A Review: Best Cutting Parameters of Cutting Tool
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Abstract—There are various machining processes which are organized for different material removal processes. For different machining processes various cutting tools are used as per requirement of machining processes. Parameters which can mainly affect to machining processes are cutting angle, Tool material and Temperature. Above stated parameters have considerable effects on accuracy, Surface finish and material removal rate (MRR) of the processes. This can be analyzed by Finite Element Analysis simulation and different machining experiments on CNC Turning Center.

Key words: Machining Process, Cutting Tool, Cutting Angles, Tool Life

I. INTRODUCTION

In machining processes, there is an object which is used to remove the extra material from the work piece is known as Cutting tool. It removes the material from work piece by means of shear deformation. Cutting operations are completed by single point cutting tool and multi point cutting tool. Single-point cutting tool has a single edge for cutting purpose and it can be used in turning, facing, shaping, planning and similar operations. Milling, drilling and grinding tools are multi point tools. Cutting tool must be made up of hard material than the material which is to be cut. And tool must be able to withstand with heat generation formed during operation. The tool must have a specific geometry without it tool can’t perform a better operation. Also, all the clearance angles designed in a manner so that cutting edge can contact the workpiece without the rest of the tool dragging on the workpiece surface.

Whenever the tool is not removing material satisfactorily then that is concluded that tool failed.

There are many reasons for tool failure as. When tool gets too much heat, When we don’t get proper surface that is surface roughness observed, We are not getting our work-piece as per our required dimensions, There are more vibration occurred during machining, When forces and power consumption is more. There are some parameters used for measurement of satisfactoriness of machining process is given below. At the beginning of machining process we got proper finished surface and it is like mirror finished surface but after sometimes when the lines are produced on surface we assumed that tool is failed. And that is due to Surface finish produced on work piece. During machining process Force is generated. But that force is constant but whenever we saw the increase in force we assumed that tool has been failed. We can measure the force by Dynamo meter. We can also find out whether the tool is failed or not by the Temperature of chip. It is concluded that during normal machining process color of chip is light blue or metallic but when there is a failure of tool then chip color is turned in to black or burnt color due to higher heat produced.

II. LITERATURE REVIEW

A. Dynamic Analysis of Single Point Cutting Tool Using Fem (2016) Akshay Ganesh Khande, 2016:
Here In this paper Akshay Ganesh Khande had study the effect of different rack angles & nose radius on the force exerted on the tool during cutting. This parameters are studied to find out the variation in values of vonmisses stress and will see the result for rack angles 3 & 5 degree and nose radius 0.3 & 0.5 mm. He had concluded that as depth of cut increases, the von misses stress developed in the tool increases. Tool shows better performance with 5 degree rake and 0.3 mm nose radius with minimal tool wear and there by better tool life. It is observed that with increasing nose radius tool life decreases, Rake angle of 5 degree provides better cutting force, lesser stress and lowest wear.[2]

In this paper Kapil Sharma, DalgobindMahto and S.S. Sendescribes a review of basic terms and visualizations of the major components of the cutting tool geometry in orthogonal
turning process. The parameters like rake angle, depth of cut, feed rate, temperature and cutting speed are taken into account so as to predict their effects on tool life. They had concluded that cutting force decreases as the tool rake angle increases. With increase in feed rate, this tends to increase in cutting force. The increase in absolute value of negative tool rake angle and cutting speed results in the decrement of tool chip friction. The tool tip temperature increases with an increase in cutting speed.[3]

C. Finite Element Modeling Of The Effect Of Tool Rake Angle On Tool Temperature And Cutting Force During High Speed Machining Of AISI 4340 Steel(2013) (S Sulaiman, A Roshana, M K A Ariffin,2013):

In this model finite element modelling method is used for determine low cutting force and low tool temperature during high speed machining of AISI 4340 steel. Assume the positive rake angle between 0-20 and cutting speed between 300-500 m/min and as per this different data put in the real situation and find the minimum cutting force and operating temperature. So as per results give a better understanding of the cutting tool design for high speed process. As per the experiment results basis conclude that the best rack angle between 10-18 at the positive side and obtained cutting speed 433 m/min so as per this data followed get minimum cutting force and low temperature at the high speed machining processes. And used the negative rake angle so, temperature will be high and its decreasing the tool life.[4]


In this model study the tool wear and surface finishing by applying the positive and negative angle in the machining process. And this process is carried on the conventional lathe machine. All parameter of the tool is constant only changed the rake angle and get different result and then take best rake angle. Then measure the accuracy or surface finish by surface roughness tester, microscope motive images etc. And as the best rake angle found out then its a low tool wear, high accuracy of operation and high tool life. As per the experiment results basis conclude that the flank wear and surface roughness is totally dependent the different rake angle and the negative & positive rake angle give the effect of flank wear in the machining process. The surface roughness value is reciprocal of the rake angle value. When the value of rake angle is more than surface roughness is low and vice versa.[5]

E. Effect Of Rake Angle On Stress, Strain And Temperature On The Edge Of Carbide Cutting Tool In Orthogonal Cutting Using Fem Simulation(2010) (Hendriyanda, Jaharah A. Ghani&Che Hassan Cheharon)

In this model study the method for getting higher production rate and good quality of work piece using FEM. This all study on the software basis because the experimental cost is very high, time consuming and labour is required. In this study the cutting force, effectivestress, strain and temperature on the edge of tool based on rake angle and also measured the frictional force between tool & workpiece. As per the experiment results basis conclude that, High positive rake angle is a low cutting force and vice versa. Increase the positive rake angle decreases the stain, stress vice versa, Increase the rake angle will be reduce the clearance angle[6]

F. Study And Analysis Of Single Point Cutting Tool Under Variable Rake Angle.(2009) (Deepak Bhardwaj, B. Kumar)

In this model we use the finite element modelling method for measure the best rake angle when the force exerted on the tool during cutting. In this method understand the chip formation of the tool, and heat generation in cutting area, tool chip interfacial frictional co-efficient and machine surface used three rake angle then its value put in the software. After applying the boundary conditions check the effect of vonmmisses stress of the tool and after getting results into the software its value put in experiment basis in tool dynamometer for lathe machine. As per the experiment results basis conclude that, When Increase the value of rake angle the tool vonmmisses stress is reduce, and stress is reduce then resulting force acting on the tool during cutting is reduce.Increase the tool life.[7]


In this model experiment with help of turning operation and tool material is AISI 1045 steel and method is FEM &Taguchis technique. The cutting speed, feedrate, depth of cut, cuttingshape, relieffangle, nose radius etc parameters will be choose and based on this perform the experiment. In this use simulation software DEFORM-3D. Input all parameters and find out the results like tool chip interface temperature, interfacenpressure, cuttingforce. As per the experiment results basis conclude that, Decrease in output parameter &archive optimum tool and machining parameter. For analysis, cutting insert shape is most significant parameter. The optimum machining parameters obtained are cutting speed of 285 m/min, feed rate of 0.203 mm/revolution depth of cut of 0.6 mm.[8]


Our work focuses on the optimization of cutting tool life of a CNC milling machine and end milling operation is performed on it by using Poly Crystalline cubic Boron Nitride (PCBN) as the cutting tool material and En8 steel (HRC 46) as work piece material to predict the tool life. This research is to test the collecting data by Taguchi method. The model is validated through a comparison of the experimental values with their predicted counterparts. The optimization of the tool life is studied to compare the relationship of the parameters involved. The result of the analysis shows that depth of cut was the only parameter found to be significant.

In this case The Experimental results demonstrate that the cutting speed and depth of cut are the main parameters that Influence the tool life of end mill cutters of CNC milling machine. The confirmation experiments were conducted to verify optimal cutting parameters. Experimental results show that in milling operations use of Low depth of cut, Low cutting speed and lowfeed rate are recommended to obtain better Tool life for the specific Range

AtSpeed (V) = 200 rpmDepth of cut (d) = 0.6 mmFeed rate (f) = 30 mm/min [9]

In this paper the study of temperature and friction the chip-tool interface zone. This information is used for simulate the high speed machining using FEM method. This model is depended parameters such as strain, strainrate and temperature was used together with a friction model bases on the workpiece at the chip tool interface. In this model uncoated carbide tool is used for the experiment as a high speed cutting condition find the co-efficient of friction for different between measured thrust force and then after match the value of FEM simulation determine the chip tool parameter. As per the experiment based result conclude that cutting speed is 200-550 m/min and feed rate is 0.025-0.100 mm/rev. And unknown co-efficient of friction is less then the 10% for the thrust force..[10]

III. CONCLUSION

In this paper a brief review is done on cutting tool parameters, now a day single point cutting tool is very important thing in manufacturing. To improve manufacturing, we need to improve cutting tool to its optimum parameters by which we can increase its life. Different parameter affect tool life like cutting speed, feed, depth of cut, tool geometry Etc. form this researches we can conclude that by increasing cutting speed surface roughness and cutting force decreases but it increase in temperature, increase in rack angle will decrease cutting force. Some optimum geometry parameters for single point cutting tool are 3 to 5 degree rack angle for low speed machining and 10-18 degree for high speed machining. Nose radius must be in between 0.3 to 0.6 mm. Optimum machining parameters are 200-550 rpm speed, 0.6 mm depth of cut and 30-60 mm/min feed rate.

REFERENCES