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Research Article

Study of Cutting Parameters on Turning using EN9

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Abstract

Study is one of the prime requirements of industries for machined parts. The present paper presents an experimental study to investigate the effects of cutting parameters like spindle speed, feed and depth of cut on hardness of EN-9. Using Infrared thermometer. We find out feed having maximum effects on surface temperature.

Keywords: *EN-9, spindle speed, Material removal rate*

1. Introduction

Aspect such as cutting forces ,tool life and wear, material removal rate, power consumption, cutting temperature (on tool and work-piece's surface) decide the productivity product quality, overall economy in manufacturing by machining and quality of machining. During machining ,the consumed power is largely converted into heat resulting high cutting temperature near the cutting edge of the tool. The amount of heat generated varies with the type of material being machined and machining parameters especially cutting speed, which had the most influence on the temperature. Many of the economic and technical problems of machining are caused directly or indirectly by this heating action. Excessive temperatures directly influence the temperatures of importance to tool wear on the tool face and tool flank and inducing thermal damage to the machined surface . All these difficulties lead to high tool wear, low material removal rate (MRR) and poor surface finish . In actual practice, there are many factors which affect these performance measures, i.e. tool variables (tool material, nose radius, rake angle, cutting edge geometry, tool vibration, tool overhang, tool point angle, etc.), work-piece variables (material, hardness, other mechanical properties, etc.) and cutting conditions (cutting speed, feed, depth of cut and cutting fluids). Many papers has been published in experimental based to study the effect of cutting parameters on surface roughness (Khidhir and Mohamed, 2011; Hardeep Singh, 2011)

1.2 Literature Review

The experimental investigation presented here was carried out on an AKASH lathe. The work piece material used for present work was EN-9 steel. EN9 is an unalloyed medium carbon steel . It is supplied at the hardness obtained after hot rolling or cold drawing, with hardness normally within the range of 180 to 230HB.

The experimental results 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. T.G Ansalam Raj and V.N Narayanan Namboothiri formed an improved genetic algorithm for the prediction of surface finish in dry turning of SS 420 materials. Now-a-days increasing the productivity and the quality of the machined parts are the main challenges of metal cutting industry during turning processes. Optimization methods in turning processes, considered being a vital role for continual improvement of output quality in product and processes include modeling of input-output and in process parameters relationship and determination of optimal cutting conditions. This paper presents an optimization method of the cutting parameters (cutting speed, depth of cut and feed) in dry turning of AISI 1055 steel to achieve minimum tool wear and low work-piece surface temperature.

Interfacial temperatures in machining play a major role in tool wear and can also result in modifications to the properties of the work-piece and tool materials. As there is a general move towards dry machining, for environmental reasons, it is increasingly important to understand how machining temperatures are affected by the process variables involved (cutting speed, feed rate, tool geometry, etc.) and by other factors such as tool wear.

The total work done by a cutting tool in removing metal can be determined from the force components on the cutting tool. Approximately, all of this work or energy is converted into heat which is dissipated into the chip, tool and work-piece material. The wear of a tool is also related to the cutting forces. Initial experiments conducted

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involved the simultaneous measurement of forces and temperature

2. Materials and Methods

2.1 Work-piece material

EN9, also known as 070m55, with a carbon content 0.50/0.60 this is a medium carbon steel which can develop a tensile strength of 700N/mm. In the normalized condition EN9 can be used for gears, sprockets and cams. EN9 steel forgings.

BS 970 1991	BS 970 1955 EN	A ISI/SA E	Werkstoff
070M55	EN9	1055	1.0535

Chemical Composition of EN-9

C	Si	Mn	S	P
0.50%	0.25%	0.70%	0.05%	0.05%

Tool used

In this experiment, in order to investigate the surface Temperature of the machined work-piece and material removal rate, during cutting of the EN-9 steel, HSS tool was used. The surface temperature of the work surface was measured with the help of an Infrared thermometer.

- Machine tool AKASH Lathe
- Work piece EN-9 steel
- Size Φ32 mm x70 mm
- Cutting condition Dry
- Tool used HSS
- Infrared thermometer

Fig1 : Centre lathe (Akash)

Fig 2: Measurement of temperature using infrared thermometer

Specifications of Infrared thermometer

Measuring range	-50-380^{0}C(-58-716^{0}F)
Accuracy	±1.5^{0}C/±1.5%
Resolution	0.1^{0}C or 0.1^{0}F
Distance spot ratio	12:01
Emissivity	.95(fixed)
^{0}C/^{0}F	Unit selectable

2.2 Experimental procedure

Turning Process

Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material as shown in Figure 3. The turning process requires a turning machine or lathe, work piece, fixture, and cutting tool. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and allowed to rotate at high speeds. The cutter is typically a single-point cutting tool that is also secured in the machine. The cutting tool feeds into the rotating work piece and cuts away material in the form of small chips to create the desire shape.

2.2 Facing

It is the process in which we decrease the length of work piece by using single point cutting tool. Machine used: lathe machine (Akash/Centre lathe) for obtaining flat surface on both ends.

2.3 Grooving

It is the process of reducing diameter of a work-piece over a narrow surface Turning is a popularly used machining process. The lathe machines play a major role in modern machining industry to enhance product quality as well as productivity. Cutting tests were carried out on AKASH lathe machine under dry conditions. Then, using different levels of the process parameters nine specimens have been turned in lathe accordingly. Machining time for each sample has been calculated accordingly. Then Surface temperature have been measured Precisely with the help of a portable Infrared thermometer.

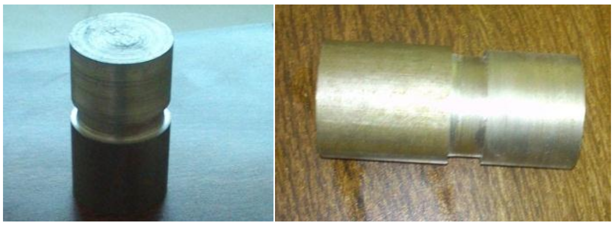

Fig 3: Specimen

3. Result and discussion

Factors	Units	Level 1	Level 2
Spindle Speed	N	239	388
Feed	mm/rev	1	0.9
Depth of cut	mm	0.25	0.5
Temperature	^{0}C	27.8	30.3

RPM	Feed	Depth of Cut	Surface Temp.
239	0.9	0.25	34.8
239	0.9	0.5	36.3
239	1	0.25	27.8
239	1	0.5	30.3
388	0.9	0.25	37.8
388	0.9	0.5	38.2
388	1	0.25	29.86
388	1	0.5	30.5

Level	RPM	Feed	Depth of Cut
1	32.3	36.77	32.56
2	34.09	29.62	33.82
Delta	1.79	7.16	1.26
Rank	2	1	3

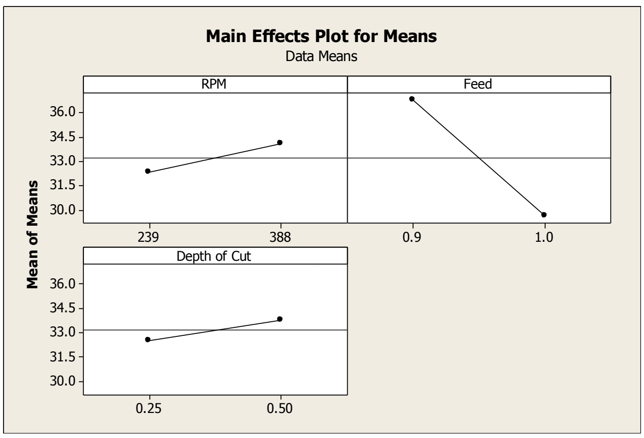

Fig: 4 Main effect plots

4. Conclusion

The relationship between cutting parameters (cutting speed, depth of cut, feed) and the performance measures (work-piece surface temperature) are expressed by the performance level for any parameter levels.The significant parameters for work-piece surface temperature were cutting speed, depth of cut and feed in which feed having highest rank so we find out that feed having most effective parameter. Surface temperature is maximum i.e. 38.20^{0}C, when we have taken rpm (388), depth of cut (0.50 mm) and feed(0.9 mm), which is worthless.The significant parameters for optimum work-piece surface temperature are, rpm(239),depth of cut(0.25 mm) and feed(1 mm).

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