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DEVELOPMENT AND OPTIMIZATION OF WORKING PARAMETER IN CNC TURNING OPERATION –A REVIEW

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ABSTRACT

Turning is the course of action in which a single point cutting tool removes unnecessary material from the surface of a revolving cylindrical work piece. This review paper discusses development in literature on optimization of process parameters in turning action by studying the influence of different process parameters like speed feed and depth of cut. The purpose of turning operation is to reduce the diameter of work piece and bring into being low surface roughness of the parts. There are three parameter which are studied in this paper, namely feed, depth of cut and spindle speed for the optimization of the surface roughness and MRR. To optimize the process parameter. it's needed to determine which parameters are most important for required output because these quality features are highly linked and are expected to be subjective directly or in some way by the direct effect of process parameters. Optimization of surface roughness of turning is a multifactor, multi objective optimization problem.

Keywords: Turning, Process Parameter, optimizations, surface finish

INTRODUCTION

In Single point turning the conditions during cutting such as cutting speed, feed rate and depth of cut should be selected to optimize the surface roughness. The selection to efficient machining parameters such as machining speed, feed rate and depth of cut has a direct impact on the metal cutting processes. The cutting tool geometry such as back rake, side rake also slightly affects the surface roughness. Turning is a major machining procedure in which a single point cutting tool removes unnecessary material from the surface of a revolving cylindrical work piece. The cutting tool is fed linearly in a path parallel to the axis of revolution. Turning is carried on a CNC lathe that gives the power to turn the work piece at a given revolving speed and to feed to the cutting tool at particular rate and depth of cut.Therefore three cutting parameters that is cutting speed, feed and depth of cut need to be indomitable in a turning operation. The reason of turning process is to construct low surface roughness of the parts. The surface roughness is one more main factor to evaluate cutting performance. Surface roughness plays an, vital role in many areas and is a factor of great significance in the evaluation of machining accuracy

Machining parameters in turning process:

In metal cutting, there are many factors related to process planning for machining operations. These factors can be classified as:

A. Type of machining operations (turning, facing, milling, etc)
B. Parameters of machine tools (rigidity, horse power etc.)
C. Parameters of cutting tools (material, geometry, etc.)

D. Parameters of cutting conditions (cutting speed, feed rate, depth of cut, etc.)
E. Characteristics of work pieces (material, geometry, etc.).

Among these factors cutting parameters (speed, feed rate and depth of cut) and tool geometry (back rake, side rake) are evidently dominating ones in a machining operation.

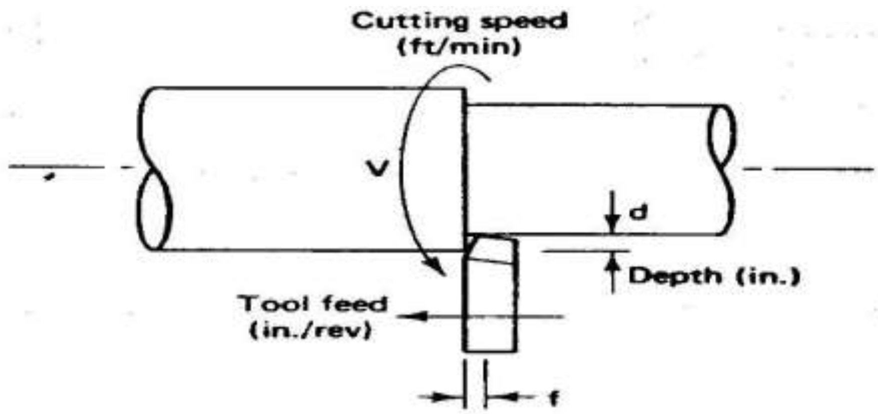

Fig 1. Turning Opereation

setting of turning process parameters as depth of cut, cutting speed as well as feed rate giving in an optimal value of the feed force when machining EN24 steel among TiC-coated tungsten carbide inserts. the variation of feed force are notably larger as compared to the contribution of the cutting speed (2·63 %).

1.Inflence Of Cutting Speed

D. Philip Selvaraj et al. [1] have studied the Taguchi optimization method was functional to find the most favourable process parameters, which minimizes the surface roughness for the duration of the dry turning of AISI 304 Austenitic Stainless Steel.The ANOVA results shows that cutting speed and affects the surface irregularity by 41.99%.

JitendraVermaet. al. [2] have taken ASTM A242 type-1 ALLOY steel of 250 mm length as well as 50 mm diameter of material for testing using a CNC lathe machine. L9 array taken and for analysed the data not only Taguchi but also ANOVA approach used. They done that speed (57.47% contribution) is the most noteworthy factor affecting surface roughness .Cutting speed is the least momentous factor affecting surface roughness.

Hari Singh et. al. [3] optimized

2.Influence Of Feed Rate

D. Philip Selvaraj et al. [1] have studied the Taguchi optimization method was functional to find the most favourable process parameters, which minimizes the surface roughness for the duration of the dry turning of AISI 304 Austenitic Stainless Steel. The ANOVA results shows that feed rate, 51.84%.

JitendraVermaet. al. [2] have taken ASTM A242 type-1 ALLOY steel of 250 mm length as well as 50 mm diameter of material for testing using a CNC lathe machine. L9 array taken and for analysed the data not only Taguchi but also ANOVA approach used feed (23.46% contribution).

Hari Singh et. al. [3] optimized setting of turning process parameters as depth of cut, cutting speed as well as feed rate giving in an optimal value of the feed force when machining EN24 steel among TiC-coated tungsten carbide inserts. The material of EN24 is a medium-carbon low-alloy steel and gets its typical applications in the manufacturing of machine tool parts. The L27 orthogonal array used for the study. They found that the percent help of and feed rate (23·33 %) in distressing the variation of feed force are notably larger.

3. Influence of Depth of cut

D. Philip Selvaraj et al. [1] have studied the Taguchi optimization method was functional to find the most process parameters, which minimizes the surface roughness for the duration of the dry turning of AISI 304 Austenitic Stainless Steel. The ANOVA results shows that feed rate, cutting speed and depth of cut affects the surface irregularity 1.66%.

Hari Singh et. al. [3] optimized setting of turning process parameters as depth of cut, cutting speed as well as feed rate giving in an optimal value of the feed force when machining EN24 steel among TiC-coated tungsten carbide inserts. The material of EN24 is a medium-carbon low-alloy steel and gets its typical applications in the manufacturing of machine tool parts. The L27 orthogonal array used for the study. They found that the percent help of depth of cut (55·15 %).

Tian –syung Lan [4] present the optimization of cutting parameter –speed, feed, depth of cut and nose radius in order to improve surface finish and MRR orthogonal array has been adopted for planning of trial and multi objective optimization by using TOPSIS. It was observing that minimum depth of cut gives better surface finish and higher MRR. J. Jadhav et al.[5] studied the effect of cutting parameters on cutting force and feed force in turning process by taking bake rake angle 12 degree, three cutting speed range from 28.91 to 65.37 m/min, three feed range from 0.1 to 0.25 mm/rev and three depth of cut range from 0.25 to 0.75 mm. Based on this study they concluded that feed rate has significant influence on both the Cutting force and Surface roughness, cutting speed has no significant effect on the cutting force as well as the surface roughness of the chosen work piece and depth of cut has a significant influence on cutting force, but an insignificant influence on surface roughness

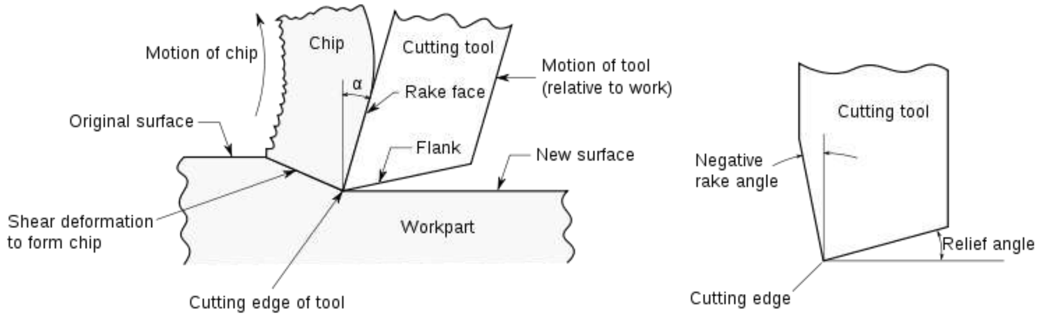

Fig 2.Machining of Work Piece

4. Influence of Rake Angle

Gunay et al [5].presented in experimental investigation of the effect of cutting tool rake angle on main cutting force depending upon eight different rake angles ranging from -5 to12.5 degree and five cutting speeds ranging from 80 to 180 rpm main cutting force (Fc) was measured while keeping depth of cut and feed rate constant. Based on this study main cutting force was reduced by increasing rake angle in positive and was increased by increasing rake angle in negative values.

Nayak et al[6] . studied on taguchi's optimization methodology, which is applied to optimize cutting parameters in machining of elastomers under ambient and cryogenic condition. For this study they used three tool rake angle range from 10 to 50 degree, three cutting speed range from 68 to 150 m/min and three feed range from 0.11 to 0.25 mm/rev and concluded that cutting force component decreases as the rake angle increases and cutting speed and feed had minimum effect on cutting force under ambient condition during machining of elastomer.

Ozturk S.et al.[7] studied the effects of the rake angle on main cutting force and thrust forces by taking rake angle -60 to 0 degree and cutting speed 0.5 m/min. Based on this study they concluded that the rake angle is the most important parameter with a contribution ratio of 56.17%.

Kumar et al[8].presented in study of Analytical investigation of rake contact, cutting forces and temperature in turning for threedifferent rake angles ranging from -5 to 5 degree and three feed ranging from .1 to .5 mm/rev. and three cutting speed ranging from 100 to 200 rpm main cutting force was measured while keeping depth of cut constant. Based on this studythey concluded that main cutting force was reduced by increasing rake angle in positive and was increased by increasing rake angle in negative values

5. Influence of Tool Extension

Renjith et al[9]. presented in study of influence of process parameters on cutting forces and taguchi based prediction of t42 -ct H.S.S single point cutting tool deflection depending upon three different rake angles ranging from 0 to 15 degree and three feed ranging from .05 to .15 mm/rev. main cutting force was measured while keeping depth of cut and cutting speed constant. Based on this study main cutting force was reduced by increasing rake angle

6. Influence of Nose Radius

Verma S. et al.[10] studied on Optimization of Radial Force in Turning Process Using Taguchi's Approach by taking two nose radius0.4 and 0.8mm,threespindlespeed range from 490 to 930rpm , three feed rate range from 0.04 to 0.16 mm/rev and three depth of cut range from 0.60 to 1.00 in turning of EN-8 steel using carbide inserts as cutting tool. Based on this study they concluded that the percent contribution of parameters in affecting variation in radial force while machining En-8 steel with carbide inserts are: feed rate (43.890%) , depth of cut (36.775%), spindle speed(3.468%)and nose radius(2.038%) and the optimal settings of various process parameters for turned parts to yield optimal radial force are: nose radius 0.8 mm, spindle speed 715 rpm, feed rate 0.04mm/rev and depth of cut 0.60 mm

7 Influence of Cutting Tool Geometry

N. S. kumar et al.[11]The optimum condition evolved is cutting insert shape 'D' (55◦ included angle), relief angle of 3◦ and nose radius of 0.4 mm. ANOVA result shows that cutting insert shape is the most significant parameter that contributes toward the output responses by 45.27 %, followed by nose radius by 36.37 %. The effect of relief angle is only 5.28 %, which is negligible. 4. The confirmation experiment conducted with the optimum cutting tool geometries shows a decrease of flank wear by 103 % and surface roughness by 30 % with increase in MRR by 12.5 %. This shows the effectiveness of Taguchi's technique in achieving better results

8. The effect of entering angle on main cutting force and tool tip temperature

[12]The main cutting edge approaches the work piece with entering angle. In large entering angle, the cutting forces are distributed over a shorter section of the cutting edge. Since the main cutting edge enters and leaves the cutting zone 6 suddenly at 90◦ of entering angle it is subjected to maximum loading and unloading. Therefore, the optimum entering angle has been obtained as 60–75◦ . At 45◦ entering angle with the same cutting speed and depth of cut, the effective cutting edge length increased greatly comparing to the 90◦ . As a result, the chip thickness becomes smaller. The entering angle affects the axial and radial components of the cutting forces. Generally, a large entering angle produces a large feed force and also smaller thrust force. The entering angle also affects the direction of chip flow.

9. The effect of rake angle on main cutting force and tool tip temperature [12]The main cutting edge approaches the work piece with entering angle. In large entering angle, the cutting forces are distributed over a shorter section of the cutting edge. Since the main cutting edge enters and leaves the cutting zone 6 suddenly at 90◦ of entering angle it is subjected to maximum loading and unloading. Therefore, the optimum entering angle has been obtained as 60–75◦ . At 45◦ entering angle with the same cutting speed and depth of cut, the effective cutting edge length increased greatly comparing to the 90◦ . As a result, the chip thickness becomes smaller. The entering angle affects the axial and radial components of the cutting forces. Generally, a large entering angle produces a large feed force and also smaller thrust force. The entering angle also affects the direction of chip flow.

CONCLUSION

From review we observed that most of the researcher have taken input parameters like feed rate, cutting speed and depth of cut and simply few researcher taken input parameter: nose radius, hardness, coating thickness of cutting tool, surroundings and output parameters: Cutting force, material removal rate, surface roughness ,tool wear, average flank wear, power expenditure and machinability. We also found that for surface roughness the largest parameters are speed, feed and nose radius and least large parameter is DOC and for MRR the most important parameters are DOC, feed and speed and least momentous parameter is nose radius. For assembly turning process cost effective along with the guarantee about quality there is need to optimize the process parameter in a orderly way by using tentative method and arithmetical models

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