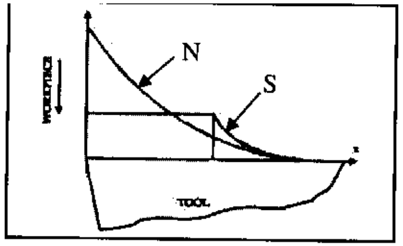

Fig. 5. Zorev's tool stress distribution

ɜM images of a wood cutting tool used during subsequent high speed cutting trials showed the ɜe of biological material on the rake face of the blade. However light microscopy did not reveal ιces of Douglas Fir on the blade used during the slow speed cutting trials. For molecular ɔn to occur molecules have to be within a few nanometres of each other [7]. In metal cutting it rted that the chip-rake face contact area approaches 100% [8]. It is possible that the high normal in wood cutting also allows for near complete contact and as such molecular adhesion.
: the low cutting velocities adhesion could occur, however the molecular bonds being weaker e shear strength of the material, the material would move over the surface of the tool. At high velocities, due to the increase in temperatures [9], it is possible for the lignin content in the :o soften [10]. The lignin could then cause complete contact with the tool rake face and ɔn. The adhesion of the lignin-tool rake face could be higher than the reduced shear strength of ened lignin and as such would shear, leaving traces on the tool rake face.

ƆNCLUSION.

is paper offers a theory that explains why using conventional friction theory the friction ent appears to vary with DOC. The introduction of a stiction zone gives a constant friction ent value independent of DOC. An explanation as to the adhesion process is also proposed.

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STUDY OF THE WEAR BEHAVIOUR OF CARBIDE-TIPPED TOOLS UNTREATED AND CRN-TREATED IN THE FIELD OF THE BREAKING UP OF THE PINE OF ALEP

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Abstract

This work aims to present an experimental step related to a technique of wood machining in order to evaluate wear for the case of the breaking up of the pine of Alep.
In our case the study has been done with one untreated and one CrN-coated carbide tools by magnetron sputtering.
The deposition conditions were already optimized in previous studies [1].
The routing machine was equipped with a numerical control ***RECORDI****, manufactured by the Italian firm* ***SCM*** *spa and located at the ENSAM of Cluny.*

1 INTRODUCTION

The execution and the interpretation of the tests of wear were considered in various ways, since the first work of Taylor, and other experimenters. In addition, the development of new varieties of tools and the evolution of the range of machined materials, very clearly widened the operating conditions, well beyond the field of the former experiments.

So the study of wear must be approached according to a progressive and systematic step. It is thus appropriate, first of all systematically to count the multiple manifestations of wear and to observe their respective evolution, then to determine until which stage of this evolution the tool will be able to preserve qualities of cut sufficient for the good completion of the work, according to qualities required. The limits thus appreciated will then be materialized in the form of quantitative criteria, applicable to various macroscopic demonstrations of wear.

However, because same of their relative nature, it will be important to specify which of this criterion is the most restrictive one, according to the various fields of application.
It is quite obvious that, in a given field, this one only, must be retained, to judge moment validly when the tool must be withdrawn from the service for the renewal of the cutting edge [2].

Machining wood is difficult because of many factors such as differences of the physical and chemical structures between wood and metals. On the one hand, wood has a good workability leaving speed crosses high, it contains a certain water, making it very corrosive [3], on the other hand, by the weak angles of cut which can be degraded abruptly by stone remains, nails, balls of hunters.... That's why the manufacturers of tools were constrained to find a compromise between the ductility and the hardness of materials of the cutting tools.

Currently, in the wood transformation chilled steels, the high-speed steel, of satellites, carbides and the diamond of Polycrystalline (PCD) are more use; among them, most common are the face-hardened carbides, because of their good wear resistance and cost relatively low compared with the PCD [3].

Since ten years, a lot of researchers worked in this field and an improvement of the lifespan of the tools was obtained by applying nitrides, carbides and diamond-based protective coatings [1-3].

The system of Cr_xN_y produced by PVD was studied during many years by C. Nouveau *et al.* [4-5] and its effectiveness at summer proven in the field of the unwinding and breaking up of the OSB, on carbide inserts and HSS tools.

This work was developed in order to verify the aptitude of CrN in the field of the breaking up of the pine of Alep.

2 EXPERIMENTATION

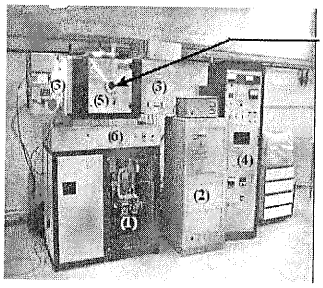
2.1 Material

A carbide insert was selected as substrate. Its chemical composition after EDS analyses is 98, 5%WC +1, 5%Co.

The deposition conditions are summarized in (Table 1).

Table1. Deposition conditions of CrN coatings

Residual pressure	2 10^{-6} mbar
Working pressure	4 10^{-3} mbar
Percentage of Nitrogen	20%
Percentage of Ar	80%
Time	90mn



Enclosure of pulverisation
1- Cryogenic pump
2- R.F generator
3- Adaptator of impedance
4- Automatic system pumping
5- Sputtering chamber
6- Massflow meter

Fig.1 Magnetron sputtering system

2.2 Test of breaking up

The tests of machining were carried out on a router with three axes with numerical control RECORDI type (Fig.2) with a carbide tool (Fig.3). The cutting conditions are presented in (Table 2). The machined materials were rectangular work piece of pine of Alep.

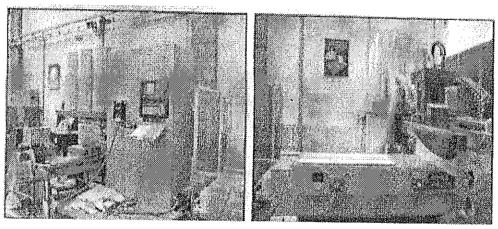


Fig. 2 3 axes router with numerical control

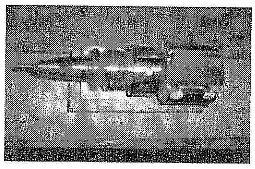


Fig. 3 Tool holder

Table 2. Cutting conditions.

Number of revolutions of the cutter :18000 rpm
Mill diameter :40 mm
Teeth number : 1
Depth of cut: 8 mm
Radial depth of cut : 2 mm
Edge angle : 55°

2.3 Characterization of wear

The wear's measurement was realized with a binocular as shown in figures 4 and 5.

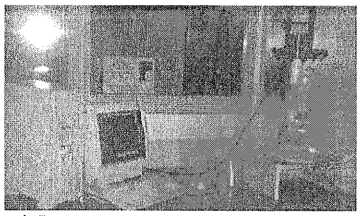


Fig. 4 Instrumentation of wear's measurements

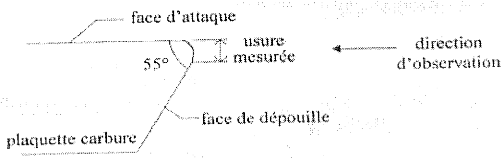


Fig. 5 Quantification of the edge's wear

3 RESULTS AND DISCUSSIONS

The results are given in (Fig. 6).

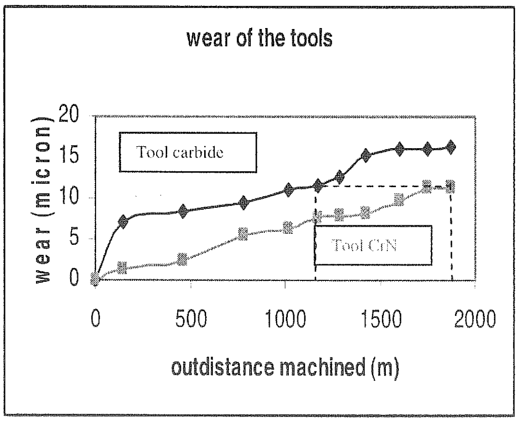


Fig. 6 Wear of the tools

We can first notice that the coated tool performed the best. It's especially notable during the beginning of the machining process that means during the tool's lapping.

This work must be supplemented by a mechanical and tribological characterization of coatings.

4 CONCLUSION

We applied PVD CrN coatings to cutting tools for the secondary transformation of wood, this coating has been applied on high speed steel HSS18, commonly used for planing and shaping knife fabrication, and onto alloy steel (AS) 90CMV8, used for chipper and canter knife fabrication. Furthermore, other coatings and surface treatments, like nitriding, were used to improve cutting performances

It is interesting to purchase the investigations in order to see the behaviour of these coatings on the tribological level.

Tribological and erosion properties have been used to rank the materials and coatings combinations in performance order with application to secondary transformation of wood.

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