International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 02, February-2015

Experimental Study to Investigate of Effects of Cutting tools on Surface Roughness and MRR of EN31 (Alloy Steel) Turning Operation on CNC Machine-Research Review

Delvadiya Parth [1], Prof. Ankit Darji[2]
[1]P.G student,
[2]Assistant Professor, LDRP-ITRGandhinagar, Gujarat (India)

***Abstract*-- The main purpose of this review paper is to check whether quality lies within desired tolerance level which can be accepted by the customers. Surface roughness relative using various CNC machining parameters including spindle speed (N), feed rate (f) and depth of cut (d) and cutting tolls. In experimental study to investigate the surface roughness relatives using various CNC machining parameters like spindle speed, feed and depth of cut and cutting tools on surface finish on EN-31.The evaluation of influence of cutting conditions in facing operation of EN-31 in this paper. Machining was done using cemented carbide insert.**

Keywords: ***CNC turning operation, EN-31, Surface roughness, Material removal rate.***

INTRODUCTION

The challenge of modern machining industries is mainly focused on the achievement of high quality in term of work piece dimensional accuracy, surface finish, high production rate, less wear on the cutting tools, economy of machining in terms of cost saving and increase of the performance of the product with reduced environmental .The mechanism behind the formation of surface roughness in CNC Lathe turning process is very dynamic, complicated, and process dependent. Several factors will influence the final surface roughness in CNC Lathe operations such as controllable factors (spindle speed, feed rate and depth of cut) and uncontrollable factors (tool geometry and material properties of both tool and workpiece).

Surface finish is one of the most important requirements in machining process, as it is considered an index of product quality. It measures the finer irregularities of the surface texture. Achieving the desired surface quality is critical for the functional behavior of a part.

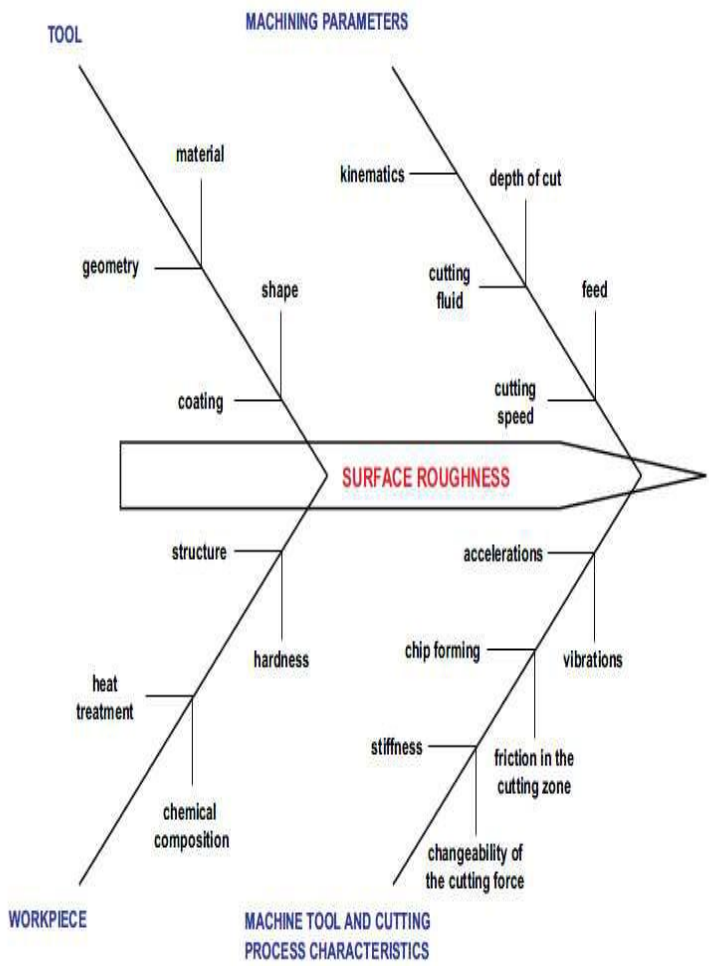

Fig. 1 Parameters affects the surface roughness

The factors that influence surface finish are machining parameters, tool and work piece material properties and cutting conditions. For example, in Turning operation the surface finish depends on cutting speed, feed rate, depth of cut, cutting fluid, tool nose radius lubrication of the cutting tool, machine vibrations, tool wear and on the mechanical and other properties of the material being machined. CNC turning process parameters are -classified according to Tool, Machining parameters, Work piece, machine tool and cutting process parameters as shown in below Figure (1).

II. EXPERIMENTAL CONDITIONS AND PROCEDURES

1. Test specimen: The experiment was conducted using one work piece material EN-31. The tests work piece relative dimension was a length 200 MM and diameter Ø32 MM. The basic used of EN-31material as Ball and Roller Bearings, Spinning tools, Beading Rolls, Punches and Dies. By its character this type of steel has high resisting nature against wear and can be used for components which are subjected to severe abrasion, wear or high surface loading.

The chemical composition and mechanical properties of the selected work piece is shown as in table 1 and table 2 respectively.

C%	Si%	Mn%	S%	P%
0.90 - 1.20	0.30 - 0.75	0.10 - 0.35	0.040	0.040

Table1. Chemical composition of EN 31 Alloy Steel

Bulk Modulus	Shear modulus	Elastic modulus	Poisson's ratio	Hardness Rockwell C
140 Gpa	80 Gpa	190 GPa	0.30	0.20

Table2. Mechanical Properties of EN 31 Alloy Steel

2. Machine tool: Machining experiment has been performed on a high rigid CNC lathe (JOBBER XL, AMS, India) equipped with variable spindle speed from 50 to 3500 rpm and 16KW maximum spindle power with Control System Fanuc 0i-Mate-TD shown in Fig. 2) under dry environment.

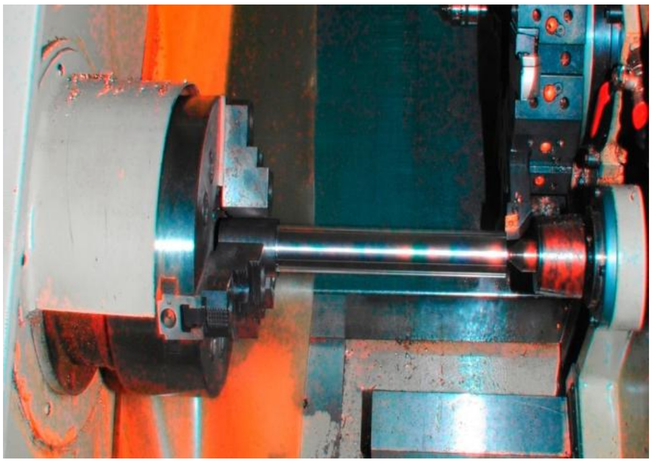

Fig.2 Photograph of CNC Lathe.

3. Cutting inserts: In tests, two types of carbide inserts use.

A) chemical vapor deposition (CVD) multilayer coated carbide inserts coated with four layers of (TiN, TiCN, Al2O3 and TiN), the outermost being TiN designated as TN 2000 grade and other is CVD coated (TiN, TiCN, Al2O3 and ZrCN), the outer most being ZrCN designated as TN 7015 grade respectively. Grade TN 2000, a CVD coated cobalt enriched substrate has required bulk toughness added with multilayer MT CVD coating which gives the wear resistance and crater resistance required in steel machining. It provides required chip impact resistance and well balanced toughness and wear resistance properties. Grade TN 7015, a CVD coated with tough surface zone and thick TiCN and ZrCN coating gives excellent wear and heat resistant properties. Grade TTS is ideally considered as universal uncoated grade for steel machining. Inserts are mounted on a tool holder designated by ISO as PCLNR2525 M12

B) Physical vapor deposited (PVD) coated carbide tools tungsten carbide substrate material is used in order to increase wear resistance and reduce insert chip-ping. Tool wear, cutting force, surface roughness and cutting power are relative responses. Tool wear results in changes in tool geometry that affect cutting forces, cutting power, and surface finish. It is the main factor that determines the economics in metal cutting. A lower rate of tool wear means increased tool life, better surface finish, reduced tooling cost and lower cost of production. In case of PVD TiAlN coating, the improvement in the cutting performance is due to the oxidation resistance of TiAlN properties at higher temperature. High wear resistance even at high temperatures is the outstanding property of TiAlN, a characteristic that makes this coating appropriate to cut abrasive work piece material such as cast iron, aluminum silicon alloys and composite materials at high speeds.

4. Cutting conditions: The cutting condition for finish hard turning under higher parametric condition is shown in Table3.

Process Parameters With Their Values At Three Levels				
Factor	Process parameters	Level 1	Level 2	Level 3
A	Cutting speed (m/min)	100	150	200
B	Feed rate (mm/rev.)	0.125	0.150	0.175
C	Depth of cut (mm)	0.2	0.3	0.4

Table3. Process Parameters of CNC Machine

5. Material removal rate (MRR): has been calculated from the difference of weight of work piece before and after experiment.

$$MRR = \frac{Wi - Wf}{\rho t} mm^3/min$$

Where, Wi is the initial weight of work piece in *g* ; *W f* is the final weight of work piece in *g* ; *t* is the machining time in minutes; *s* ρ is the density of alloy steel. The weight of the work piece has been measured in a high precision digital balance meter (Model: DHD – 200 Macro single pan DIGITAL reading electrically operated analytical balance), which can measure up to the accuracy of 10-4 *g* and thus eliminates the possibility of large error while calculating material removal rate (MRR) in straight turning operation.

6. Surface roughness measurements: The arithmetic average surface roughness (Ra) of the work piece is measured by SURFTEST SJ 201P surface roughness tester (shown in Fig. 3), where the cutoff length and assessment length was fixed as 0.8 mm and 4 mm respectively. The instrument was calibrated using a standard calibration block prior to the measurements. The measurement was taken at four locations (90_apart) around the circumference of the workpieces and repeated twice at each point on the face of the machined surface and the average values reported for the response.

Fig 3. Surface roughness tester (MITUTOYO SURFTEST SJ 201P).

III. References

1. D.I. Lalwani, N.K. Mehta, P.K. Jain, Experimental investigations of cutting parameters influence on cutting forces and surface roughness in finish hard turning of MDN250 steel, J. Mater. Process. Technol. 206 (2008) 167–179.
2. Y.W. Park, Tool material dependence of hard turning on the surface quality, Int. J. Korean Soc. f Prec. Eng. 3 (1) (2002) 76– 82.
3. T. Ozel, Y. Karpat, L. Figueira, J.P. Davim, Modelling of surface finish and tool flank wear in turning of AISI D2 steel with ceramic wiper inserts,J. Mater. Process. Technol. 189 (2007) 192–198.
4. Y. Sahin, A.R. Motorcu, Surface roughness model in machining hardened steel with cubic boron nitride cutting tool, Int. J. Refract. Metals Hard Mater. 26 (2008) 84–90.