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60
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Investigation of Process Parameters for Improving Surface Finishing Quality by using Square Radius Carbide Tips

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Abstract: Metal cutting is one of the most significant manufacturing processes in the area of material removal. Black of the many teeth around the milling cutter provides a fast method of machining. The machined surface may be flat, angular, or curved. The surface may also be milled to any combination of shapes. The machine for holding the work piece, rotating the defined metal cutting is the removal of metal chips from a workpiece in order to obtain a finished product and with desired attributes like , size, shape, and surface roughness. The imperative objective of the science of metal cutting is the solution of practical problems associated with the efficient and precise removal of metal from work piece. It has been recognized that the reliable quantitative predictions of the various technological performance measures, preferably in the form of equations, are essential to develop optimization strategies for selecting cutting conditions in process planning. In this thesis experiments has to be conducted to improve the surface finish quality of a work piece by using carbide tips. The type is bull nose tip. Material used for work piece areEN24 and En31. These two materials are die steels. A series of experiments have to be done by varying the milling parameters spindle speed(2100, 2200, 2300, 2400, 2500 RPM),Feed rate (700, 980, 1400, 1900, 2600 mm) and depth of cut are constant 0.25 mm

Keywords: Analysis, depth of cut, feed rate, finish, spindle speed, surface milling parameters.

1 INTRODUCTION

Milling is the process of cutting away material by feeding a work piece past a rotating multiple tooth cutter. The cutting action cutter, and feeding it is known as the Milling machine.

Material	Density Kg/m³	Ultimate Tensile Strength(M.pa)	Modulus of Elasticity (G.Pa)	Poisson Ratio	Tensile Strength, Yield(M. Pa)
EN24	7830	1005	207	0.29	938
EN 31	7850	1050	213	0.29	960

In the milling process surface finish are depends on the parameters like depth of cut, Spindale speed, cut feed, type of cutter used, Machine Guide ways, turkete, ball screws.

Cutting tool also plays major role in surface finishing. In this thesis carbide tips are used.

A. Carbide Physical and Mechanical properties

Material	Density Kg/m³	Hardness , Rockwell	Hardness , Vickers	Rupture Strength (M. Pa)	Compressi-ve Strength (M. Pa)
Carbide	1495	91.9	1575	2200	6200

Component Elements Properties

Cobalt, Co ----------6.0%
WC ----------94.0%

Work piece Materials are EN24 and EN31 these two materials are Die steels.

B. Material physical and Mechanical properties

Component Elements Properties

Carbon, C	1.00 %
Chromium, Cr	1.50 %
Iron, Fe	96.9 %
Manganese, Mn	0.350 %
Silicon, Si	0.250 %

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2 INTRODUCTION TO SURFACE ROUGHNESS

Surface roughness, often shortened to roughness, is a measure of the texture of a surface. It is quantified by the vertical deviations of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small the surface is smooth. Roughness is typically considered to be the high frequency, short wavelength component of a measured surface (see surface metrology). However, in practice it is often necessary to know both the amplitude and frequency to ensure that a surface is fit for purpose.

Roughness plays an important role in determining how a real object will interact with its environment. Rough surfaces usually wear more quickly and have higher friction coefficients than smooth surfaces (see tribology). Roughness is often a good predictor of the performance of a mechanical component, since irregularities in the surface may form nucleation sites for cracks or corrosion. On the other hand, roughness may promote adhesion.

Although roughness is often undesirable, it is difficult and expensive to control in manufacturing. Decreasing the roughness of a surface will usually increase exponentially its manufacturing costs. This often results in a trade-off between the manufacturing cost of a component and its performance in application.

Roughness can be measured by manual comparison against a "surface roughness comparator", a sample of known surface roughness, but more generally a Surface profile measurement is made with a profilometer that can be contact (typically a diamond styles) or optical (e.g. a white light interferometer).

However, controlled roughness can often be desirable. For example, a gloss surface can be too shiny to the eye and too slippery to the finger so a controlled roughness is required. This is a case where both amplitude and frequency are important. The scattering of light Light scattering obviously depends both on amplitude and frequency. Less obviously, touch is mediated by both amplitude and frequency detectors in the finger.

2.1 Objective Of The Work

Metal cutting is one of the most significant manufacturing processes in the area of material removal. Black defined metal cutting as the removal of metal chips from a work piece in order to obtain a finished product with desired attributes of size, shape, and surface roughness.

The imperative objective of the science of metal cutting is the solution of practical problems associated with the efficient and precise removal of metal from work piece. It has been recognized that the reliable quantitative predictions of the various technological performance measures, preferably in the form of equations, are essential to develop optimization strategies for selecting cutting conditions in process planning.

The progress in the development of predictive models, based on cutting theory, has not yet met the objective; the most essential cutting performance measures, such as, tool life, cutting force, roughness of the machined surface, energy consumption, … etc., should be defined using experimental studies.

The demand for high quality and fully automated production focuses attention on the surface condition of the product, especially the roughness of the machined surface, because of its effect on product appearance, function, and reliability. For these reasons it is important to maintain consistent tolerances and surface finish. Also, the quality of the machined surface is useful in diagnosing the stability of the machining process, where a deteriorating surface finish may indicate work piece material non-homogeneity, progressive tool wear, cutting tool chatter, etc.

Among several industrial machining processes, milling is a fundamental machining operation. End milling is the most common metal removal operation encountered. It is widely used in a variety of manufacturing industries including the aerospace and automotive sectors, where quality is an important factor in the production of slots and dies. The quality of the surface plays a very important role in the performance of milling as a good-quality milled surface significantly improves fatigue strength, corrosion resistance, and creep life.

Surface roughness also affects several functional attributes of parts, such as wearing, heat transmission, ability of holding a lubricant, coating, or resisting fatigue. Therefore, the desired finish surface is usually specified and the appropriate processes are selected to reach the required quality. Several factors influence the final surface roughness in end milling operation. Factors such as spindle speed, feed rate, and depth of cut that control the cutting operation can be setup in advance. However, factors such as tool geometry, tool wear, and chip formation, or the material properties of both tool and work piece are uncontrolled.

One should develop techniques to predict the surface roughness of a product before milling in order to evaluate the robustness of machining parameters such as feed rate or spindle speed for keeping a desired surface roughness and increasing product quality. It is also important that the prediction technique should be accurate and reliable.

Researchers in this area attempt to develop models which can predict surface finish of a metal for a variety of machining conditions such as speed, feed, depth of cut, etc. Reliable models would not only simplify manufacturing process planning and control, but would assist in optimizing machinability of materials. Therefore, the purpose of this study is to study the effect of machining parameters on the surface quality of the machined surfaces, effect of cutting fluid on surface roughness.

3 EXPERIMENTAL WORK

Experiments have been performed in order to investigate the effects of one or more factors of the process parameters (spindle speed, feed rate and depth of cut) on the surface finish of the machined surface.

The main aim of the project is to determine the influence of radius carbide tips in metal working. The investigation is based on surface roughness during milling of EN 24 and EN31 steel with carbide tool. The cutting parameters considered are feed rate, spindle speed and depth of cut.

This experiment employed a CNC vertical milling machine. Carbide cutting tool is used. The experiment has been done under conditions of feed rate 700mm/min, 980mm/min, 1400 mm/min, 1900 mm/min and 2600 mm/min. For EN24 Spindle speeds are2000rpm, 1800rpm, 2100rpm, and depth of cut 0.25mm, And for EN31, spindle speeds are 2100rpm, 2200rpm, 2300rpm, 2400rpm and 2500rpm.

Two square pieces of EN 24 material and three round pieces of EN31 material are taken for machining.

C. MACHINE SPECIFICATIONS

Machine manufacturing
Company ------CHEN HO
Machine Type ------ Vertical Milling Machine
Number of axis ------3 Axis
Work travels --------X-1820mm, Y-850mm, Z-790 mm.
Type of guide ways --------Box type
Maximum feed rate --------6000mm/min
Maximum spindle speed ------- 5000 R.P.M.
Hydraulic operated spindle
Machine controller ---------MELDAS 500A

D. CUTTING TOOL

Type of cutter ---------Tip cutter
Cutter specification ------25 r2 (Diameter 25mm, corner radius 2mm)

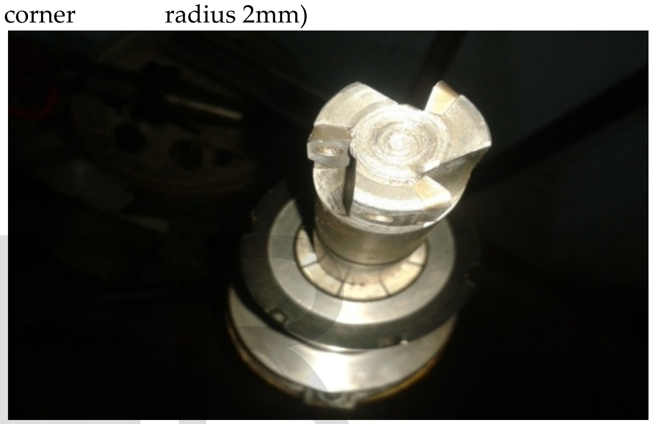

Fig 1 cutting tool

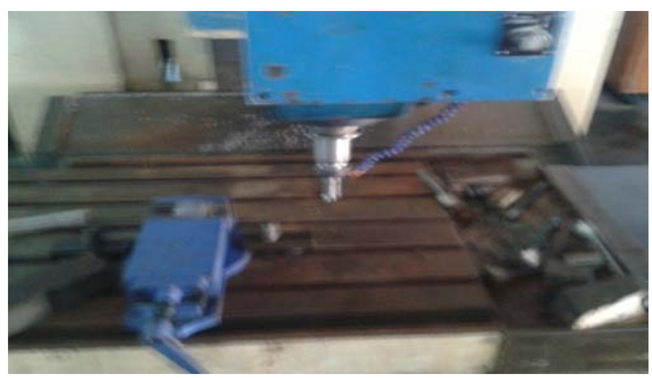

Fig.2. Work piece setup

Fig.3. Machine controller

4 Results & Discussions

Surface roughness experimental results:-

4.1 Final results of the Machined specimen for various machining parameters:

Surface profile measurement is made with a profilometer that can be contact with the work piece on profile area.

EN-24 MATERIAL
SECTION-A

S, NO.	FEED mm/Min.	SPEED rpm	DEPTH OF CUT mm	SURFACE FINISH (R_a) µm
1.	700	2000	0.25	4.36+2.78/2=3.57
2.	980	1800	0.25	4.1+2.85/2=3.475
3.	1400	2100	0.25	1.16+3.76/2=2.46
4.	1900	2000	0.25	1.34+1.30/2=1.32
5.	2600	2000	0.25	1.2+1.24/2=1.22

Above table shows the surface roughness for EN24 for first set of parameters.

SECTION-B

S, NO.	FEED mm/Min.	SPEED rpm	DEPTH OF CUT mm	SURFACE FINISH (R_a) µm
1.	700	2100	0.25	4.23+2.90/2=3.63
2.	980	2200	0.25	4.6+2.97/2=3.785
3.	1400	2300	0.25	1.45+3.92/2=2.685
4.	1900	2400	0.25	2.13+1.72/2=2.785
5.	2600	2500	0.25	1.61+1.4/2=2.31

EN-31 MATERIAL
SECTION-A

S, NO.	FEED mm/Min.	SPEED rpm	DEPTH OF CUT mm	SURFACE FINISH (R_a) µm
1.	700	2000	0.25	4.76+3.1/2=3.93
2.	980	1800	0.25	4.41+3.1/2=3.755
3.	1400	2100	0.25	1.32+3.86/2=3.25
4.	1900	2000	0.25	1.53+1.71/2=1.62
5.	2600	2000	0.25	1.3+1.56/2=1.96

Above table shows the Surface roughness for EN31 for first set of parameters.

SECTION-B

S, NO.	FEED mm/Min.	SPEED rpm	DEPTH OF CUT mm	SURFACE FINISH (R_a) µm
1.	700	2100	0.25	4.86+3.31/2=4.085
2.	980	2200	0.25	4.92+3.42/2=4.17
3.	1400	2300	0.25	1.61+3.92/2=2.765
4.	1900	2400	0.25	2.42+2.1/2=2.26
5.	2600	2500	0.25	1.71+1.52/2=1.615

Above results shows the Surface Roughness for EN31 for second set of parameters.

5 CONCLUSION

In this thesis, experiments are conducted to improve the surface finish quality of a work piece by using carbide tips. The type of tip is bull nose tip. A series of experiments is done by varying the milling parameters spindle speed, feed rate. The experiments are conducted on vertical milling machine of make Chenho. The work piece materials are alloy steel EN24 and EN31.

Two sets of each work piece material are machined by specifying following parameters: Feed rates of 700mm/min, 980mm/min, 1400mm/min, 1900mm/min and 2600mm/min, Spindle speeds of 2000rpm, 1800rpm, 2100rpm, and 2000rpm. By observing the experimental results, for EN24 material machining at 2600mm/min feed rate and spindle speed of 2000rpm yields better results as the surface finish is good.For material EN31 machining at 1900mm/min and 2000rpm yields better results as the surface finish is good.

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