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Review on Cutting Process Parameter for Surface Roughness during Turning Operation

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Abstract - *The focus of the present study is to review the effect of cutting process parameter for minimum surface roughness and to design an experiment for better understanding of the effect of the process parameters and their interactions on surface roughness. The cutting parameter such as cutting speed, feed rate, nose radius, depth of cut were taken into consideration.*

***Key Words*: Cutting speed, Feed rate, Nose radius, Depth of cut, Surface roughness, MRR, Taguchi.**

1. INTRODUCTION

In today competitive environment it is a continuously challenged for manufacturing industry is to ensuring higher productivity and high quality product. The most important objectives for manufacturing companies have always been costs, time and quality. The quality of the machined parts can be assured when the cutting parameters are controlled. The characteristics of the machined parts are influenced by two types of parameters: the parameters of the cutting tool and the ones related to the cutting operation. The selection of these parameters is associated to the material of the work piece, and this selection is also linked to the machine tool. The suitable cutting parameters are determined based on experience or by use of a handbook which does not guarantee optimal performance. Hence, the proper selection of cutting tools and process parameters is essential to achieve the desired quality of the product with low manufacturing cost and higher productivity. Roughness plays an important role in determining how a real object will interact with its environments.

Surface roughness is the critical quality indicator for machined surfaces,good quality turning surface can lead to improvement in strength properties such as fatigue strength, corrosion resistance, assembly tolerance, wear rate, coefficient of friction, thermal resistance and aesthetics etc.

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.

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.

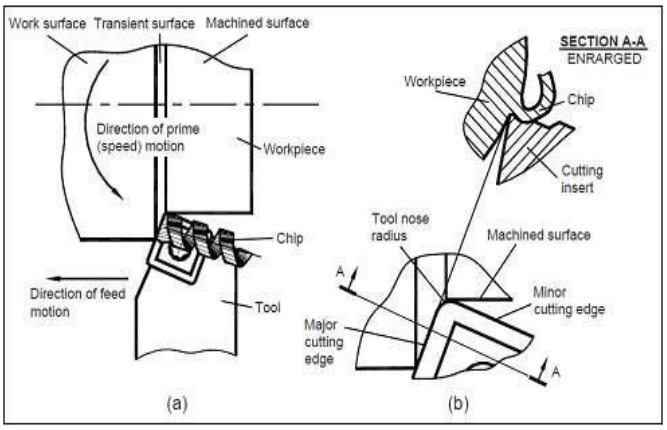

Fig. -1: Turning terminologies

The desired shape, size and finished ferrous and non ferrous materials are conventionally produced through turning the preformed blanks with the help of cutting tools that moved past the work piece in a machine tool.

2. LITERATURE SURVEY

A.EstevesCorreiaet al. (2011) analyzed the effect on surface roughness in turning steel AISI1045 using wiper inserts. Finish machining with high feed rate conventional insets present high values of surface roughness when compared with wiper inserts. Consequently it is possible to get surface quality in workpiece of mechanics precision without cylindrical grinding operations.

Süleyman Neseli et al. (2011), investigates the influence of tool geometry on the surface finish obtained in turning of AISI 1040 steel and also find out the effect of tool geometry

parameters on the surface roughness during turning, response surface methodology (RSM) was used and a prediction model was developed related to average surface roughness (Ra) using experimental data. A good agreement between the predicted and measured surface roughness was observed. Therefore, the developed model can be effectively used to predict the surface roughness on the machining of AISI 1040 steel within 95% confidence intervals ranges of parameters studied.

Harsh Y Valera (2014) represented the Experimental Investigation of Surface Roughness and Power Consumption in Turning Operation of EN 31 Alloy Steel. They analyzed the effect of three cutting parameters spindle speed, feed rate and depth of cut for surface roughness and power consumption.

Sayak Mukherjeea (2014) investigated the Optimization of Material Removal Rate during turning operation using Taguchi method and produced a predictive equation for determining MRR with a given set of parameters in CNC turning. The material selected for machining was SAE 1020 with carbide cutting tool. They used L25 orthogonal array for performing the experiment.The analysis showed that Depth of Cut had the most significant effect on MRR followed by Feed.

P.Jayaraman, L.Mahesh Kumar (2014) used Orthogonal Array of Taguchi method coupled with grey relational analysis considering three parameters viz. cutting speed, feed rate, depth of cut etc. For optimizing three responses: surface roughness, roundness and material removal rate in precision turning of AA6063 Aluminium Alloy. They concluded that feed rate is the most influencing factor in determining the multiple performance characteristics or grey relational grade (GRG) followed by depth of cut and cutting speed.

Shreemoy KumarNayak(2014)used grey relational analysis to performed multi-objective optimization of Machining Parameters During Dry Turning of AISI 304 Austenitic Stainless Steel. They investigate the effect of cutting speed, feed and depth of cut on surface roughness, cutting force and material removal rate in turning of AISI 304 Austenitic Stainless Steel using uncoated carbide insert as cutting tool under dry condition. During this study, L27 orthogonal array Taguchi design was used to study the influence of machining Parameters.

R. Deepak Joel Johnson(2014) worked on Optimization of Cutting Parameters and Fluid Application Parameters during Turning of OHNS Steel for surface roughness using taguchi technique. For this study Design of experiment with orthogonal L27 array has been used for conduct the experiment. The experimental study shows that Turning with minimal cutting fluid application improved the cutting performance by giving improved surface finish and also produced promising results when compared with dry turning and conventional wet turning. They also concluded that feed rate was having more influence on surface roughness and by tuning the fluid application parameters properly, surface roughness can be improved.

Carmita Camposeco-Negrete(2014) employed the response surface methodology for optimizing the cutting process parameter for minimizing energy consumption and maximizing cutting quality in turning of AISI 6061 T6 aluminium. They revealed that Feed rate and depth of cut were the most significant factors for minimizing the total specific energy consumed, and , feed rate was the most significant factor for minimizing the surface roughness.

Md.Maksudul Islam (2015) focused on to find out the optimal combination of process parameter in turning operation for ASTM A48 Grey Cast iron in Turning operation using Taguchi method and analysis of variance (ANOVAs).For investigation they considered ASTM A48 grey cast iron as work piece and spindle speed, feed rate and depth of cut have been considered as cutting parameters, while as HSS (High Speed Steel) has been used as cutting tool. Experimental result showed that spindle speed has the most significant contribution on the material removal rate among all the three parameters.

S.J. Raykar(2015) discussed the Multi-objective optimization of high speed turning of Al 7075 using grey relational analysis. The experiments were carried out on a CNC turning, using coated and uncoated carbide tool for the high speed turning of Al 7075.For this experimental study they considered surface roughness, power consumption, material removal rate and cutting time as response variable. From this analysis they concluded that Grey Relational Analysis is very effective technique for optimization of machining processes which involves multiple responses and also determined the optimized cutting parameter values for high speed turning of Al 7075 as 200 m/min of Speed, 0.1 mm/rev of feed rate and 0.5 mm of depth cut under dry machining conditions.

G.M.Sayeed Ahmed (2015)highlighted the effect of Feed and Radial Force in Turning Process by using Taguchi Design Approach. They optimized the Feed and Radial forces and study the effects of process parameters in Lathe turning on Mild Steel work material in dry environment conditions using HSS tool. The orthogonal array, signal to noise ratio and analysis of variance are employed to study the performance characteristics in Lathe machine turning operation. The result show that depth of cut, and cutting speed in affecting the variation of feed and radial forces are significantly larger as compared to the contribution of feed rate.

Deepak (2015) investigated that Aluminium and aluminium alloys were vital to the aerospace industry. They are the great significance to other areas of transportation and building in which durability, strength and light weight are required. They analyzed the effects of feed rate, cutting speed and depth of cut on surface roughness in turning of Al 6061 alloy. Taguchi

optimization method was employed in order to optimize the experimental result and the effect of each parameter on the obtained results was determined by use of analysis of variance (ANOVA). From the analysis, feed rate is found to be the most influential process parameters which influence the surface roughness followed by cutting speed and depth of cut. Increase in feed rate and depth of cut is found to increase the surface roughness

The effects of the feed rate, cutting speed and depth of cut on surface roughness, cutting temperature and MRR can be accessed after reviewing the literature. In order to optimize the experimental results, application of Design of Experiments (full factorial or partial), Taguchi's Method, RSM etc. are sufficiently found in literature. The effects of each parameter on obtained results were determined for different materials, tools and machining operations. .

3. CONCLUSION

Most of the study in turning operation is to reduce surface roughness during machining. Various methods, used to design experiments are suggested such as Factorial design, Taguchi and Response Surface Methodology. Low feed rate produces a good quality of surface as it is the most affecting parameter in deciding surface roughness. Most of the study to reduce surface roughness is done using considerable feed rate, not much work has been done on feed rates below 0.05 mm/rev.

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