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A Review on Optimization of end Milling for Stainless Steel (AISI 316)

KEYWORDS: CNC end milling, Surface roughness, Tool Wear, AISI 316.

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ABSTRACT *Quality and productivity play important role in today's manufacturing market. Now a day's due to very stiff and cut throat competitive market condition in manufacturing industries. The main objective of industries reveal with producing better quality product at minimum cost and increase productivity. CNC end milling is most vital and common operation use for produce machine part with desire surface quality and higher productivity with less time and cost constrain. To obtain main objective of company regards quality and productivity. In the present research project an attempt is made to understand the effect of machining parameters such as cutting speed (m/min), feed rate (mm/min),depth of cut (mm), four no. of cutting flute that are influences on responsive output parameters such as Surface Roughness and Tool Wear by using optimization philosophy. The effort to investigate optimal machining parameters (Speed, Feed and Depth of cut) and their contribution on producing better Surface quality and higher Productivity.*

INTRODUCTION

Milling is the process of machining flat, curved, or irregular surfaces by feeding the work piece against a rotating cutter containing a number of cutting edges. The milling machine consists basically of a motor driven spindle, which mounts and revolves the milling cutter, and a reciprocating adjustable worktable, which mounts and feeds the work piece. Among several CNC industrial machining processes, milling is a fundamental machining operation. End milling and face

Milling is the most common metal removal operation encountered. It is broadly used in a variety of manufacturing industries including the aerospace, automotive sectors, where quality is vital factor in the production of slots, pockets, precision moulds and dies [6].

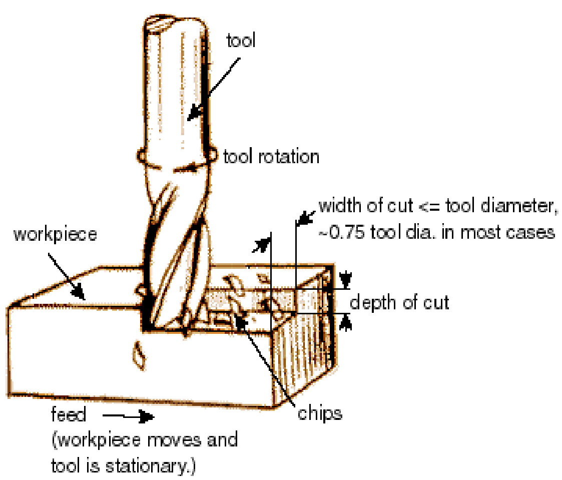

Fig. 1.1 Milling Operation

END MILLING OPERATION

End milling is the most common metal removal operation encountered. It is widely used to mate with other part in die, aerospace, automotive, and machinery design as well as in manufacturing industries. The cutter called end mill has diameter less than the work piece width.

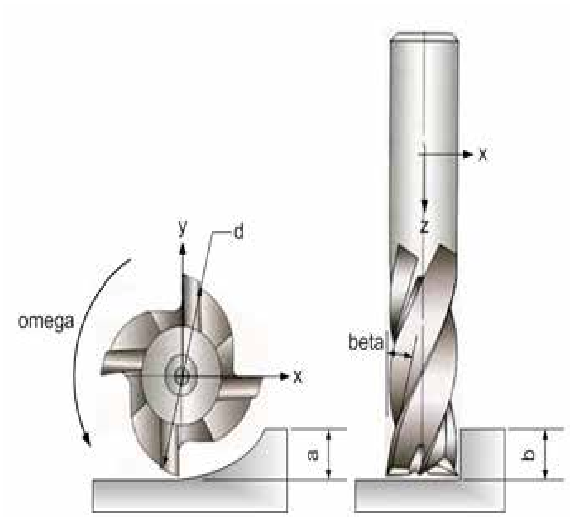

Fig 1.2 End milling operation

OBJECTIVE OF TOPIC

- ✓ To study the effect of Solid carbide tool on end milling of AISI 316 in dry machining.
- ✓ To compare the outcomes resulting from Solid carbide tools while milling of AISI 316.
- ✓ To decide the range of machining parameter (feed, speed, depth of cut) by which one can optimize the performance of AISI 316.
- ✓ To evaluate the effect of cutting conditions on Tool wear, surface roughness of solid carbide tools in end milling of AISI 316.
- ✓ To measure the Tool wear & Surface Roughness by tool maker's microscope and surface roughness tester respectively.

SCOPE OF TOPIC

The scope of this research is focused on milling of AISI 316 using cemented carbide tools. The processes will be conducted under various independent variables which include cutting speed, feed rate, and depth of cut. At the end of the study the performance of each cutting tool will be compared by observed data while milling process on

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CNC. Finally measurement of Tool wear by Tool Maker's Microscope & Surface roughness will be carried out using surface roughness tester.

SURFACE ROUGHNESS

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. Surface roughness is an important parameter of quality of work piece surface and has so much effect on final function and production cost of pieces, and also on mechanical properties such as fatigue life, corrosion resistance, creep resistance and on the other features of the piece like as friction, lubrication, electrical conductivity and so on. Hence it is necessary to carried out on modelling surface roughness and optimizing and controlling the parameters in order to find ideal surface roughness through choosing correctly the machining parameters. If these deviations are large, the surface is rough; if they are small the surface is smooth.

TOOL WEAR

Tool wear describes the gradual failure of cutting tools due to regular operation. It is a term often associated with tipped tools, tool bits, or drill bits that are used with machine tools.

CUTTING PARAMETER

✓ Cutting speed:Cutting speed may be defined as the rate (or speed) that the material moves past the cutting edge of the tool, irrespective of the machining operation used.

Speed is calculated from the equation;

$V = \pi DN$.

Where D= diameter of end mill cutter,

N= rotational speed of the cutter.

✓ **Feed:** Feed rate is the velocity at which the cutter is fed, that is, advanced against the work piece. It is expressed in mm/min.

Feed is calculated from the equation;

FR = RPM*T*CL

FR = the calculated feed rate in inches per minute or mm per minute.

RPM = is the calculated speed for the cutter.

T = Number of teeth on the cutter.

CL = the chip load or feed per tooth. This is the size of chip that each tooth of the cutter takes.

✓ **Depth of cut:**Depth of cut is the material removal rate, which is the volume of work piece material (metal, wood, plastic, etc.) that can be removed per time unit.

LITERATURE REVIEW

S.kalidass, at el, [1] were carried out "Prediction of tool wear using regression and artificial neural network models in end milling of AISI 304 Austenitic Stainless Steel"They describe use and steps of four factors at five level design of experiments to find a specific range and combinations of machining parameters like spindle speed, feed rate and depth of cut to achieve optimal values of response variables like Roughness parameters (Ra) in machining of material AISI 304.Six Sigma software was used for finding the coefficients to develop the regression model. Artificial neural network is used to predict the tool wear.Predicted values of response by both models, i.e. regression and ANN are compared with the experimental values. The predictive neural network model was found to be capable of better predictions of tool flank wear within the trained range.

Jignesh G. Parmar&Prof.AlpeshMakwana, [2]were carried out"Prediction of surface roughness for end milling process using Artificial Neural Network". They describe to prediction surface roughness for end milling process by using artificial neural network analysis.The neural network model can be effectively find the best cutting parameters value for a specific cutting condition in milling operation and achieve minimum surface roughness. In this experimental investigation of the end milling of M.S material up to 30 HRC with carbide tool by varying feed, speed and depth of cut and the surface roughness was measured using Mitutoyo Surface Roughness Tester. The neural network design and development was done using MATLAB. Neural Network Fitting Tool Graphical User Interface is used to establish the relationship between the surface roughness and the cutting input parameters (spindle speed, feed and depth of cut). The result from this research is useful to be implemented in industry to reduce time and cost in surface roughness prediction.

Hossam M. Abd El-rahman, at el, [3]were carried out "Implementation of neural network for monitoring and prediction of surface roughness in a virtual end milling process of a CNC vertical milling machine".in this reserchthe effects of various parameters of end milling process like spindle speed, depth of cut, feed rate have been investigated to reveal their Impact on surface finish using AlyudaNeuroIntelligence. The neural network is used to predict surface roughness of the virtual milling machine to analyze and pre-process pre measured test data. The simulation for the geometrical modelling of end milling process and analytical modeling of machining parameters was developed based on real data from experiments carried out using Prolight2000 (CNC) milling machine. This application can simulate the virtual end milling process and surface roughness Ra (μm) prediction graphs against cutting conditions simultaneously. The user can also analyze parameters that influenced the machining process such as cutting speed, feed rate of worktable.

MuatazHazza F. Al Hazza, at el, [4]were carried out "Simulation of Tool Life for ceramic with negative rake angle using neural network"The purpose for this research is to increase tool life by reducing tool wear. In this research a set of sparse experimental data for finish end milling on AISI H13 at hardness of 48 HRC have been conducted to measure the flank wear length. High speed milling has many advantages such as higher removal rate and high productivity. However, higher cutting speed increase the flank wear rate and thus reducing the cutting tool life. Therefore estimating and predicting the flank wear length in early stages reduces the risk of unaccepted tooling cost. This research presents a neural network model for predicting and simulating the flank wear in the CNC end milling process. Then the measured data have been used to train the developed neural network model. Artificial neural network (ANN) was applied to predict the flank wear length. The neural network contains twenty hidden layer with feed forward back propagation hierarchical. The neural network

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has been designed with MATLAB Neural Network Toolbox. The results show a high correlation between the predicted and the observed flank wear which indicates the validity of the models.

Sivasakthivel, P., at el, [5]were carried out "Prediction of tool wear from machining parameters by response surface methodology in end milling" Tool wear increases cutting force, vibration, temperature, etc in end milling and reduces surface finish of the machined work piece. Mathematical model has been developed topredict the tool wear in terms of machining parameters such as helix angle of cutting tool, spindle speed, feed rate, axial and radial depth of cut. Central composite rotatable second order response surface methodology was employed to create a mathematical model and the adequacy of the model was verified using analysis of variance. The experiments wereconducted on aluminum Al 6063 by high speed steel end mill cutter and tool wear was measured using tool maker's microscope. The direct and interaction effect of the machining parameter with tool wear were analyzed, which helped to select process parameter in order to reduce tool wear which ensures quality of milling.

MATERIAL SELECTION

AISI 316 flat bar (115*50*10 mm)

CHEMICAL COMPOSITION

AISI 316	Carbon	0.026 %
	Manganese	1.010 %
	Phosphorus	0.028 %
	Sulphur	0.011 %
	Silicon	0.380 %
	Chromium	16.490 %
	Nickel	10.130 %
	Molybdenum	2.060 %

MECHANICAL PROPERTY

Sectional dimension, width & thickness	38.00 & 9.81 mm
Gauge length	50 mm
Final gauge length	77.2 mm
Yield load	117.78KN
Ultimate yield load	214.05 KN
Yield stress	315.79 MPa[205 MPa min.]
Ultimate tensile stress	574.19 MPa [515 MPa min.]
Hardness in HRB	84/84/85[95 max.]
% Elongation	54.4 [40 min.]

APPLICATION

- ✓ Parts exposed to marine atmospheres and tubing.
- ✓ Chemical equipment.
- ✓ Jet engine parts.
- ✓ Valve and pump trim.

CONCLUSION

From various literatures survey efforts to found out that many researchers have investigated on S.S 304. There is very few investigator research worked on SS316 stainless steel material so, I want to do work on this material. In this research work I want to investigate influences of input machining parameters like cutting speed, feed rate, depth of cut on response parameters like surface roughness and Tool-wear.

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