INCREASING QUALITY OF PROCES EDUCATION WITH CA-SYSTEMS APPLICATION

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Abstract

The paper described research a new trends in proces education by technical discipline. Application of CA-systems is very important for practice and a quality of proces education. The paper is part of result from solution of Project VEGA 1/3173/06.

Key words: cutting, simulation, technological process

1 Introduction

Quality of products, quality of details and then and quality geometric elementary on details are four - square defined quality applied the technology. Technology production and him individual methods are the factors requisite evalue for given to manufactory suit. Interaction betweeen honey surface finish after rust and him function, which is defined applied technological methods, we can appraised on base this is factors:

- ⇨ distribution surface in zone (morphology, texture, roughness surface)
- ⇨ surface properties after rust (integrity surface)
- ⇨ influencing technological method on surface properties after rust and their first fiddle comparison on function of detail are priming the condition for creating a new surface.

Machining is an important manufacturing operation in industry. The purpose of a machining process is to generate a surface having a specified shape and acceptable surface finish, and to prevent tool wear and thermal damage that leads to geometric inaccuracy of the finished part. The thermodynamic approach to the activity at the cutting edge attempts to account for the energy consumed [1]. Research has shown that at least 99% of the input energy is converted into heat by deformation of the chip and by friction of the chip and workpiece on the tool [1]. The interface at which the chip slides over the tool is normally the hottest region during cutting. The actual temperature is strongly affected by workpiece material, cutting speed, feed, depth of cut, tool geometry, coolant, and many other variables [1]. Due to the interaction of the chip and tool, which takes place at high pressures and high temperatures, the tool will always wear. In machining operations, mechanical work is converted to heat through the plastic deformation involved in chip formation and through friction between the tool and the workpiece.

2 Application CA-systems in technological proces

The objectives of this research include investigate robust and reliable work material constitutive models and friction models for more accurate predictions in simulation of high speed machining processes. Very important is define of parameters of screw drill analysis. In an earlier work, a methodology is developed to determine simultaneously the flow stress of the workpiece material, and the friction at the chip-tool interface at high deformation rates and temperatures encountered in the cutting zone using FE simulations. This methodology uses the cutting and thrust force data measured from high-speed orthogonal cutting experiments as reference in order to calibrate a simulated process model. The work material constitutive model given below is used for P40 based mold steel. In more recent studies, we use constitutive material model to represent flow stress behavior of the work material. Temperature term in material model reduces the flow stress to zero at the melting temperature of the work material, leaving the constitutive model with no temperature effect. In general, the parameters of the model are fitted to the data obtained by several material tests conducted at low strains and strain rates and at room temperature as well as tests at strain rates up to 104 s^{-1} and at temperatures up to 600 °C. We developed an improved methodology to characterize work material flow stress at primary and secondary deformation zones around the cutting edge and interfacial friction at the tool-chip interface by using metal cutting theory and orthogonal cutting tests. In these studies, we use constitutive work flow stress model to characterize work flow stress in deformation zones. The friction model is based on estimation of normal stress distribution over the rake face. The stress distribution over the tool rake face can either directly be entered in FEM software or used in determining a coefficient of the friction at tool-chip interface. The methodology is practical and estimates the unknowns of both the work material constitutive model and the friction model over the rake face. Figure 1 shows the model influencing of the main factors in technological factors.

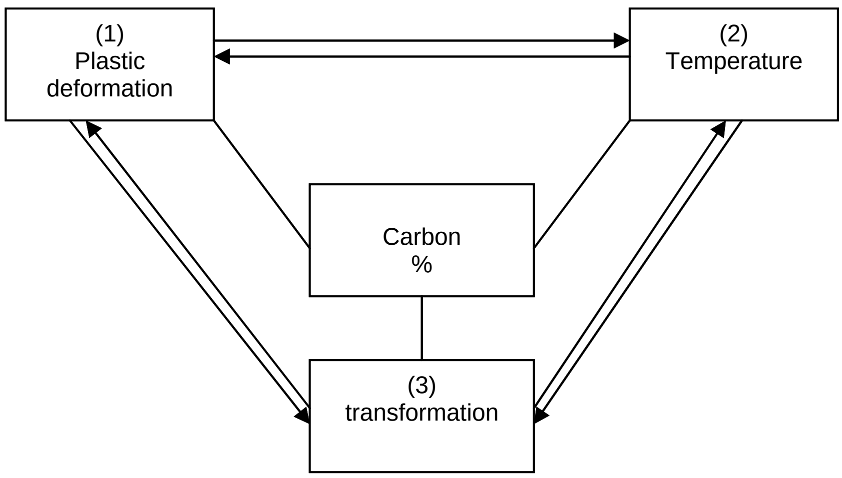

Fig. 1 Model influencing of the main factors in technological factors

1⇒2 Deformation generating therm
1⇒3 Deformation creating plasticity
2⇒1 Increasing of temperature
2⇒3 Transformation of therm
3⇒1 Transformation of therm influencing stresses
3⇒2 Transformation of therm influencing of a new therm

The FE simulation is obtained using Arbitrary Eulerian Lagrangian technique with pure Lagrangian boundaries and adaptive meshing capability. This simulation technique simulates chip formation from incipient to steady-state and does not require use of chip separation criteria or an assumed chip geometry as many of the other researchers use in their simulations with different software. The animation below shows the FE simulation of orthogonal cutting in which work material model and friction conditions implemented by using the aforementioned methodology. A science-based modeling of the chip formation provides a better understanding of stresses, temperatures and forces generated during cutting processes. Cutting tool geometry and machining parameters can be optimized through simulations minimizing experiments, for example the residual stress distributions on the machined surface are simulated during machining of DIN 1.4301 stainless steels using HSCo. Such FEM models are very useful in predicting chip formation, temperatures, stresses and forces during various metal cutting operations including orthogonal cutting by drilling process in figure2.

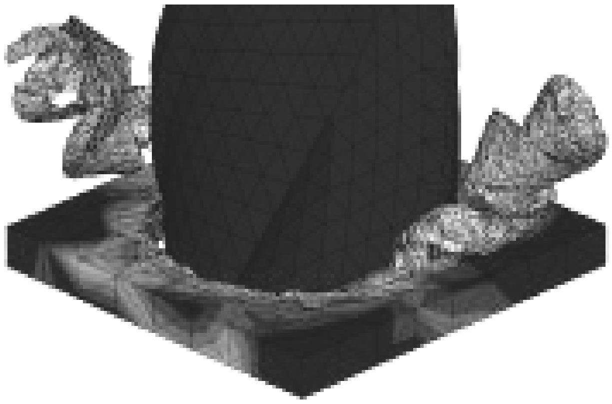

Fig.2 Simulation of drilling proces

3. Discussion about technology

The cutting edge of an insert in a finishing operation is worn out when it can no longer generate a certain surface texture. Not a lot of wear is needed along a very small part of the insert nose for the edge of an insert to need changing. In a roughing operation wear develops along a lot longer part of the edge and considerably more wear can be tolerated as there are no surface texture limitations and accuracy is not close. The tool-life may be limited when the edge looses its chip control ability or when the wear pattern has developed to a stage when the risk for edge breakdown is imminent.

The selection of the right cutting tool is critical for achieving maximum productivity during machining. Especially the choice of tool-material and cutting geometry are important. But however right the tooling is, if the machining conditions are not up to standard, especially as regards cutting data and general stability, optimum tool-life will not be reached. Vibrations and lack of rigidity in tool holders and clamping will prematurely end many cutting edges.Tool wear is the product of a combination of load factors on the cutting edge. The life of the cutting edge is decided by several load, which strive to change the geometry of the edge. Wear is the result of interaction between tool, workpiece material and machining conditions by drilling in figure 3.

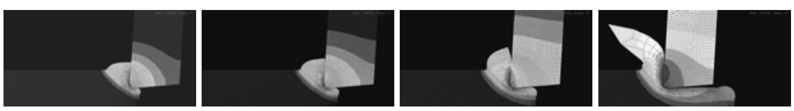

Fig. 3 Simulation of tool wear – interaction between cutting tool workpiece

4 Conclusion

Improving of machining processes is determined by growing demand on preciseness and quality of surface finish. Therefore cutting process analysis and carrying out research employing theoretical and experimental methods seems to be inevitable for practical purposes. Cutting process is characterized by accompanying features as cutting forces, tool wear, surface finish, vibration and chip formation. Especially the process of tool's cutting edge wear and its interaction to workpiece is of high importance in cutting process analysis. Experiments results point out at the factors that influence cutting tool wear and its durability. The term machinability implies qualitative condition of workpiece from the aspect of its ability to yield to the effects of cutting tool. Machinability can also be articulated in volume of material removed in a period of time under efficient cutting conditions, constant section of removed part and arbitrary working conditions. Variable costs of machining from the aspect of machinability depend on cutting speed, technologically allowed of working feed, power consumption and secondary time for tool change and cleaning working place of chips. It is obvious that machinability can not be articulated by one feature only. When discussing properties which determine machinability the two aspects must be differentiated – complex and relative machinability.

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