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An Investigation of Cutting Zone Temperature for Dry and Wet Turning Operation

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Abstract: This paper focus on machinability of mild steel cutting throughout turning operation. The intention of this paper is to check the result of machining parameter like cutting speed, feed, Depth of cut within the dry and wet machining condition. The experiment was conducted in center lathe for various machining conditions with dry and wet. Flood cooling is mainly used to cool and lubricate the cutting tool and work piece interface during machining process. This paper also focus on reducing cutting fluid cost and investigation of turning operation on mild steel material for optimization the temperature of tool tip-work piece interface, material exclusion rate in dry and flood by considering three convenient input parameters such as cutting speed, feed rate, depth of cut. To analyze the tool tip temperature at different machining condition by using infrared thermometer with dry and wet machining.
Keywords: Cutting Zone Temperature, Dry Turning, Wet Turning, Taguchi Method

Introduction

Today's speedy changing manufacturing background requires the application of optimization techniques in metal cutting processes to with success react to serve aggressiveness and to fulfill up the increasing demand of customizable quality product within the market. The mild steel find large application in manufacturing, like to manufacture nut and bolts, shaft, gears-pinions etc. lathe machine is a usual machine used to generate the shaft, bearing, threading from cylindrical part. The turning operation is most important operation for the machining process. Many difficulties that follow in machining are measure because of heat generated and so that the hot temperature reason by it. Thus proper choice of cutting fluid is very essential, as a result of it may have an impression on the tool life, cutting force, power consumption, machining accuracy, surface end. It is necessary to use the cutting fluids to reduce the friction from it and take away the heat as early as possible. There are two different kinds of machining environments are; 1. Dry machining 2. Wet machining

Experiment Setup

Fig. Experimental setup temperature measuring by infrared thermometer

This experiment study was carried out on a centrelathe machine under dry and wet cutting condition. Fig shows the experiment set-up in photographic view. The work piece was positioned into 4-jawchuck and the jaws remained tightened with the help of chuck key while waiting for the jaw start to hold the work piece. The High Speed Steel cutting tool were used and it is generally used cutting tool material. The tool was strongly clamped in the tool holder for machining the work piece. The angle of the tool holder remained adjusted so as to the tool remained almost perpendicular to the side of the work piece. Mild steel has been used as a work material with the dimension of 25 mm and 70 mm length. In this experiment the selection of input processparameters selected for cutting condition are feed, depth of cut, cutting speed. The process is repeated continuously till the certain diameter of work piece was reached. The diameter of the work piece was measured using a vernier caliper.The following steps repeated for different depth of cut and following cutting fluids. The cutting temperature was also taken in regular interval of cutting by infrared thermometer in dry and wet condition. This experiment was conducted in dry and wet condition on a four jaw chuck in centre lathe. Lathe removes undesired material from outer diameter of a rotating cylindrical work piece in the form of chips with the help of tool which is traversed across the work and can be fed deep in the work. The device which has been used to measure the temperature between tool and work piece interface by infrared thermometer. The thermometer has a measuring temperature range between 50 to 500 ºC.

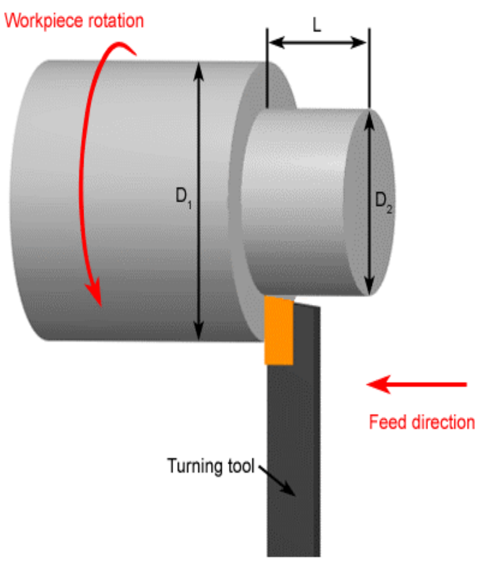
Work piece material

The present investigation mild steel of initial diameter 25mm and length 70 mm is used in turning operation.

- Mild steel is the low-cost and most common form of steel and help all application which need a bulk amount of steel.
- It is not brittle.
- Mild steel is a type of steel in that small amount of carbon content and other element is present. It is softer and it can be shaped more easily then higher carbon steel.
- A higher amount of carbon makes steel stronger, harder and stiffer than the low carbon steel. The higher amount of carbon makes steel changed from low carbon mild type steel.
- It decrease the machine ability.
- Some mild steel properties and there uses:
- Mild steel has a maximum limit of 0.16 to 0.18% carbon. The proportions in mild steel is of 0.70 to 0.90% manganese, 0.6% copper and 0.40% maximum silicon, and in sulphur and phosphorus is 0.040% maximum.

Turning Operation

Turning is a form of machining process where a single-point cutting tool removes material from outer diameter of a rotating cylindrical work piece. The tool is fed linearly in a direction of parallel to the axis rotation of the work piece. The common research work on the cryogenic machining takes remained completed on turning operation. Unique reasons for that is easy contact of the cryogenic media to enter the cutting zone with an external nozzle in a single-point turning. Turning is used to remove the diameter of the work piece, typically to stated dimension, and to produce a smooth finishing on metal. Regularly the work piece will be turned so that nearby sections have their different diameters.



Taguchi method

Taguchi methodology area unit statical methodology or typically it additionally called strong style methodology developed by Genichi Taguchi to boost of quality producing product and additional recently additionally applied to engineering, biotechnology, selling and advertising. The taguchi methodology relies on orthogonal arrays to attenuate the sum of experiments and to efficiently increase product quality.

Steps

1. Choice of design parameters.
2. No. of levels of design parameters.
3. Conductivity of experiments supported arrangement of orthogonal arrays.
4. Analysis of result using S/N ratios.
5. Choice of optimum level of design parameter.
6. Verification through conformation experiment.
7. Conduct the matrix experiment.

Taguchi creates use of designed experiments and signal to noise ratios to define the optimal parameter settings. The signal to noise ratios is derived from the Taguchi loss function. Whereas Taguchi has projected a large number of signal to noise ratios three are the most widely used:

1. Normal is best.
2. Larger is better.
3. Smaller the better.

Result & Discussion

The following machining conditions are shown in the tables.

For Dry

Table: 1 machining parameters

parameters	**Code**	**Value**
Speed(m/min)	A	5.49,5.49,5.49
Feed(mm/rev)	B	0.2,0.3,0.4
Depth of cut(mm)	C	0.5,1,1.5

Table: 2 Dry temperature in signal to noise ratio

A	B	C	Dry temperature in ºC	SNRAI
1	1	1	32.2	-30.157
1	2	2	33.4	-30.474
1	3	3	33.1	-30.396
2	1	2	34.1	-30.655
2	2	3	35.5	-31.004
2	3	1	35.6	-31.029
3	1	3	41.9	-32.444
3	2	1	42.3	-32.526
3	3	2	42.6	-32.588

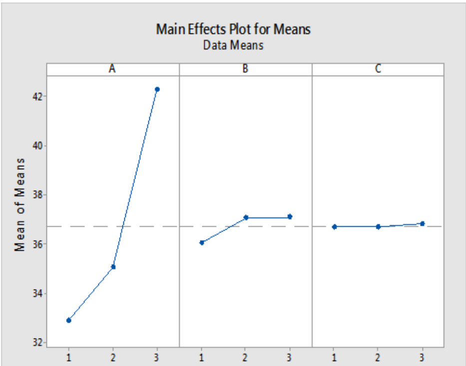


Fig: graph of temperature during dry machining

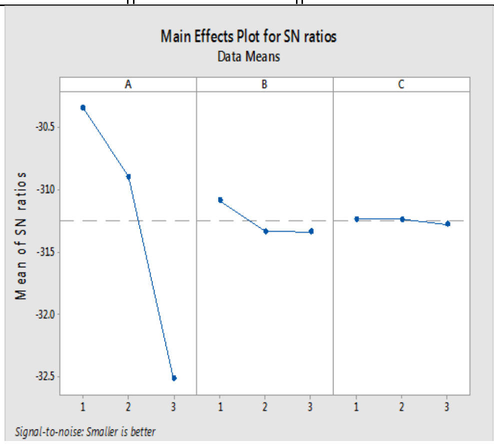


Fig: graph during effect plot on SN ratio

Taguchi Analysis: DRY (Temp) versus A, B, C

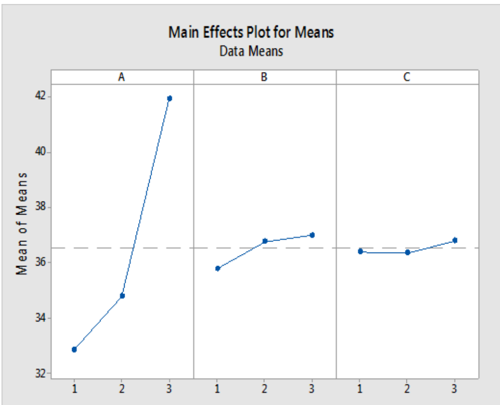
Response Table for Means

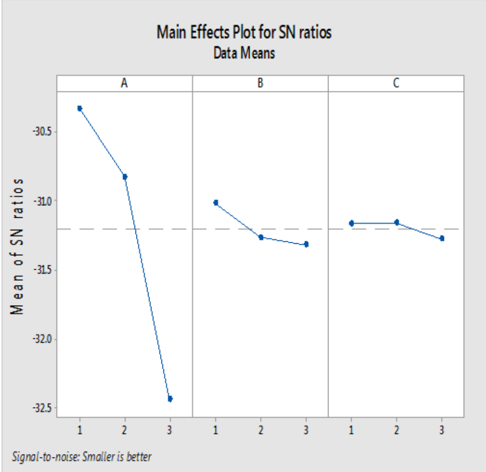
level	A	B	C
1	32.90	36.07	36.70
2	35.07	37.07	37.70
3	42.27	37.10	36.83
Delta	9.37	1.03	0.13
Rank	1	2	3

For Wet

Table: 3 Wet temperature in signal to noise ratio

A	B	C	Wet temperature in °C	SNRAI
1	1	1	31.9	-30.075
1	2	2	33.2	-30.422
1	3	3	33.5	-30.500
2	1	2	33.8	-30.578
2	2	3	35.2	-30.930
2	3	1	35.4	-30.980
3	1	3	41.7	-32.402
3	2	1	41.9	-32.444
3	3	2	42.1	-32.485





Taguchi Analysis: WET (TEMP) versus A, B, C

Response Table for Signal to Noise Ratios

Smaller is better

level	A	B	C
1	-30.33	-31.02	-31.17
2	-30.83	-31.27	-31.6
3	-32.44	-31.32	-31.28
Delta	2.11	0.30	0.12
Rank	1	2	3

The experimental results from table 2, were analyzed by using signal-to-noise (S/N) ratio. From the tables the cutting speed was the most important factor, followed by feed. The depth of cut had a lower effect on temperature compared to the other factors. The optimum temperature during dry machining at 32.2ºCis obtained as cutting speed 5.49m/min, feed 0.2mm/rev and depth of cut 0.5mm. table 3, shows that the same ranking tendency was observed during wet machining at 31.9ºC as the cutting speed was also the most important factor followed by feed and depth of cut. The depth of cut had a lower effect on temperature. The optimum control factor for the wet machining at 31.9ºC are cutting speed 5.49m/min, feed 0.2mm/rev and depth of cut 0.5mm. It can be seen that the work piece and tool interface temperature is reduce

Through using the cutting fluid Max Mist ST2020. As coolant would give less temperature. Which reduces the tool life and its hardness.

Conclusion

The resulting conclusion can be prepared on the basis of experiment

- This paper provides us the information about the effect on the temperature using various cutting parameter like cutting speed, feed rate, depth of cut.
- This paper provide us the information about the effect on the temperature by dry and wet machining.
- The maximum temperature reduction is obtained with the cutting fluid at all the cutting parameter.
- The choice of the cutting fluids for the machining processes mostly provides many benefits such as higher surface finish quality and well dimensional accuracy and longer tool life and reduce the friction and remove the heat as early as possible and the prevention of corrosion.

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