PARAMETRIC OPTIMIZATION OF TURNING PARAMETERS OF CNC MACHINE

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Abstract - This thesis was all about the experimentation work, data analysis and the results of the experimental out come. By this chapter one can find that the Feed rate is the most effective process parameter, then depth of cut at last the cutting speed while turning IRS:R-19 material with both cemented carbide tools of 0.4mm and 0.8mm nose radius and also found that the tool with larger nose radius provides better surface finish all shown by experimental work.

KEY WORD-: CNC, depth of cut, surface roughness, MRR (Material Removal Rate), Taguchi method, ANOVA.

1. INTRODUCTION

TURNING OPERATION

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters. Turning is the machining operation that produces cylindrical parts. In its basic form, it can be defined as the machining of an external surface:

- With the work piece rotating.
- With a single-point cutting tool, and
- With the cutting tool feeding parallel to the axis of the work piece and at a distance that will remove the outer surface of the work.
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▪ ADJUSTABLE CUTTING FACTORS IN TURNING

The three primary factors in any basic turning operation are speed, feed, and depth of cut. Other factors such as kind of material and type of tool have a large influence, of course, but these three are the ones the operator can change by adjusting the controls, right at the machine.

Speed: Speed always refers to the spindle and the work piece. When it is stated in revolutions per minute (rpm) it tells their rotating speed. But the important feature for a particular turning operation is the surface speed, or the speed at which the work piece material is moving past the cutting tool. It is simply the product of the rotating speed times the circumference of the work piece before the cut is started. It is expressed in meter per minute (m/min), and it refers only to the work piece. Every different diameter on a work piece will have a different cutting speed, even though the rotating speed remains the same.

$v = \pi DN/1000$ m/min

Here, v is the cutting speed in turning, Dis the initial diameter of the work piece in mm, andN is the spindle speed in RPM.
Feed: Feed always refers to the cutting tool, and it is the rate at which the tool advances along its cutting path. On most power-fed lathes, the feed rate is directly related to the spindle speed and is expressed in mm (of tool advance) per revolution (of the spindle), or mm/rev.

$F_m = f.N$ mm/min

Here, F_m is the feed in mm per minute, f is the feed in mm/rev and N is the spindle speed in RPM.

Depth of Cut: Depth of cut is practically self explanatory. It is the thickness of the layer being removed (in a single pass) from the work piece or the distance from the uncut surface of the work to the cut surface, expressed in mm. It is important to note, though, that the diameter of the work piece is reduced by two times the depth of cut because this layer is being removed from both sides of the work.

d_{cut} = D-d/2 mm

Here, D and d represent initial and final diameter (in mm) of the job respectively.

CNC Machines: Nowadays, more and more Computer Numerical Controlled (CNC) machines are being used in every kind of manufacturing processes. In a CNC machine, functions like program storage, tool offset and tool compensation, program-editing capability, various degree of computation, and the ability to send and receive data from a variety of sources, including remote locations can be easily realized through on board computer. The computer can store multiple-part programs, recalling them as needed for different parts.

MESUREMENT OF SURFACE ROUGHNESS

Surface properties such as roughness are critical to the function ability of machine components. Increased understanding of the surface generation mechanisms can be used to optimize machining process and to improve component function ability. The experiment is conducted to determine the effect of parameters such as feed rate, tool nose radius, cutting speed and depth of cut on surface roughness in turning the axle. The first step is to demonstrate the use of Taguchi parameter design in order to identify the optimum process parameter for surface roughness. The second is to demonstrate a systematic procedure using Taguchi design in process design of turning operations. In this experiment both were achieved. Value of surface roughness (Ra) is given in table 2

Test. No	Nose Radius (mm)	Cutting velocity (m/min)	Feed Rate (mm/rev)	Depth of Cut (mm)	Surface Roughness in (µm) Ra1	Ra2	Ra3	Mean Surface Roughness Ra (µm)	Signal to Noise Ratio (S/N) ratio
1	0.4	80	0.06	0.10	3.48	3.32	2.82	3.21	-10.15
2	0.4	80	0.08	0.20	9.80	5.84	5.16	6.93	-17.18
3	0.4	80	0.10	0.40	6.20	9.00	5.60	6.93	-17.01
4	0.4	120	0.06	0.40	5.30	6.70	6.80	6.27	-15.99
5	0.4	120	0.08	0.10	3.25	6.12	5.92	5.10	-14.42
6	0.4	120	0.10	0.20	8.40	7.16	5.64	7.07	-17.09
7	0.4	160	0.06	0.20	3.60	4.36	3.78	3.91	-11.88
8	0.4	160	0.08	0.40	3.16	6.23	5.24	4.88	-14.05
9	0.4	160	0.10	0.10	5.80	5.50	3.83	5.04	-14.18
Test. No	**Nose Radius (mm)**	**Cutting velocity (m/min)**	**Feed Rate (mm/rev)**	**Depth of Cut (mm)**	**Surface Roughness in(µm) Ra1**	**Ra2**	**Ra3**	**Mean Surface Roughness Ra (µm)**	**Signal to Noise Ratio (S/N) ratio**
1	0.8	80	0.06	0.10	2.35	2.55	3.11	2.67	-8.59
2	0.8	80	0.08	0.20	7.20	4.67	5.05	5.64	-15.19
3	0.8	80	0.10	0.40	4.05	8.00	4.00	5.35	-15.07
4	0.8	120	0.06	0.40	4.68	5.81	4.67	5.05	-14.12
5	0.8	120	0.08	0.10	2.70	4.90	3.97	3.85	-11.95
6	0.8	120	0.10	0.20	9.17	6.48	5.40	7.02	-17.14
7	0.8	160	0.06	0.20	3.42	3.92	3.40	3.58	-11.10
8	0.8	160	0.08	0.40	2.53	4.36	3.67	3.52	-11.12
9	0.8	160	0.10	0.10	4.55	5.10	3.24	4.30	-12.80

Results and Calculations of ANOVA for Surface Roughness

Table.1 Result of ANOVA for Surface Roughness contribution (tool nose radius 0.4 mm)

Symbol	Cutting Parameter	DOF	Sum of Square	Mean Square	Fisher's Value	Percentage Contribution
A	**Cutting speed**	2	9.18	4.59	1.44	19.01%
B	**Feed rate**	2	18.93	9.47	2.98	39.22 %
C	**Depth of cut**	2	13.82	6.91	2.17	28.64 %
Error=Total –Total (Actual)		2	6.34	3.17		13.13%
Total		8	48.27	24.14		

Table.2.Result of ANOVA for Surface Roughness contribution (tool nose radius 0.8 mm used)

Symbol	Cutting Parameter	DOF	Sum of Square	Mean Square	Fisher's Value	Percentage Contribution
A	Cutting speed	2	11.15	5.57	2.22	20.22%
B	Feed rate	2	21.21	10.60	4.23	38.46%
C	Depth of cut	2	17.78	8.89	3.54	32.24%
Error=Total-Total (actual)		2	5.01	2.507		9.09%
Total		8	55.15	27.575		

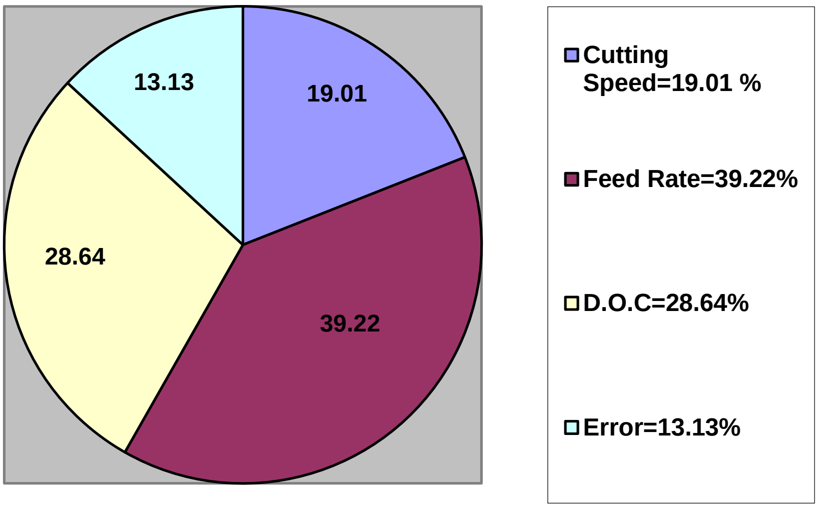

Figure-1. Percentage Contribution by pie chart for 0.4 mm tool

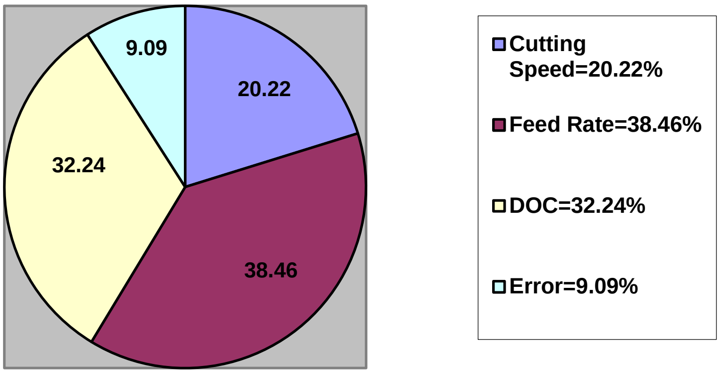

Figure:2. Contribution pie chart for 0.8 mm tool

RESULTS AND DISCUSSIONS

This paper has presented an investigation on the optimization and the effect of turning parameters on the surface finish of steel rod. The level of importance of the turning parameters on the surface finish is determined by using ANOVA. This chapter was all about the experimentation work, data analysis and the results of the experimental out come. By this chapter one can find that the Feed rate is the most effective process parameter, then depth of cut at last the cutting speed while turning IRS:R-19 material with both cemented carbide tools of 0.4mm and 0.8mm nose radius and also found that the tool with larger nose radius provides better surface finish all shown by experimental work.

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