Deformation effects on the machined surface with screw drill by drilling

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Abstract: **This paper is concerned with the topic of drilling. It will be of importance to teachers of Industrial Technology, those involved in machining research, and industrialists with an interest in process monitoring in the cutting zone. This paper will describe the deformation effects of the interface between conventionally produced 1.4301 stainless steel and the screw drill in the drilling process. Stainless steels are often considered to be poorly machinable materials; materials with high elasticity are also difficult to machine. In drilling stainless steel with a pseudo-elastic coating material, machinability difficulties are caused by the high strength and work hardening rate of steel and the pseudo-elastic properties of the coating material.**

The deformation effects were studied by analyzing of high speed steel with cobalt drills. The interface between stainless steel and the screw drill was examined with REM.

Keywords - **cutting tool-screw drill, drilling, stainless steel, machined surface, plastic deformation**

I. Introduction

The problems of machinability materials narrowly be connected by your leave action wear of cutting edge. 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 elementar element boundary juncture coat 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. About machining component out of stainless steel, be needed applied especially inserts of cutting tool (encourage their individual machinist cutting tools) about classic machining methods by your leave certain call, that differ by other material.

This study describeds the thermodynamic plastic deformation behavior and microstructural evolution of 1.4301 stainless steel by turning. The austenitic stainless steels are used in many industrial products, where the corrosion resistance associated to the high mechanical properties are necessary. Type 1.4301 stainless steel is an attractive engineering material because of its outstanding properties such as corrosion resistance, weldability, high strength, and good form-ability.

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Machining is the world's most common manufacturing process, with 15 to 20% of the cost of all goods being attributed. Machining may either be the primary manufacturing process as in the aerospace industry, or a secondary process as in the machining of castings, forgings, and powder metals. Most automotive castings are liable to be machined on up to 30% of their surfaces. Also, machining can be an indirect manufacturing process as in the production of press tools used in the stamping of automotive body panels. In the education of both technologists and engineers the basic mechanics of machining are explored. However, due to its nature, students should have exposure to the many variables that change with both workpiece and tooling materials, as well as the actual shop floor variables. This is important since they affect not only tool life but surface finish, component performance and material removal rates.

Drilling was selected because most students who do not have a machining background will be familiar with a standard "twist/jobber" drill. Drilling is one of the oldest and most common machining operations. The tools themselves have not changed much over the centuries, but the cutting materials and machine tools that employ them have. However, for its simplicity and commonality, the cutting geometries in drilling are extremely complicated and the process is terribly inefficient. Tool wear influences the quality of surface finish of the products produced and thus, if unnoticed, can cause high costs. The economical tool life can not be benefited from without tool wear monitoring.

II. Plastic deformation in cutting zone

All cutting tools wear during machining and continue to do so until they come to the end of their tool-life, the life of a cutting edge is counted in minutes and today tool-lives are often less then the old, established mark of fifteen minutes, but often quite a bit more as well. It is the productive time available during which the edge will machine components to be acceptable within the limiting parameters. In the early days of man tools, the tool-life parameter was simply when the tool could not cut any more. Today, the usual parameters are surface texture, accuracy, tool-wear pattern, chip formation and predicted reliable tool-life, the one applied depends upon the type of operation, finishing or roughing, and often the amount of manual control and supervision involved.

Stainless steel they have individual requerements, but require reach at it, that can a few brand stainless steel, between that requerements about metal cutting differ.

Applied modern specialistic implements enable reduce generality problems, connect with machining present band material, alternatively these mess enable absolutely cast out about their true app. Austenitic stainless steel are one from the main tip of stainless steels, that applied because machining fabrication component. Be due broad appliance and machined chiefly turning and drilling. Bases requerements about cutting tool because metal cutting of stainless steel in compare with another alloy steel are, figure 1:

- advanced addiction at built up edge (BUE)
- drift at hardening of material.

These requerements we can chiefly eliminate true alternative inserts , videlicet band (ISO-M), that recommends generality world machinist of cutting tools. Action machining of stainless steel is dearly many a time accompanying birth BUE on the cutting edge, that make bucking tool life (currency) of cutting tool, affects brand of machined surfacess, give out at alteration dynamic characteristic of cutting process (cutting forcess, cutting resistance,…), come-down action chipformation, as well as affect about assurance machining.

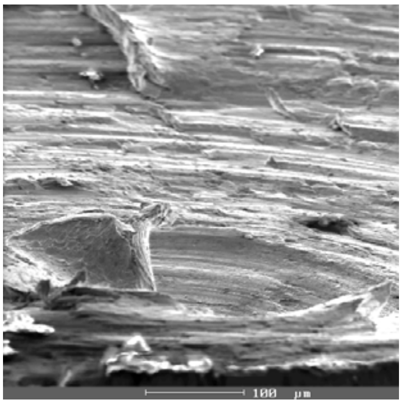

Fig. 1 Plastic deformation alongside machined surface of stainless steel by drilling, REM

III. Characteristic of stainless steel

Stainless steels normally have more than 12% chromium. Chromium makes the surface passive by forming a surface oxide film which protects the underlying metal from corrosion. In order to produce this film the stainless steel surface must be in contact with oxidising agents.

IV. Experimental part

The material used in this study is a typical austenitic type 1.4301 stainless steel. Figure 1 shows the microstructure of the material and Figure 2 defined of system technology. To measure the thermodynamic plastic deformation rates, a potential method by ISO 3685 and REM is used. To measure the cutting temperature is applied CCD thermovision

The microscopic plastic deformation of work material is illustrated in figure 1. The intensive plastic deformation is distributed the main in area corner of screw drill.

The macroscopic wear pattern of a cutting tool edge was illustrated in figure 2 and figure 3. The mechanisms described above will eventually cause wear that exceed the worn out criteria, either as a certain width of the flank, the rake face or as a certain edge blunting. The work material was carbon steel and the wear that eventually controlled tool life occurred on the rake face.

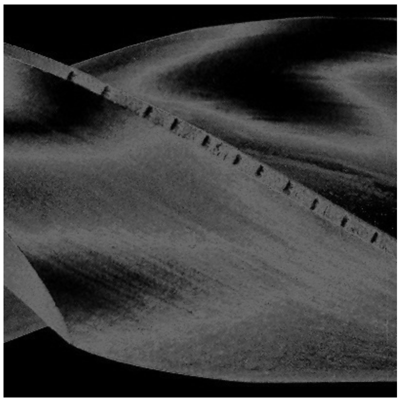

Fig. 2 Thermal analysis on the minor cutting edge by screw drill (black place – 620 ^{o}C)

At the same time, thermal softening of tool material in the rake face (over tempering revealed by the dark contrast adjacent to the coating) reduced the load bearing capacity of the coating, which failed by cracking and brittle fracture. Once the coating was removed, a large crater was rapidly developed in the unprotected HSS by severe adhesive wear. An initial wear, often involving tip blunting through minor fractures (chipping) is followed by a linear, steady-state wear regime dominated by abrasive and adhesive wear. A gradual tip blunting is one of the reasons behind a successively increasing edge temperature, and eventually, a situation of accelerated wear through edge fracture or severe plastic deformation is reached.

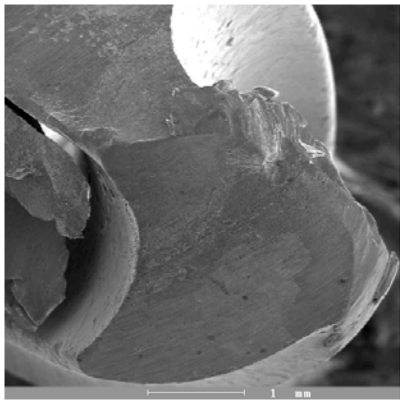

Fig. 3 The base tool wear mechanism - plastic deformation of major cutting edge

TABLE I
CHEMICAL COMPOSITION

Chemical composition [%]						
C	Cr	Ni	Mo	Si	P	S
0,1	20	10	2,6	1	0,03	0,030

This is further accentuated by coating. However, the improved wear resistance obtained by coating is often used to increase the productivity rather than to obtain a longer tool life. For experiments was applied of the stainless steel 1.4301 in the table 1, and cutting condition in the table 2 for the cutting tool with diameter 5,5 mm and the cutting material is HSCo.

TABLE II
CUTTING CONDITIONS

Cutting Speed v_c [m/min]	5	7	12	15	18	20
Feed f [mm]	0,04	0,08	0,1	0,12	0,16	0,2

Figure 4 show is the machined surface in the section the cutting zone. This machined surface is very intensive the plastic deformation from point two problems: the first is one the part of section cutting edge is cutting and the second part of section the cutting edge is only push deformation in the cutting zone – is it influence of the ploughing effect.

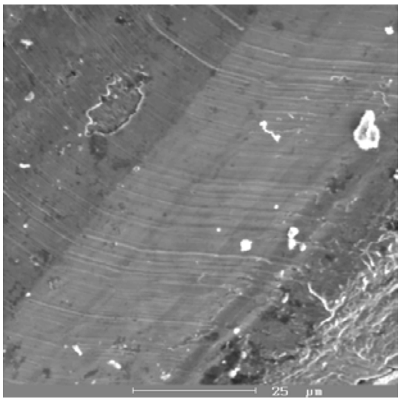

Fig. 4 Plastic deformation in cutting zone, on the machined surface, steel 1.4301

V. Conclusion

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 of cutting tool, the next is defined internal energy of workpiece. The themodynamic phenomenas is orientated on the problems of research of tensions on the tooland definition the motion energy between interaction two materials influence. From the demonstrated mechanisms of wear of HSS cutting tools we can draw the conclusion that hardness, heat resistance (hot hardness) and fracture toughness both macroscopically and microscopically are the prerequisites of high tool performance. Recent HSS development has focused on the homogeneity and cleanliness of the HSS steel.

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.

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