
	Level-3	Level-3	Level-2

4. Real Life Application & Future Work

Real life application of this study is that, the results and conclusion will be beneficial for providing the optimal combination for Temperature rise to the operator, so that maximum MRR & min Temp according to the need. This will be very beneficial for industrial purpose as turning is mostly used in industries. In future the experimentation can be done on other grades of stainless steel like SS 301L, SS 302HQ, SS 321 and SS 430 which are widely and commonly used in the industry.

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