ANALYSIS OF THERMODYNAMIC EFFECTS WHEN DRILLING

Jozef, Jurko, Faculty of Production Technology with seat in Prešov, Technical University in Košice, Štúrova 31, 080 01 Prešov, Slovakia

Abstract: Metal cutting today is a chip formation process. All processes connected with system machine-fixture-tool-workpiece (M-F-T-W). Generally it is the ability of the workpiece material to be machined, meaning, how easy or demanding it is to shape a workpiece with a cutting tool. The metalurgy, chemistry, mechanics, heat treatment, additives, inclusions, surfaces skin, etc. Of the workpiece material affect the machinability as does the cutting edge, tool holding, machine tool, operation and machining conditions. Content article is sweep-up on evaluation choice the parameters finish machined surface of steel X12CrNi 18 8 (hardness and microhardness, morphology, roughness surface and tensions) when drilling. For experiments grief used of different the cutting materials for solid o screw drill. The paper presented and integrated the conclusions the authors and recommended the conclusions for theory and practice in cutting. This paper is solution of science work VEGA number 1/3173/2006 entitled in automatized production.

Key words: cutting tool, cutting, drilling, stainless steels

1. INTRODUCTION

Stainless steel X12CrNi 18 8 is attractive engineering material because of its outstanding properties such as corrosion resistance, weldability, high strength, and good form-ability. The basic properties of stainless steel have been studied and can be found in the materials the strain-rate effect plays an important role in plastic deformation of materials, several investigators have focused on the strain-rate effect for X12CrNi 18 8 stainless steel at low rates. Over the past decades, many researchers have indicated that the plastic deformation of materials under dynamic loading is very different from that under static loading. Dynamic plastic behavior is often found during the metal-forming process, vehicular accidents, and unexpected foreign impacts. Products made from X12CrNi 18 8 steel are not infrequently subjected to dynamic loading.

![Fig.1 Structure of X12CrNi 18 8 stainless steel](image)

The cutting proces is interaction between cutting tool and workpiece. Every material has a internal energy, which in cutting proces change. This is energy has the main influence on
the results by drilling. On the start is defined internal energy $E_t$ of cutting tool, the next is defined internal energy of workpiece $E_w$. The thermodynamical phenomenas is orientated on the problems of research of tensions on the tool and definition the motion energy between interaction two materials influence. The result is equations

\[ E_w + E_t \Rightarrow \text{surface conditions (quality, precision, tension)} \] (1)

\[ E_w = \text{function (microstructure, chemical condition)} \] (2)

\[ E_t = \text{function (microstructure, chemical condition, hardness)} \] (3)

2. DRILLING OF STAINLESS STEELS

Drilling tests were carried out using a vertical machining centre equipped with 10 000 rpm, 16 kW spindle. The tests used and TiCN-coated high speed steel with cobalt (HSCo) drills with a diameter of $\phi$ 5,5 mm, at a cutting speed of 30 m/min and feed rates of 0,1 and 0,2 mm/rev were used without coolant. All experiments was realitized in practice by production disks from X12CrNi 18 8 (tablesteel in figure 2. In the tests used HSCo steel drill with built-up edge is presented in figure 2.

![Image of hole production from X12CrNi 18 8 steel](image)

**Fig.2 The hole production from X12CrNi 18 8 steel**

On the cutting edge of in figure 2 presented HSCo drill with TiCN coating was SEM analysed. It was found between TiCN-coating and X12CrNi 18 8 steel built-up edge (BUE) acts as an adhesive. Cutting speed 30 m/min and feed rate 0.1 mm/rev was used.

| Chemical condition of stainless steels [%] |
|---|---|---|---|---|---|---|
| C   | Cr  | Ni  | Mo | Si  | P   | S   |
| 0,07 | 20,0 | 10,0 | 2,0 | 1,0 | 0,045 | 0,030 |

Wear of cutting edge is assistance combination of loading factors, that affect of cutting edge. Tool life of cutting edge is impact all loading factors, that they have aspiration alter geometry of cutting edge. Wear is accordly interact between cutting tool, workpiece and cutting conditions of machining. Mechanism wear is characterise abrasion element and their disposal at concert pitch assistance abrasion forth cutting zone. General wear of cutting edge is generally results abrasion, plastic deformation and breakable breach. 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.
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.

3. RESULTS AND CONCLUSION

About machining of stainless steel be needed adhere following commendation, that are results experimental measured at laboratory and applied clause [Jurko 2005, Vrba 2001, Lukovics 2004]:

- be needed act machining material attest
- apply inserts ISO-M
- secure consistence system machine-tool-workpiece-fixture
- technological discipline maint manufactural engine
- cutting tool exchange already about knock-down number of cutting edge
- cutting tools cast a voice by your leave capacity conjuction because surety adequate consistence and efficacious conscription warm of cutting tool
- the machined surface is different

The metalworking fluid forms part of a production process. Its economic aspects can therefore only be looked a from the point of view of its total effect on this process. Looking at it this
way, the purchase price is of infinitesimal significance. The costs which arise if the metalworking fluid does not completely fulfil its technical task are far greater. The purchase price alone is consequently unsuitable as an economic criterion. A product which, although it is expensive to buy, has to be changed less often and fulfils its technical task better, may be cheaper in the long run than one which is cheaper to buy. Tool wear and surface quality are also affected by the metalworking fluid and therefore have to be taken into account as factors influencing the costs. The continuity of product quality and the services provided by the metalworking fluid manufacturer have a substantial effect on the economic aspects, along with the numerically identifiable costs [Brychta 2004, Czán 2001]. The selection of a metalworking fluid is affected by many aspects, which differ in importance from one case to another. No generally valid prescription for selection can therefore be given. An understanding of the influencing factors can, however, contribute to ensuring that the optimum compromise is found. It should be remembered as a matter of principle in selecting that a metalworking fluid is primarily a constituent part of the specific machining process and has a major effect on productivity, the health of workers, economics, operational reliability and machining quality.

4. REFERENCES


ADDRESS FOR CORRESPONDANCE

SLOVAKIA
Assoc.Prof. Jozef JURKO, Ph.D.
Technical University of Košice
SK – 080 01 Prešov
Štúrova 31, Slovak Republik, e-mail: jurko.jozef@fvt.sk