International Conference on Computational and Experimental Methods in Mechanical Engineering
G.L. Bajaj Institute of Technology and Management, Greater Noida (U.P) India ICCEMME-2017
8th- 9th December 2017, www.conferenceworld.in ISBN: 978-93-86171-85-6

A Review on Effects of Cutting Tool Parameters on Surface Roughness

Rajesh Kumar Maurya[1]

[1]*Department of Mechanical Engineering,*

G.L. Bajaj Institute of Technology and Management, Gr. Noida, India

ABSTRACT

This review papers finds the impact of various cutting process parameters in turning of different hard metals in a CNC lathe machines. Cutting parameters may be (rotational speed, feed rate, depth of cut and nose radius).Any parameters may be varied for studying their effect on surface roughness of various hard metals. The experiments are carried out using one factor at a time approach. The different hard metals can be used for turning are SAE8620, EN8, EN19, EN24, EN47, EN31, Co28Cr6Mo,Al – 6061, AISI D2 etc.The observation shows that the surface roughness of any hard metals is directly mortmain by the spindle speed and feed rate. It is perceived that the surface roughness have the great effect by increasing the feed rate and at lower speeds and vice versa for all feed rates.The tool geometry also have a great effect on surface finish such asNose radius, Rake angle, Side cutting edge angle and Cutting edge, apart from these ,there are some other factors which also have a major impact on surface finish likeWork piece and tool material combination and their mechanical properties, Quality and type of the machine tool used, Auxiliary tooling, and lubricant used, and Vibrations between the work piece, machine tool and cutting tool.

Keywords:Work Piece,Feed Rate, Spindle Speed, Surface Roughness,Cutting Parameters, CNC Turning

I INTRODUCTION

In manufacturing industries and metal turning process, the product quality is totally determined by their degree of surface finish. Good surface finish not only specifies the quality but also reduces manufacturing cost. In tolerance point of view good surface finish are very important terms, it reduces the assembly time as well as prevents the need of secondary operation, thus reduce the overall cost by saving the operation time. In spite of good-quality turned surface is significant in providing fatigue strength, corrosion resistance and creep lifeSurface. Surface roughness of a machined part plays an important role in modern manufacturing process because of increasing demand of higher precision components for its functional aspect. Turning is a machining operation, whichis carried out on CNC lathe. The quality of the surface plays a very important role in the performance of turning as a goodquality turned surface significantly improves fatigue strength, corrosion resistance, or creep life. Surface roughnessalso affects several functional attributesof Parts, such as contact

causing surface friction, wearing, light reflection,heat transmission, ability of distributing and holding a lubricant, load bearing capacity, coating or resisting fatigue.Therefore, the desired surface finish is usually specified and the appropriate processes are selected to reach therequired quality [1].Surface roughness plays an important role in affecting friction, wear and lubrication of contacting bodies [2]. Surfaceroughness is one of the parameters that greatly influence the friction under certain running conditions [3]. Surfaceroughness of the contacting surfaces influences the frictional properties of those surfaces during the forming processes [4]. It is fact now that surface roughness geometry strongly influences the manner in which the contacting surfaces.

II MEASUREMENT 0F SURFACE ROUGHNESS

Inspection and assessment of surface roughness of machined work pieces can be carriedout by means of different measurement techniques. These methods can be ranked into theFollowing classes:

1. Direct measurement methods
2. Comparison based techniques
3. Non-contact methods
4. On-processmeasurement

2.1Principle of Measurement of Surface Roughness

The surface roughness of any machined parts can be measured by different techniques such as direct measurement methods; Comparison based techniques, Non contact methods and On-process measurement. Generally roughness measurement is done by using a portable stylus-type profilometer; Talysurf (Taylor Hobson, Surtronic 3+, UK).This instrument is a portable, self-contained instrument for the measurement of surface texture. It is a microprocessor based to evaluate parameter. The measured results are displayed on LCDscreen and output can be taken with the help of printer or other computers for further evaluation. The instrument is operated by non-rechargeable alkaline battery (9V).There is a diamond stylus having a tip radius 5 µm.The measurement is always done from the extreme outward position .At the end of the measurement the pickup returns to the position ready for the next measurement

The cut-off length determines the traverse length.Generally, the traverse length is five times the cut-off length though the magnification factor can be changed.The profilometer has been set to a cut-off length of 0.8 mm, filter 2CR, and traverse speed 1 mm/sec and 4 mm traverse length. On the work pieces where surface roughness measurement has been taken are repeated four times in the transverse directionand average of four measurements of surface roughness parameter values has been recorded. Theadvanced surface finish analysis software *Talyprofile*is used for measuring profile which make it in digitized form and processed for evaluation of the roughness parameter.

III Literature Review

1.Mehmet Alper İNCE1 et.al.(2015)

This paper investigate the effects of cutting parameters such as rotational speed, feed rate, depth of cut and nose radius on the surface roughness of Co28Cr6Mo medical alloy. The graphical presentation is done for the

understanding of the influences of cutting parameters. For getting minimum surface roughness the optimum values obtained for rpm, feed rate, depth of cut and nose radius were respectively, 318 rpm, 0.1 mm/rev, 0.7 mm and 0.8 mm.whereas the rpm, feed rate, depth of cut and nose radius were respectively, 318 rpm, 0.25 mm/rev, 0.9 mm and 0.4 mm. has been revealed the maximum surface roughness.[1]

2. Mohit K Pandya1et.al. (2015)

In this paper researchers have found the experimental investigation on surface roughness by using PVD and CVD coated carbide insert and uncoated carbide insert during dry turning of Ti-6Al-4Von CNC machine. This paper deals with the machining of Ti6Al4V material. This paper discusses an experimental investigation on surface roughness of Ti-6Al-4V using PVD and CVD coated carbide insert and uncoated carbide insert during dry turning on CNC machine. Ti-6Al-4V is widely used in automotive, marine applications, aerospace and jet engine components due to its high strength to weight ratio. The effect of different process parameter like speed, feed and depth of cut is examined for better surface roughness. Analysis of variance was carried out for analyzing the contribution of process parameters for the coated and uncoated carbide insert. And comparison of coated and uncoated inserts.

3. Ula¸sÇayda¸ et.al (2012)

In this paper researcher has find the surface roughness quality of AISI 304 austenitic stainless steel in CNC turning operation with three different types of support vector machines(SVMs) tools such as least square ,spider and artificial neural network(ANN).In this model cutting speed, feed rate and depth of cut were taken as model variables of the cutting parameters .for finding the surface roughness quality or values the papers has utilizes the mathematical tool i.e.design of experiments (DOE).A feed forward neural network with a multilayered architecture made up of 15 hidden neurons which was based on back propagation algorithm had been placed between input and output layers. All results shown by this model used by SVMs were quiet better than used with ANNwith high correlations between the prediction and experimentally measured values.

4. N. Satheesh Kumar et.al (2012)

This paper investigates the effect of process parameters in turning of Carbon Alloy Steels in a CNC lathe. The parameters namely the spindle speed and feed rate are varied to study their effect on surface roughness. The experiments are conducted using one factor at a time approach. The five different carbon alloy steels used for turning are SAE8620, EN8, EN19, EN24 and EN47. The study reveals that the surface roughness is directly influenced by the spindle speed and feed rate. It is observed that the surfaceroughness increases with increased feed rate and is higher at lower speeds and vice versa for all feed rates. The better surface finish may be achieved by turning carbon alloy steels at low feed rate and high spindle speeds.

5. IlhanAsiltürket.al (2011)

This paper investigates the measurement of surface roughness at different cutting parameters such as speed, feed and depth of cut. The surface roughness of AISI 1040 steel are modeled by two approaches i.e. Artificial neural network (ANN) and multiple regression approaches and both models are compared by statistical methods. It is found thatthe ANN model appear the surface roughness with high accuracy as compared to the multiple regression model.In this study, multiple regression and artificial neural network approaches were used to predict the surface roughness in AISI 1040 steel.

6. Ranganath M. S. et.al (2015)

In this paper researchers have presented the effect of the cutting process parameters such as cutting speed, feed rate and depth of cut on surface roughness, while turning of Aluminium (6061) in CNC turning at dry condition. This paper uses Design of experiments(DOE) calculating the influence of the turning parameters on the surface roughness by using Taguchi design and Analysis of Variance (ANOVA) to find minimum surface roughness.

7. H. K. Dave et.al (2012)

This paper finds characteristics of different grades of EN materials in CNC turning process using TiN coated cutting tools on experimental investigation of the machining process. The better surface finish is the main criterion in machining operation for many turned work pieces. The main aim of this paper is to get the lowest surface roughness and maximum material removal rate of different grades of EN materials in CNC turning by Taguchi method. Thus it can increase machine utilization anddecrease production cost in an automated manufacturing environment.

7.1 In this paper the experimental observations highlights the MRR in CNC turning process which is greatly influenced by depth of cut.

7.2 It is found that if speed is increase then MRR would increase and positive inserts are superior as compare to negative inserts for more MRR.

7.3 Analysis of Variance finds that the insert is the most significant factor for surface roughness.

V.GAPS IN THE LITERATURE REVIEW

On the basis of reviewed papers it has been found that researchers had been investigated the effect of various cutting parameters on the surface roughness of different hard metals by using different mathematical tools such as design of experiments (DOE), Taguchi methods, Analysis of Variance (ANOVA) , Artificial neural network (ANN) and multiple regression approaches but they didn't uses the heat transfer system i.e. HTS tools and nano fluids particles in coolant for optimization of surface roughness.

VI. CONCLUSION

This review papers presented an experimentation approach to see the effects of turning parameters on surface roughness. These papers used a Systematic approach to design and analyze the experiments, and to absorb the data obtained to the maximum extent. The following resultsare found on the basis of experimental investigation conducted at different levels by employing varioustechniques to determine the optimal level of process parameters.

1. CNC turning give the better results as compare to the conventional turning in which only some fixed values can be selected.
2. Better output has been achieved by using DOE techniques as compare to Taguchi using MINITAB software.
3. At a certain limit of cutting speed the surface roughness decreases but beyond that the surface roughness increases.
4. It has been seen that Increase in feed rate has a adversely affects on surface finish
5. ANOVA and F-test shows that the speed has more affective parameter than depth of cut and feed

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