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A REVIEW PAPER ON OPTIMIZATION OF TURNING PARAMETERS FOR SURFACE ROUGHNESS AND MATERIAL REMOVAL RATE FOR SS 310

KEYWORDS: surface roughness, material removal rate, ANOVA, RSM

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ABSTRACT Machining of medium SS310 is very difficult. There are a number of parameters like cutting speed, feed and depth of cut etc. which must be given consideration during the machining of SS 310. The prediction of optimal machining conditions for good surface roughness and material removal rate plays a very important role in process planning. This study optimizes the process parameters for surface roughness and Material Removal Rate (MRR) in turning of SS 310 round bars on CNC machine.

I. INTRODUCTION

The CNC system has a computer in it, which controls the functions. In the conventional system the control is hard wired and therefore any modifications or addition in facility call for many changes in the controller which may or may not be possible due to limitations of basic configurations. As compared to this in a CNC system a bare minimum of electronic hardware is used while software is used for the basic function. That is why it is sometimes termed as software control. This assists in adding extra facilities conveniently without much problem and cost. Since these computers are dedicated type, they need comparatively much less storage and with the present cost and high reliability.



Fig. 1.2 CNC machine

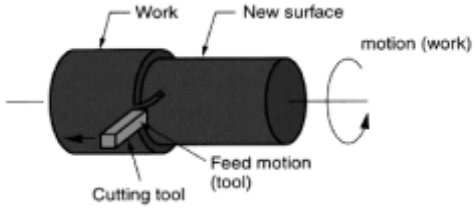

Fig. 2.1 Turning operation

II. LITERATURE REVIEW

Shihab[1] were carriedout "RSM Based Study of Cutting Temperature during Hard Turning with Multilayer Coated Carbide Insert"they describesIn the present study, an attempt has been made to investigate the effect of cutting parameters (cutting speed, feed rate and depth of cut) on the cutting temperature in hard turning of AISI 52100 alloy steel using multilayer coated carbide(TiN/TiCN/Al2O3/TiN) insert. Central Composite Design (CCD) was used to perform machining experiments to collect data. Several diagnostic tests were performed to check the validity of assumptions. Significance of the cutting parameters was determined using statistical analysis of variance (ANOVA). The model equation to predict the cutting temperature is also proposed. Response surface methodology (RSM) was employed to determine optimal values of cutting parameters. The ANOVA results indicated that all the three cutting parameters have significant effect on the cutting temperature. Results also revealed that within the range investigated, the cutting temperature is highly sensitive to cutting speed and feed rate. Optimized model indicated 100% desirability level for economy in the conventional turning process.

Subramanian[2] Were carried out "optimization of turning parameters for surface roughness using rsm and ga" they describe The paper presents an experimental study of roughness characteristics of surface profile generated in CNC turning of AISI 1040 mild steel and optimization of machining parameters based on genetic algorithm. The three level rotatable central composite designs are employed for developing mathematical models for predicting surface roughness parameters. Response surface methodology is applied successfully in analyzing the effect of process parameters on different surface roughness parameters. The second order mathematical models in terms of machining parameters are developed based on experimental results. The experimentation is carried out considering three machining parameters, viz., depth of cut, spindle speed and feed rate as independent variables and three different roughness parameters, viz., centre line average roughness, root mean square roughness and mean line peak spacing as response variables.

M.Subramanian[3] Were carried out "Optimization of Cutting Parameters for Cutting Force in Shoulder Milling of Al7075-T6 Using Response Surface Methodology and Genetic Algorithm"they describes This paper aims at developing a statistical model to predict cutting force in terms of machining parameters such as cutting speed, cutting feed rate and axial depth of cut. Response surface methodology experimental design was used for conducting experiments. The work piece material was Aluminum (Al 7075-T6) and the tool was a shoulder mill with two carbide insert. The cutting forces were measured using three axis milling tool dynamometer. The second order mathematical model in terms of machining parameters was developed for predicting cutting force.

The adequacy of the predictive models was tested by analysis of variance and found to be adequate. The direct and interaction effect was graphically plotted which helps to study the significance of these parameters with cutting force.

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B. Tasdele[4] Were carried out "An experimental investigation on contact length during minimum quantity lubrication (MQL) machining"they describeThis paper describes experimental investigations on influence of different media such as minimum quantity lubrication (MQL), compressed air and emulsion on tool–chip contact length. The results are compared with dry cutting in terms of tool–chip contact and chip morphology. The tool–chip contact area was examined with scanning electron microscopy (SEM), optical microscopy and white light interferometer. The orthogonal turning test series were planned in such a way that the engagement time was altered from long to very short (intermittent turning). The results showed that MQL and compressed air lowers the contact length compared to dry cutting at short and longer engagement times. The contact length is almost the same for MQL and compressed air assisted cutting, but the difference is in sliding region with the shorter engagement times. Emulsion assisted cutting gave the shortest contact length. The chips were also examined with optical and scanning electron microscopy. Wider chips were observed with dry cutting which is a result of side flow. Different oil amount was also investigated with TiN coated inserts. The effect of oil and air component of MQL on the contact length is understood that helps to clarify their role in the whole process.

D. Sai Chaitanya Kishorewere[5] carried out "Investigation of cutting force, surface roughness and flank wear iturning of In-situ Al6061-TiC metal matrix composite"they describeAl6061-TiC composite with 2%TiC and 4%TiC were produced by the reaction of K2TiF6 and C with the molten aluminium. SEM and EDX tests were performed to know the presence of the TiC reinforcement. Vickers micro hardness test was done and find that the hardness was increased by the addition of TiC. Turning experiments were performed on 0, 2 wt % and 4 wt% of TiC reinforcement. The effect of process parameters such as cutting speed, feed rate and depth of cut on response cutting force, surface roughness and flank wear were studied during turning process. L25 Taguchi design was used for designing the experiments, from the analysis of means of the responses at all the levels it was found that addition of TiC reinforcement raises surface roughness and flank wear and reduces cutting force.

Raja Kountanya[6] were carried out "Effect of tool edge geometrconditions on experimental and simulated chip morphology in orthogonal hard turning of 100Cr6 steel"they describe Understanding chip formation mechanisms in hard turning is an important area of research. In this study, experiments with varying cutting conditions and tool edge geometry were performed concurrently with finite element simulations. The aim was to investigate how the two mechanisms reported in literature namely—surface shear-cracking (SCH) and catastrophic thermoplastic instability (CTI) contribute to overall chip geometry and machining forces. By varying tool edge geometry and cutting conditions predominance of one over another is discussed. The calculation prescribed byRecht [Recht, R., 1964. Catastrophic thermoplastic shear. J. Appl. Mech. 31, 189–193] for representative cutting conditions resulted in a small critical cutting speed of 0.034 m/min indicating CTI was operative in the range of cutting conditions tested. FEM simulationswere conducted on a subset of experimental conditions. Chip geometry and forceswerecompared between experiments and simulations. The experimental results indicated that SCH predominated in amajority of conditions.

Brian Isk[7]Were carried out "Experimental investigations of surface roughness in orthogonal turning of unidirectional glass-fiber reinforced plastic composites "they describeAbstract Cutting parameters and the resulting cutting forces have a great effect on the machinability of materials during the turning process. The effects of cutting parameters on machinability have been examined by many researchers and studies on determination of suitable cutting conditions for various materials are still under investigation. In this study, surface roughness of unidirectional glass-fiber reinforced plastic composite was examined on the basis of cutting parameters such as depth of cut, feed rate, tool geometry, and cutting speed. The surface quality was found to relate closely to the feed rate, cutting speed, and cutting tool.

E.Bassett[8] were carried out" On the honed cutting edge and its side effects during orthogonal turning operations of AISI1045 with coated WC-Co inserts"they describe The design of the cutting tool microgeometry influences the thermo-mechanical load profile on the wedge. Applying the appropriate hone design stabilizes the cutting edge, leads to improved wear behavior and higher tool life. Higher process forces and temperature, induced by larger hone, can be described as a side effect of cutting edge preparation, which should also be observed. This paper presents the quality oriented cutting edge preparation via abrasive brushing. The influence of the hone design on process forces, wear behavior and tool life of coated inserts will be analyzed within a wide range of cutting edge microgeometries and process parameters.

Z. G. Wang[9] Were carried out "Study on orthogonal turning of titanium alloys with different coolant supply strategies" they describesAbstract In this paper, the effects of different coolant supply strategies (using flood coolant, dry cutting, and minimum quantity of lubricant [MQL]) on cutting performance in continuous and interrupted turning process of Ti6Al4V are investigated. Based on the observation of the cutting forces with the different coolant supply strategies, the mean friction coefficient in the sliding region at the tool–chip interface has been obtained and used in a finite element method (FEM) to simulate the deformation process of Ti6Al4V during turning. From the FEM simulation and Oxley's predictive machining theory, cutting forces have been estimated under different coolant supply strategies and verified experimentally.

S.S. Bosheh[10] Were carried out "White layer formation in hard turning of H13 tool steel at high cutting speeds using CBN tooling" they describe White layers formed during machining have negative effects on surface finish and fatigue strength of products. The white layer is generally a hard phase and leads to the surface becoming brittle causing crack permeation and product failure. This is a major concern with respect to service performance especially in the aerospace and automotive industries. Numerous authors have investigated the formation of white layer under different manufacturing processes. In turning, it was suggested that the white layer structure is a martensitic phase whose formation is correlated to tool wear. Past studies have tended to concentrate on the formation of white layers at conventional cutting speeds, but never examined the formation at high cutting speeds. This paper reports on an investigation of white layer formation for wide range of cutting speeds in hard turning of 54-56 HRC H13 tool steel. The specimens were analysed using a micro hardness tester, SEM with EDAX software and Electron Micro-Probe. In addition tool wear and workpiece temperature were studied.

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III. CUTTING PARAMETERS

Speed

Speed always refers to the spindle and the work piece. When it is stated in revolutions per minute (rpm) it tells their rotating speed.

$$v = \frac{\pi DN \ m}{1000 \ min} \quad (4.1)$$

Here, v is the cutting speed in turning,
D is the initial diameter of the work piece in mm,
N is the spindle speed in RPM.

Feed

Feed always refers to the cutting tool, and it is the rate at which the tool advances along its cutting path.

$$F = fN \text{ mm min}^{-1} \quad (4.2)$$

Here, F is the feed in mm per minute,
f is the feed rate in mm/rev and
N is the spindle speed in RPM.

Depth of Cut

Depth of cut is practically self explanatory. It is the thickness of the layer being removed (in a single pass) from the work piece or the distance from the uncut surface of the work to the cut surface,

$$\text{Depth of cut} = \frac{D-d}{2} \text{ mm} \quad (4.3)$$

Here, D and d represent initial and final diameter (in mm) of the job respectively.

Surface Roughness

Roughness is a measure of the texture of a surface.

Material Removal Rate (MRR)

The material removal rate (MRR) in turning operations is the volume of material/metal that is removed per unit time in mm3/min. For each revolution of the work piece, a ring shaped layer of material is removed.

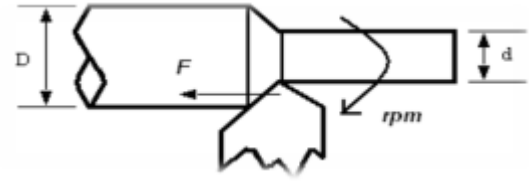

Fig. 4.1 Material Removal Rate in Turning

$$MRR = \left(\frac{\pi D^2}{4} - \frac{\pi d^2}{4}\right) \times F \times rpm \quad (4.4)$$

Where,
D= diameter of workpiece before cutting
d= diameter of workpiece after cutting

IV. CONCLUSION

From the above literature survey we found that most effected parameters to cutting condition are cutting speed, feed rate and depth of cut and they are easily controlled by operator at the machine at same time. All turning operation will be performed on CNC turning machine. In which input parameters are cutting speed, feed rate and depth of cut and the response parameters are surface roughness and material removal rate. We will use surface roughness tester to measure surface roughness and MRR will measured by mathematical equation or practically by comparing initial and final weight of workpiece. We will use AISI 310 work piece material for turning operation. For Experimental design we will use full factorial method ($L=m^n$) to find out number of readings. To find out percentage contribution of each input parameter for obtaining optimal conditions, we will use ANOVA method and finally for optimization Response surface method(RSM) will be used.

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