

OPTIMIZATION OF CUTTING PARAMETERS ON TOOL WEAR AND WORKPIECE SURFACE TEMPERATURE BY ANOVA METHODS

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Abstract:

Now a day's increasing the productivity and the quality of the machined parts are the main challenges of metal cutting industry during turning processes. Aspects such as tool life and wear, surface finish, cutting forces, material removal rate, power consumption, cutting temperature(on tool and work piece surface) decide the productivity, product quality, overall economy in manufacturing by machining and quality of machining methods. Optimization methods in turning processes, considered being a vital role for continual improvement of output quality in product and processes include modeling of input-output and in process parameters relationship and determination of optimal cutting conditions. Orthogonal array technique and analysis of variance (ANOVA) was performed to identify the effect of cutting parameters on the response variables. The results showed that depth of cut and cutting speed are the most important parameter influencing the tool wear. Optimal ranges of tool wear and work piece surface temperature values were predicted. Finally, the relationship between factors and the performance measures were developed by using multiple regression analysis. Different case studies observed for using technique of ANOVA.

Keywords: Wear, surface finish, cutting forces, material removal rate, optimization techniques, ANOVA.

INTRODUCTION

In general, a faster rate of material removal is desirable from a production standpoint, and high speed machining can be economically advantageous in terms of power consumption as the cutting forces tend to drop cutting speed increases.

However, the speed of machining is often limited by the machine tool itself (spindle power, machine dynamics) and rate at which front line of apparatus wears.

Accepting the machine tool itself is adequate for the task, the limiting factor becomes the wear rate of the tool and its effect of increasing the machining power required or compromising dimensional precision and surface nature subsequent segment.

LITERATURE REVIEW

Niketh, S et.al (2017) the present work explores the viability of smaller scale surfaces in lessening the sliding grating at the contact surfaces and its application on drill instruments for the practical machining of Ti-6Al-4V. Starter trial results from the stick on plate tests substantiated the tribology upgrading wonder of miniaturized scale finished surfaces, with a superior act if there should arise an occurrence of smaller scale dimpled surfaces recording a contact coefficient of 0.42. Henceforth out of the blue, an endeavor has been made to make smaller scale surfaces on both the flute and edge side of the drill apparatuses with a goal to limit the cutting powers by decreasing the sliding grinding at the instrument chip and device work piece interfaces. Smaller scale surfaces as dimples were made on the flute and edge side of drill device utilizing laser micromachining system. Penetrating tests were performed on Ti-6Al-4V work

material by boring a through gap of 10 mm profundity utilizing non-finished, woodwind finished and edge finished devices. From the cutting powers recorded amid machining, it was seen that even at the higher cutting rate of 60 m/min and feed 0.07 mm/rev, the edge finished instrument performed superior to anything all other apparatus types recording a net decrease of 10.68% in push constrain and 12.33% in torque contrasted with non-finished devices. The examinations on the chip morphology further uncovered less obstructing of chips if there should be an occurrence of woodwind finished device which is an unmistakable sign decrease in the chip departure drive. The trial results from this examination work demonstrated miniaturized scale finishing of drill apparatus to be reasonable method for limiting the vitality misfortune because decrease in frictional powers at the cutting routine while machining Ti-6Al-4V.

Siddhpura, A et.al (2012) Device wear is the most ordinarily watched and unavoidable part of metal cutting. The ragged instruments unfavorably/influence the surface completion of the workpiece, and they can be supplanted in time if a device wear observing framework is utilized. Amid turning, the naturally produced workpiece surface comes into contact with the flank face and grinding happens at the interface. Because of rubbing, flank wear happens. Expanding flank wear results in an expansion in the contact territory at the flank-work piece interface. This thus builds the coefficient of grinding, and because of this, stick slip vibration is probably going to happen. The displaying of such a framework is done in this paper. The grating at the flank-work piece interface is as yet considered as

intricate, however the event of stick-slip because of flank wear can be used to create instrument wear checking frameworks. Most examinations in regards to grinding in metal slicing bend restricted to instrument chip interface. This paper diagrams technique to correspond flank wear and rubbing. The conditions of movement cutting instrument curve inferred considering stick-slip grinding occurring at flank-work piece interface, and subsequent powers following up on device flank are related with flank wear. The impact rubbing on instrument flank wear is contemplated utilizing MATLAB reproductions an expansion in adequacy of hardware vibration, worn apparatus cutting powers coefficient erosion with expanding flank wear were watched. The connection between contact device wear determined here can be utilized to complete compelling device condition checking and apparatus life guess.

Oxley, P.L.B (1997) Ill temper collaboration slipline field models are given to clarify the job of hardware surface unpleasantness, grease condition and evident contact weight on the apparatus work interface factional conditions in metal shaping and machining forms. It is indicated how the slipline fields used to demonstrate ill temper distortion can be participated in a steady way with the slipline field speaking to the mass disfigurement for the procedure considered. On account of machining, thought is given to the impact of Chip material stream stress and stress and no longer in a collision situation in the device chip interface. Proof given the oil at the interface to work on that device some shaping procedures can be elasto hydrodynamic in nature notwithstanding for conditions where

severity connections are occurring.

Markopoulos, A.P et.al (2015) the influence of the friction and material modelling on results of Finite Element simulations machining is investigated. An orthogonal cutting model is proposed, which incorporates Coulomb's friction law. The validity of this model is tested against similar experimental and numerical results from the relevant literature and the influence of the friction coefficient is investigated. Then, a second model, with a friction model based on Zorev's stick-slip theory, is prepared and compared to the first one. Furthermore, simulations with Johnson-Cook material model for both kinds of friction modelling are presented and compared to the other models. The results of the different kinds of models although exhibit small discrepancies between models' results such as cutting forces, affect temperatures and chip morphology.

CUTTING PARAMETERS

In managing the turn, there are some parameters that govern the process and affect the device life, surface finish and content removal rate. The ideal determination of handling parameters is with these rows, which is the result of the most ideal tradeoff between three recently referenced factors, depending on the requests being made. Their definitions and units are shown with the following short parameters that will use everyone through this task.

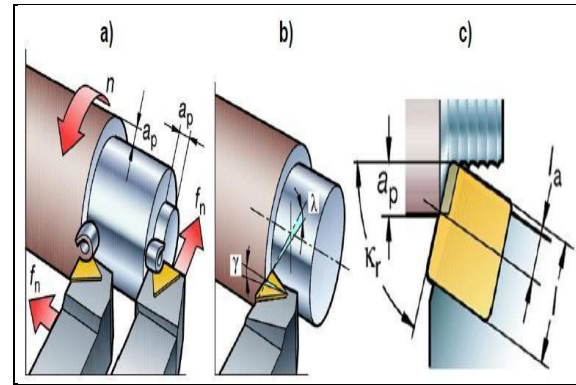


Figure 1 a) Definition of feed (here called f_n to clarify that it is in mm per revolution ($=n$)) and cutting depth (a_p) for longitudinal turning (left tool) and facing (right tool). b) Definition of rake angle (γ) and inclination angle (λ) in longitudinal turning. c) Definition of entering angle (κ_r), cutting depth (a_p), total cutting edge length (l) and effective cutting edge length (l_a).

The cutting speed (VC) - Relative speed between the surface and the mechanism of the workpiece. Axel depends on rotational speed and the distance across the workpiece is usually given in unit M / min. Feed (F) - Regular development of per rebirth device per millimeter per Profitability of Cut (AP) - Isolation between whole and in (estimated in mm) slice surfaces estimated opposite to feed bearing. The accompanying parameters are apparatus subordinate parameters are an aftereffect of mix device holder and cutting supplement.

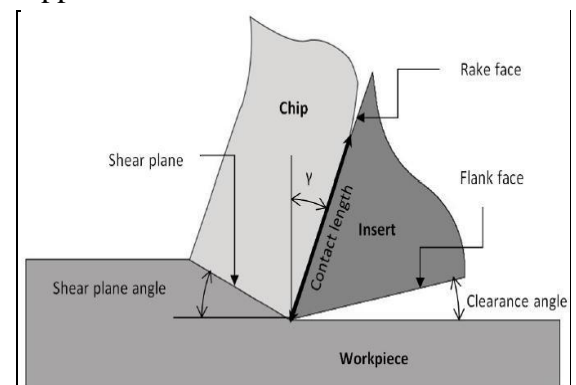


Figure 2 shows basic definitions and

important angles and faces. Worth noticing is that the rake angle (γ) shown is positive

Rake point (ake) - A line parallel to the workpiece rotational hub and the edge between the rake face of the harvesting joint, see Figure 3b and figure 4. A negative rake edge gives a more grounded frontline, besides higher higher powers Indicates.

Entry Point () r - The entryable edge is characterized as the border between the hemorrhagic edges and the feed curriculum. The entryable edge controls the length of the front line and also affects the cutting power. A small entry point gives a huge hemorrhagic edge length for the abundance of the cut and thus expands the inactivated (or spiral). A little enterprising edge moves life forward in different ways:

As a length of the side of the hemorrhage, a continuous development of the powers is extended step by step.

Starting contact with workpieces is further made apart from the minor Flushier tip. The surface layer, which is often more enthusiastically, may be scaled down from the last framing process, heat treatment or work-out from the past cutting pass, spread to the largest length. This reduces the score ware. The more prominent contact length leads to better heat conduction in the workpiece, and all the more warm dissemination except for cutting.

Freedom edge flak face between digression and supplement for workpiece surface. Regularly on request of 6-10 ab, leve shore is to stop the flak face from scratching against the work piece. Nose Limit ($R \epsilon$) - The motivation behind the nose sweep is to give the nose of the supplement (nose) together and it is basic in deciding to complete the surface. A small nose limit is

helpful for small harvested amounts, and vibration decreases, although there is less quality experience, while large noses are cut off due to cuts and feed rates, because in higher powers. This result requests more grounded forest. An extraordinary example of turning is symmetrical bite. In a symmetrical bite a direct instrument edge is used and it is specific for both the action and feeding of the slice. This can be accomplished by cutting in the cylinders or ribs, where the ribs have the benefit of continuous cutting motion on the bleeding edge. The drawback is that rotational speed must be expanded bit by bit as width diminishes so as have consistent cutting rate.

So as have an absolutely symmetrical setup, nose span of device ought not utilized for cutting; generally condition is known as "semi-symmetrical" cutting.

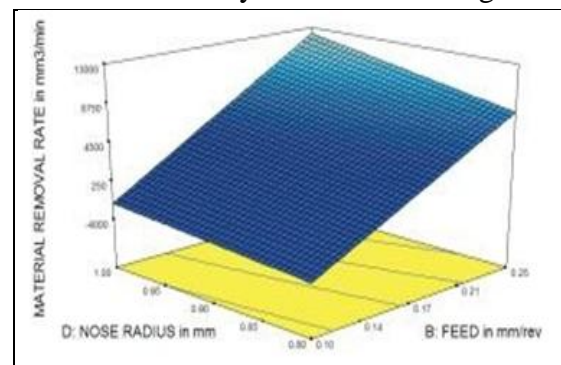


Figure 3: Effect of feed and nose radius on MRR

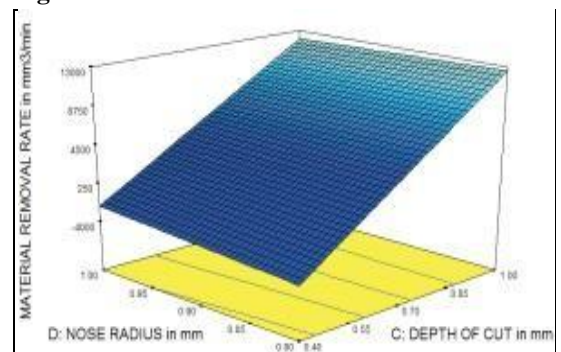


Figure 4: Effect of depth of cut and nose radius

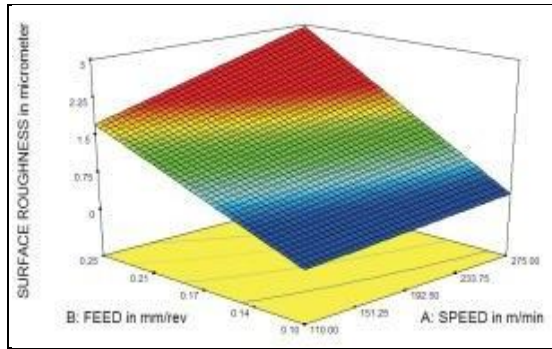
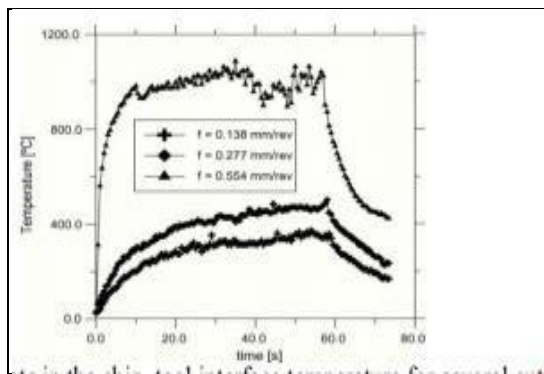
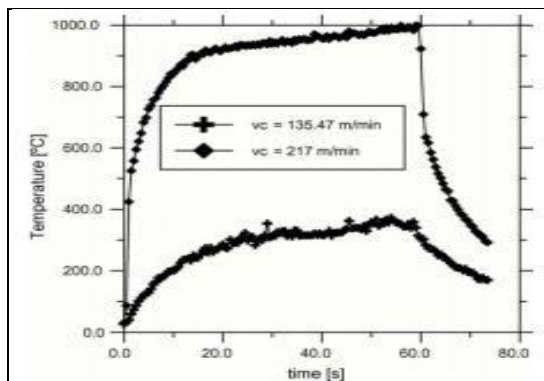


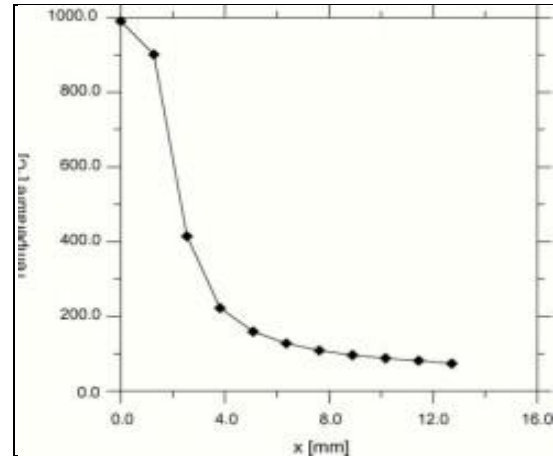
Figure 5: Effect of speed and feed on SR INFLUENCE OF CUTTING CONDITIONS IN THE TEMPERATURE ESTIMATION



Graph-1. Influence of feed rate in the chip-tool interface temperature for several cutting conditions



Graph-2. Influence of cutting speed in the chip-tool interface temperature for several cutting conditions



Graph-3. Chip-tool interface temperature at 60s in the x-direction CONCLUSION

In the figure displayed separately, the temperature of the temperature against the cutting velocity and the feed rate is embedded, a slow cast iron work piece is embedded for the installed carbide. Figure shows that the higher the cutting rate interface the higher the contact temperature. This behavior is due to the fact that as the cutting velocity spreads, the rate of stress increases in essential and assisted shear areas, thus creating a hot speed.

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