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Study of the Wear of Turning Cutting Tools

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Abstract

The study in question has spent a very large party wear cutting tool and monitoring the surface condition of the cutting tool because it is the main factor in the field of industry. For it was made a study of the roughness and wear our work applies to the dry machining of steel 42CrMo4 with a carbide tipped tools uncoated and coated with a coating layer of a few micrometers Titanium carbide. We performed measurements of the different flank wear (Vb) and the roughness (Ra) (roughness arithmetic). Moreover, it takes a few micrograms of the cutting tools during the machining or to wear of the development time of cutting.

Keywords: tool wear, Cutting tool, hard coating, roughness characterization.

1. Introduction

Study of materials cutting phenomena is to look for relationships between the characteristics of the material being machined, those of the tool and the basic parameters characterizing the cutting conditions (strength, power usage, tool wear and cutting quality). The set of conditions and data determine the performance of the process. Ideally, one could imagine dissociate the effect of the process environment of the mechanism itself, which summarizes the interactions between the workpiece and the tool.

In reality, many studies have shown that this was not possible because the tool part interaction zone is included in the system in the following figure (Figure 1). For example, for a round, the tool is mounted on a turret, which is itself mounted on a frame, and the piece is held in a chuck is itself supported by a spindle that it requires a proper maintenance.

2. Experimental Section

2.1. Machine

Universal Tour: SN40C having a power of 6.6 kW with mechanical speed variation.

2.2. Measuring device

- The flank wear was followed and measured approximately after each experiment with, an optical microscope HAUSSER workshop equipped with a cross table and a circular plate with a precision of 10^{-2}.
- The crater wear was visualized using a device equipped with a dial gauge and a tip, with an accuracy of 10^{-3} mm.
- The roughness of the contact surfaces was measured using a pertographe with a table with three axes.
- Wear surfaces were observed on SEM (scanning electron microscope).

2.3. materials of the tool

The cutting tools used in the tests are either coated TiN or TIC - triangular carbide inserts.

3. Experimental Result

For our experiment, a Grade logs machine were used (42CrMo4V, HB = 257 kg/mm$^{2)}$. Figures 2 and 3 show the variation of the flank wear and crater function of cutting parameters. The experimental curves exhibit quasi-linear speeds. Indeed, the curves resulting from the evolution of wear, shows that the final decommissioning of the edge is reached usually after two stages of evolution and when wear reaches 0.2 to 0.5 mm. Beyond this value, the behavior of the tool becomes random.

4. Analysis

The roughness is represented by triangular protrusions which define a hollow volume called volume Abbott. These hollow empty initially fill with debris and as the wear rate can overflow. Thus, the tool is used as the front and the back and each groove and takes the same amount of debris per unit of distance traveled along the contact due to debris. A loose particle from the rear of the contact is eliminated immediately, while a particle detached from the front to cross the entire length contact before being eliminated. The wear debris is thus transported from the front to the rear. The volume of loose particles is independent of the abscissa along the contact; transport concentrates the particles toward the back of the contact (Figures 3 and 4).

5. Electronic Image

The observation and measurement of surface states carried out jointly (Figures 5 and 6) in a tool life test to determine the optimal machining conditions, at least in the carefully chosen intervals depending, that one is in the draft plan or finish. Furthermore, the physical phenomena that causes progressive deterioration of the cutting edge and, correspondingly, the geometrical and mechanical properties of the machined surface, resulting in appearance of some modifications thereof, visible to the naked eye with the aid of an average enlarger [1]. These macroscopic and microscopic events allow an objective assessment of the increase of the evolution of roughness based on the cutting length of the two antagonists. Thus, continuous monitoring of the nature and roughness of materials in contact shows that the initial roughness in a significant impact on the location and development of the initial contact. The discrete contacts determine the local stress field and thus the thickness of the damaged areas. Thus, the appearance of a single contact area may lead to very deep degradation. Where as, in the case of rough contact, the contact areas are distributed over all the facing surfaces. The length of the first cracks and its harmfulness depend heavily on this rough geometry [2].

The behavior of the first body is described by their ability to accommodate the imposed displacement. If the normal force is fully transformed the first body at the microscopic level to the macroscopic level. The tangential forces transmitted through the interfaces that are based on the notion of adhesion between the surfaces. Also, the relative movement between these rough surfaces can be obtained by cracking of the interface, or cracking of the substrates. Due to adhesion, a portion of the displacement can be accommodated by the plastic deformation of the surface layers which work harden and which may be the site of structural modification [3].

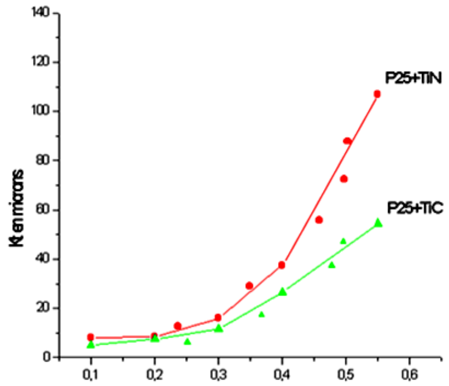


Figure 1: Evolution of the Kt wears according ahead

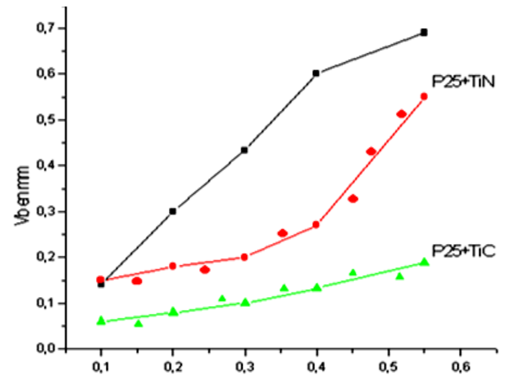


Figure 2: Evolution of wear Vb according to advance

V = 450 m/min; a = 0.4 mm*/rev*. ; p = 1 mm ; t = 40 min ; On 42Cr Mo4V.

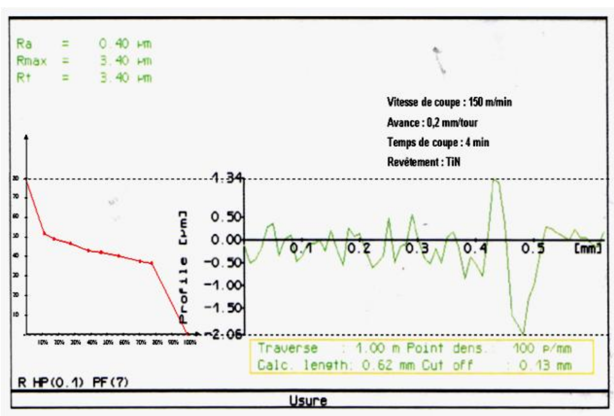


Figure 3: The layout of roughness curves and curves corresponding.

Abbot and Firestone

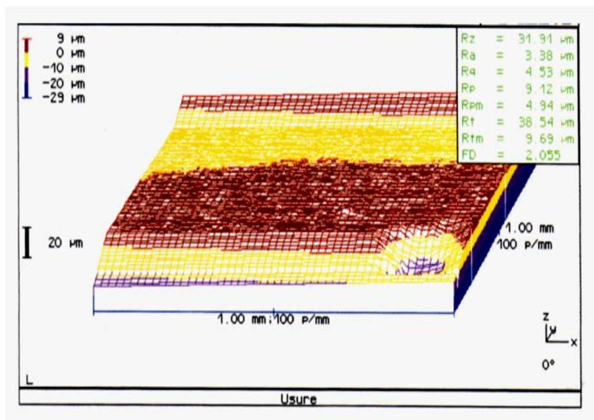


Figure 4: Plastic deformation and physicochemical 3D

TiN coating

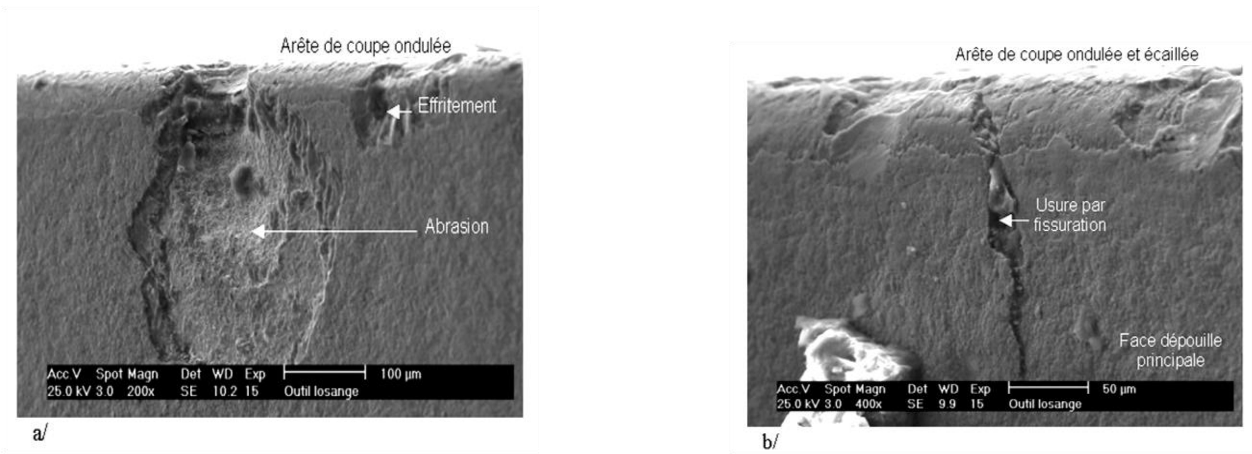
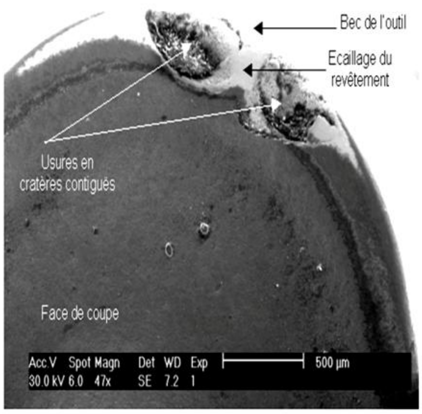


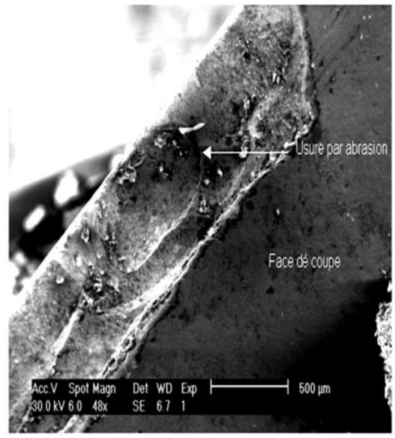
Figure 5: Morphology of topography on MEB of wear of the tool on TiN 42CrMo4V, V = 450 m/min; a = 0.4 mm*/rev*.; p = 1 mm; t = 40 min

a / wear by abrasion and erosion

b / Wear cracking and chipping



a/



b/

Figure 6: Morphology of topography on MEB of wear of the tool on TiN 42CrMo4V; V = 450 m/min; a = 0.4 mm/*rev.*; p = 1 mm; t = 40 min

a / Crater wear with formation of a white layer b / Wear by groove ridge chipping

6. Conclusions

The average roughness curves plotted on petrography revealed two phenomena. Up to 500m cut, there is growing linear roughness. From 500m, there is still growth, but it is less acute. It can be understood in the following way.

The cavities or roughness due to wear to an average use, are of small size and the effect of the third body is very harmful, and its role is similar to an abrasive which is manifested by wear constantly growing. When these asperities become cavities or large dimensions, there is a cumulative effect of the third body and the abrasive effect is less important. Note also identical roughness evolution, both for the TiC coating than TiN coating with a slight advantage for the latter. Furthermore, the material interest of 3D topography optical profilometry gives us more information on the diversity of roughness [3, 2].

Indeed, surveys on two remote yet close shots along the y axis (0.88 and 0.9 mm) show in the first case that the roughness is low over a certain length and then rises sharply from 0.5mm while in the second If the roughness remains approximately constant [4,5]. Even there is a significant difference with respect to the value of the average roughness. Also, the advantage of Abbot and Firestone curves learn about the importance of the roughness. For the first curve, i.e. TiC coating we see a very flat profile at the center, which shows a low roughness. For the other two curves, there is a slightly accentuated central slope shows an average roughness. Thus, when the coating is perfect, it plays the role of diffusion barrier thus protecting the most sensitive substrate. However, we find that this one is never perfect but has a crack network or possibly porosities. These defects are then weak points in a high-temperature working. Oxygen enters through imperfections in the layer and impairs the base layer. The tool will perish by chipping or breaking. Often the machined material plays a chemically active and causes the rapid destruction of the tool.

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