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ANALYSIS OF TOOL LIFE, SURFACE ROUGHNESS, AND CUTTING FORCES OF SINGLE POINTED CUTTING TOOL

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ABSTRACT

Metal cutting is the process of removing material in the form of chips, using cutting tool, and input work material, machine Parameter settings will influence the process efficiency and output quality characteristics. For turning process, the cutting condition that is speed, feed, and depth of cut plays an important role in the efficiency use of machine.

In this work we have determined the tool chip interface temperature during cutting of medium carbon steel workpiece with High speed steel tool. The effects of different parameters like depth of cut, feed rate and cutting speed are taken into consideration so as to predict their effects on tool life and surface roughness are studied. From the results we can see that change in cutting speed and feed rate gives maximum effect on cutting force, tool life and surface roughness.

Keywords:-*parameters of cutting, distribution of temperature, work-tool thermocouple, life of tool.*

I. INTRODUCTION

Metal cutting is the process of removing of material in the form of chips, using cutting tool, input work material, Machine parameter setting will influence the process. The process and parameters are shown in figure 1. An Eulerian reference co-ordinate is used to describe the steady state motion of the workpiece relative to a stationary cutting tool. This cutting method is a common and time favored metal removal process which produces finished surfaces with high quality. It is mostly used process in industry with cheaper method. But this process is also have a main disadvantage of tool failure and change of physical form of workpiece. Now in this era of automation cost estimation and tool life calculation tell us the expenditure before starting the manufacturing. The various parameters involved in metal turning process are cutting speed, depth of cut, feed rate, tool nose radius, tool and workpiece materials and rake angle

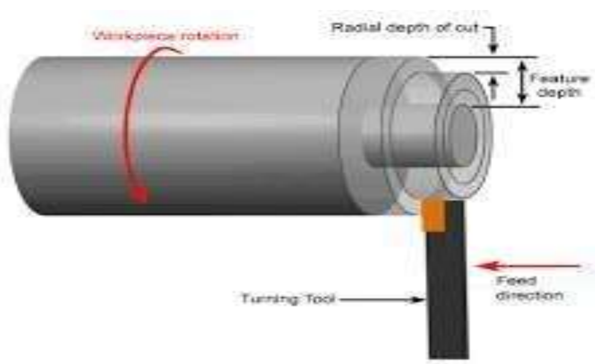

Fig1. Turningprocess

Tool life is defined as the time elapsed between the two successive grindings of the tool. During this time the tool cuts the material efficiently and effectively. The life of a cutting tool must be higher.

II. LITERATURE REVIEW

Maheshwari N Patil and Sarange S [1] Finite element analysis based techniques are available to analyses the effect of temperature and cutting forces (Horizontal force, vertical force) on the tool tip by taking three dimensional model of a single pointed cutting tool in software named ANSYS and simulate processes of cutting and offer several advantages including prediction of temperatures, distribution of von misses stresses and deformation of tip of single point cutting tool using tool forces, estimation of tool wear and residual stresses on machined surfaces. The conclusions obtained in the analysis of single point cutting tool are as follows as depth of cut increases, the von-misses stresses developed in the tool increases and also the temperature generated in the tool at the tool tip also increases which causes the failure of the tool.

Kapil Sharma et al [2] The parameters like depth of cut, rake angle, feed rate, cutting speed and temperature are taken in to account so as to predict their effects on tool life. The force of cutting got decreases as the rake angle of tool gets increases. This affects feed rate results in increase in cutting force. The increase in absolute value of cutting speed and negative tool rake angle, makes decrement in friction between tool chip. The tool tip temperature increases with an increase in cutting speed. If positive rake angle is increases, decrement is seen in force/power is required to machining.

T T M Kannan et al [3] Cubic Boron Nitride tool insert are used because these are one of the most suitable material for machining of steel which have property of high hardness, chemical inertness and wear resistance. In this experimental investigation regarding about heat partition, tool life and develop Merchant circle and tool wear of CBN cutting tool and analyzed while turning of AISI316 steel rods. CBN cutting tool insert has been damaged in moderate cutting velocities and produce fairly good machinability. As we know that higher temperature produced by cutting decreases the strength yield which produce white layer formation. However Cubic Boron Nitride tool insert used for cutting was suitable for turning of Austenite stainless steel (AISI316) and produce good performance.

P. Albertelli [4] Experimental study regarding Spindle Speed Variation technique on tool wear in steel turning is presented in this method. The wear tests on tool were arranged and full factorial design performance was seen in this experimental analysis. The cutting speed and the cutting speed modulation were the main investigated factors. During wear tests up to the end of the tool lifethe flank wear width was the main considered process response and it was monitored continuously.

Sushil D. Ghodam [5] proposed that we can increase tool life by applying coating on the tool. In the experimental setup the tool work thermocouple was used life because it was inexpensive. The comparisons were made between the temperature distribution for coated and uncoated tool. These showed that with coatings the temperatures generated within the tool were decreases so the tool life was increase.

III. EVALUATION OF TOOL LIFE, SURFACE ROUGHNESS AND CUTTING FORCE BY EXPERIMENTS

The experiment is carried out on the High Speed Steel tool which was operated on medium carbon steel workpiece during operation of turning. These tests of machining were performed on a conventional lathe. The material used for workpiece in the experiment was cylindrical bar having a diameter of 30mm and a length of 300mm having material of medium carbon steel.

For the trial of machining a Lathe machine which has speed range of spindle from 230 to 514rpm was used. The machining center was driven by 5.5kW electric motor. The experiment was done under dry machining environment.

A tape rule model Fat Max Blade Armor35`was used to measure the total cutting length a tool will cut effectively. Tool life was determined by the ratio of the length of total effective cut to the feed rate and spindle speed product of machining. All experimental work was performed on the same machine. The data were collected for each tool life cutting conditions. Table 1 presents the cutting parameters.

Table1.The cutting parameters and their eve

Symbol	PARAMETERS	Levels		
		1	2	3
A	Spindle speed N,rev/min	230	340	514
B	Feedrate f, mm/rev	0.35	0.7	1.4
C	Depthofcutd, mm	0.5	1	1.5

The influence of cutting parameters on tool life, surface finish and cutting force are evaluated and tabulated in below shown
table 2.

Table 2. Cutting forces, tool life and surface finish for medium carbon steel

S.No	Factors			Parameters			Cutting force F_CN	Tool life (seconds)	Ra (µm)
	A	B	C						
	N	f	D	Nrev/min	f mm/rev	d mm			
1	1	1	1	230	0.35	0.5	315	178.88	6.12
2	2	2	2	340	0.7	1.4	1695.4	60.50	8.35
3	3	3	3	514	1.4	1.5	3360	20.01	13.26
4	3	1	1	514	0.35	0.5	315	80.04	8.19
5	1	2	2	230	0.7	1	1211	89.44	13.14
6	2	3	3	340	1.4	1.5	3360	30.252	13.08
7	2	1	1	340	0.35	0.5	315	121.00	8.16
8	3	2	2	514	0.7	1	1211	40.02	11.67
9	1	3	3	230	1.4	1.5	3360	44.72	11.92

The formula einvolved in present work are
Cutting force $F_C = K_C x d x f$
Where K_C= specific cutting energy oefficient(N/mm^2)
d = depth of cut (mm)
F = rate of feed in (mm/rev)
Life of tool T = L x 60/f
L = Effective cut length in (mm)
F= rate of feed in (mm/min)
Surface roughness Ra =0.0321 f2/r
Where f = feed rate (mm/rev)
r = Nose radius of cutter in (mm)
Ra = surface roughness (µm)

IV. RESULTS AND DISCUSSION

Increases in force of cutting can be shown linearly with the increment in depth of cut from 0.5mm to 1.5mm. The Tool life is more when the depth of cut is minimum, the feed rate is moderate and spindle speed is moderate,. When there is a higher feed rate then there is a significant effect on cutting force, tool life and surface roughness. The depth of cut and speed have insignificant effect on tool life, surface roughness and cutting force.

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