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Experimental Analysis of Machining Parameters on Turning with Single Point Cutting Tool

P. H. J. Venkatesh, R. Rudrabhi Ramu, M. S. R. Viswanath

Department of Mechanical Engineering, Vignans Institute of Information Technology (A), Visakhapatnam, Andhra Pradesh, India

ABSTRACT

The metal cutting process for material removing in turning process using a single point tool on the work piece will influence, the machining parameters in terms of efficiency under variable cutting conditions such as speed of the spindle , feed rate and depth of the cute rate during the removal of material in the form of chips from the cylindrical work piece. The HSS Single point cutting tool is one of the important tool for machining operations in many manufacturing industries. In this paper, the experimental analysis is performed and the effect of parameters like variable speed on the spindle, depth of the cut and feed on surface roughness, tool life and MRR are determined and compared. The work piece choosen for the experiment is S50C medium carbon steel with HSS single point Cutting tool and the results are obtained, calculated and tabulated.

KEYWORDS: *Cutting Tool, depth, MRR, roughness, Tool life*

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INTRODUCTION

Turning is metal cutting process to remove a metal from the outer part of the diameter of a rotating cylindrical work piece. Turning is used to decrease the diameter of the work piece, according to the required dimension and application, and to provide a smooth finish on the work piece. The cutter to remove the material is a single-point cutting tool and is tightly clamped to the tool holder the single point cutting tool feed into the rotating cylindrical work piece and cuts the material in the form of small chips. An orthogonal metal cutting process is used in this process

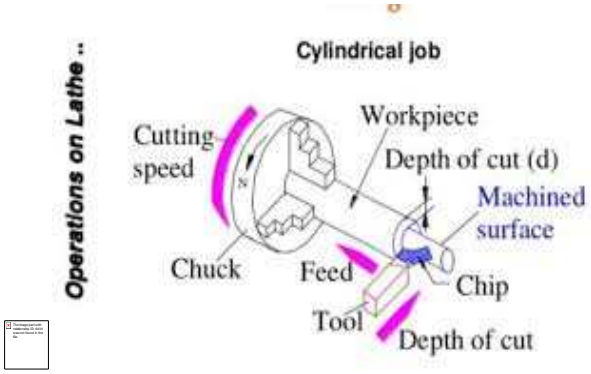

Fig.1.Turning of cylindrical work piece Single Point Cutting Tool Nomenclature

The single point tool consists of a sharp cutting point called as shank,the point of the tool is bounded by the face, the side flank , the end flank and the base.The single tools are made up of different materials like high carbon steels, HSS, and Diamonds. Single Point Cutting Tool Geometry consists of *shank,Flank,Face,Heel,Nose,Nose radius and Cutting Edges and tool angles consists of side Cutting edge, end cutting edge angle, side relief angle, end relief angle,back Rack angle, side rake angle.*

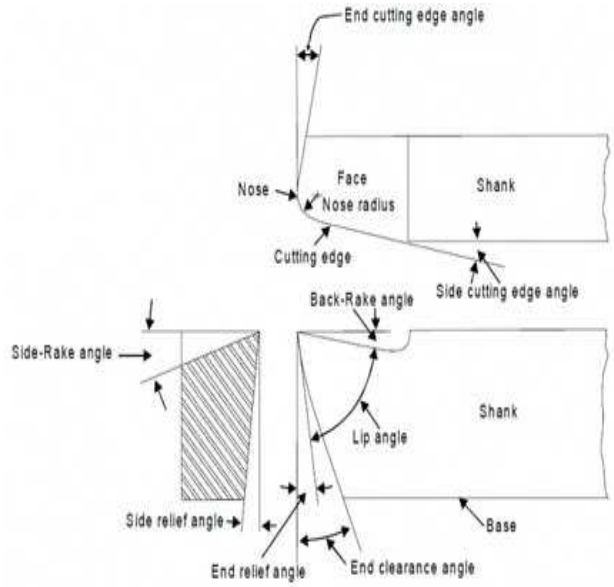

Fig.2.Single point tool Nomenclature

PARAMETERS EVALUATED USING TURNING PROCESS

The experiment is conducted by considering HSS[2] single point tool operating on S50Cmedium carbon steel work piece in turning process.These machining test is performed on a conventional lathe machine. The work piece of cylindrical shape having a diameter of 30mm and a length of 350mm. A Lathe machine with a spindle speed range from 200rpm to 700 rpm was used for the machining.The machining center was driven with 6.5 kw electric motor.

The experiment is performed under the dry machining environment.The tool life can be determined by mathematical relation for calculation of total length of effective cut.The tool life data is collected for each of the different cutting conditions and tabulated.

S50C medium carbon steel composition:

Table.1.S50C composition

Grade	C	Mn	p	si	s
S50C	0.47-0.53	0.60-0.90	0.030	0.15-0.35	0.035

S50C grade carbon steel is widely used in machine manufacturing, mechanical parts such as springs, gears, tension bars, the rollers, the axis, and the load spindle.

Table 2.Process parameters of turning process

S.NO	PARAMETERS	LEVEL		
		1	2	3
1.	Spindle speed N, rev/min	250	450	650
2.	Feed rate f, mm/rev	0.4	0.8	1.2
3.	Depth of cut d, mm	0.5	1	1.5

The effect of cutting parameters on cutting force, tool life and surface finish are evaluated and tabulated.

Theoretical calculations for the experimental values [1]
Consider,

F_C Cutting force in N
T_L Tool life (seconds)
R_a Theoretical Surface Roughness in (µm)
MRR Material Remove Rate in cm^3/min
N Spindle speed in rpm
f feed rate in mm/rev
d depth of cut in mm
V_C Cutting speed in m/min

Diameter of the work piece
D = 0.03m

Length of the work piece,
L= 0.35m

For 250 rpm,

Cutting speed in m/min

$V_C = \frac{\pi \times D \times N}{1000}$

$= \frac{\pi \times 0.03 \times 250}{1000} = 0.2356$ m/min

Theoretical Surface Roughness in (µm)

$R_a = \frac{f^2}{8 \times r} \times 10^3$

$= \frac{0.4 \times 0.4}{0.8 \times 0.8} \times 10^3 = 25\mu m$

Material Remove Rate in cm^3/min

$MRR = V_C \times d \times f$

$= 0.2356 \times 0.5 \times 0.4 = 0.05$ cm^3/min

Tool life (seconds)

$T_L = \frac{60 \times D}{2 \times f \times N}$

$= \frac{60 \times 300}{0.4 \times 250} = 210$ Seconds

Similar way for all other calculations are done and tabulated in the following table 3.

RESULT AND DISCUSSION

Table.3. Experimental value of different parameters of turning process

S.NO	N	f	d	Fc	V_C	R_a (µm)	T_L	MRR
1.	250	0.4	0.5	490	0.235	25	210	0.05
2.	250	0.8	1	1672	0.235	25	105	0.19
3.	250	1.2	1.5	2340	0.235	25	70	0.42
4.	450	0.4	0.5	490	0.424	100	116	0.08
5.	450	0.8	1	1672	0.424	100	59	0.34
6.	450	1.2	1.5	2340	0.424	100	38	0.76
7.	650	0.4	0.5	490	0.612	225	81	0.12
8.	650	0.8	1	1672	0.612	225	40	0.49
9.	650	1.2	1.5	2340	0.612	225	27	1.10

Graphs

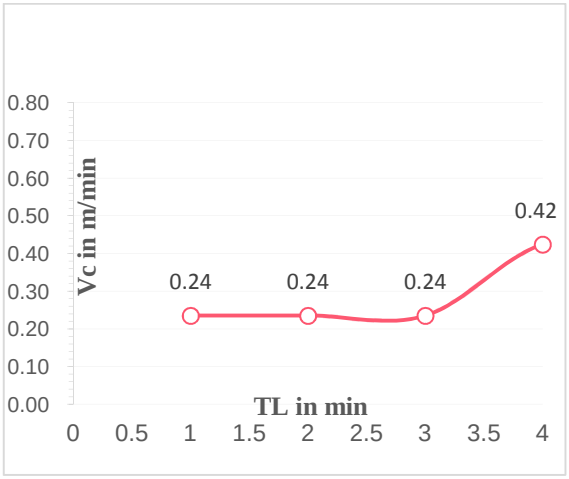

Fig.3. T_L varied with V_C

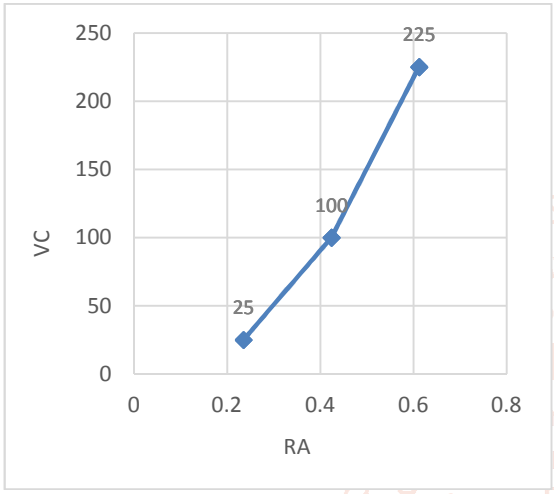

Fig.4. R_a varied with V_C

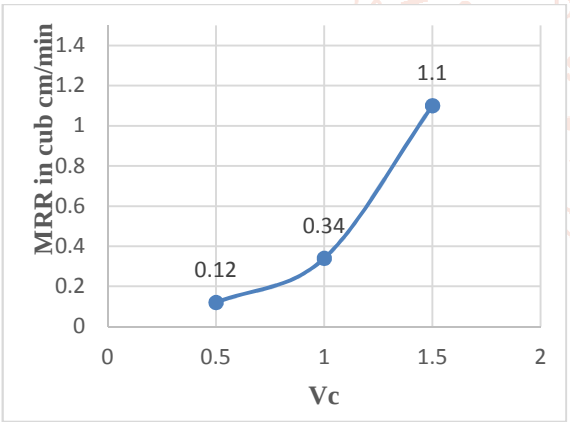

Fig.5. MRR varied with Vc

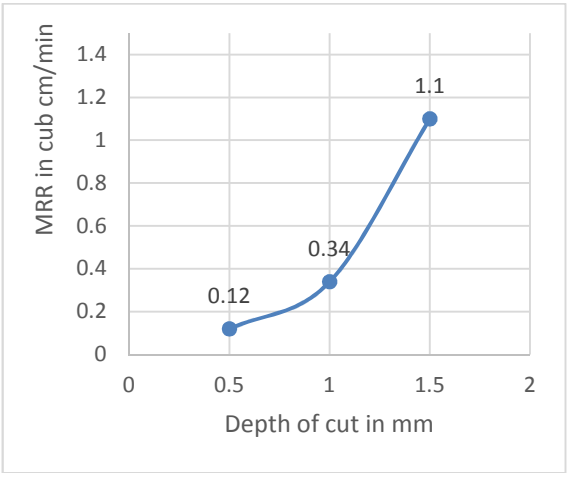

Fig.6.MRR varied with depth of cut

CONCLUSION

The results obtained shows the variable changes on all machining parameters such a high depth and feed rate the effect on the MRR increased with the increase in feed rate of the cut and when cutting speed value is increased the MRR value is also increased it clearly shows that when there is increase in the spindle speed the material rate is increased and tool life time varied with the cutting speed also. The surface roughness value increased with high cutting speed. The experiment further can be conducted on different materials of single point tool in presence of coolant for better results than obtained as this experiment was conducted in the dry environment and with the same considerations the above experiment can be conducted with the CNC Lathe with a correct correlation of machining parameters with correct material of single point tool can be choosen to reduce the loss of energy and better finishing of
work piece.

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