CUTTING PLATES MADE OUT OF SINTERED METALLIC CARBIDES COATED USING CVD METHOD

Stela Constantinescu, Danube Down River University, Galați, România
Alina-Crină Ciubotariu, Danube Down River University, Galați, România
Tamara Radu, Danube Down River University, Galați, România

Abstract
In case of sintered hard carbides, damaging of cutting edge is a gradual process which takes place under the combined action of wear on the side flank and on the face of the tool. In the practice of tool endurance determination, the trace on the side flanks is limited to 0.3 – 0.5mm.

There are three types of alloys, depending on the composition: WC–Ti–Co, WC–TaC(Nb–C)–Co and WC–TiC–TaC(Nb–C)–Co. alloys based on many carbides with small or medium amount of TiC or TaC(NbC) can also be used for cutting materials with short chips and this way so called “universal alloys” have emerged. These alloys can be used to cut any material, under certain cutting conditions.

The endurance of coated plates is 2.2 times higher than that of uncoated plates, when processing steel type OLC45 with cutting rates of 140m/min and 2.4 for cutting rates of 200m/min.

Therefore, coated plates behave much better than those uncoated with increase in cutting rate, which justifies once again use of coated plates instead of uncoated ones, especially for hard duty processes.

1. INTRODUCTION
Hard alloys made out of sintered metallic carbides produced on a large, industrial scale for cutting processes can be divided in two categories, depending on their use. The first categories comprises alloys mainly used for cutting materials with short chips(cast iron, glass, china etc). Alloys of type WC–Co, sometimes with additional small amount or other carbides, are used almost exclusively for such cutting operations. Same compositions with other particle-size range are also used for wear parts(drawing dies, stamping dies etc). The second category comprises alloys made out of many carbides used for cutting materials with long and continuous chips(all types of steel).

There are three types of alloys, depending on the composition: WC–Ti–Co, WC–TaC(Nb–C)–Co and WC–TiC–TaC(Nb–C)–Co. alloys based on many carbides with small or medium amount of TiC or TaC(NbC) can also be used for cutting materials with short chips and this way so called “universal alloys” have emerged. These alloys can be used to cut any material, under certain cutting conditions.

Cutting plates made out of sintered metallic carbides coated using CVD method are produced and used in industrial sector on a larger scale. This trend of development is explainable through the following: for uncoated plates, an increase of cutting rates by only 15% results in s decrease of tool life down to a half. Coated cutting plates behave better on matters such endurance, even for higher cutting rates.
2. EXPERIMENTAL TESTS AND RESULTS
Cutting tests of lathing, milling, drilling etc are the most important tests in quality control. While hardness, tenacity and microstructure testing and control of sintered hard alloys are very important for practical reasons of production, the client is mainly interested in alloy cutting performances. The curves T-v (T is tool endurance in minutes, v-cutting rates in m/min) allow comparison of cutting efficiency of sintered hard alloy tools of various compositions working under various cutting conditions (see fig.1).

![Figure 1: Endurance T-v for the plates P30 coated and uncoated with TiC, tested for lathing of steel type OLC45](image1)

Cutting carbide tool edge destruction is not so easily noticeable as it is in the case of steel tools (where destruction of cutting edge can be seen through sudden worsening of part roughness). In case of sintered hard carbides, damage of cutting edge is a gradual process which takes place under the combined action of wear on the side flank and on the face of the tool. In the practice of tool endurance determination, the trace on the side flanks is limited to 0.3-0.5mm.

This wear is usually measured by means of a microscope or a Brinell magnifying glass. For each sample processed under the same values of cutting process parameters VB wear of plates P30 and K20 coated with TiC and uncoated have been noted, after certain time intervals corresponding to one tool passing, to two and to three passing. Figure 2 is a result of the experimental data.

![Figure 2: Wear of plates P30 coated with TiC, tested for lathing of steel type PLC45](image2)

![Figure 3: Uncoated plate after one passing on steel. Wear VB = 6.24µm(X9)](image3)
In the case of cutting processing of materials with long continuous chips, wear on the face of tool becomes ultimate. Measurement of this wear trace is made by measuring the crater depth (figures, 3, 4 and 5).

![Figure 4: Coated plate after two passing on steel. Wear VB = 5.42µm(X9)](image)

![Figure 5: Coated plate after three passing on steel. Wear VB = 9.12µm(X9)](image)

It is also possible to measure wear on the side flank noted VB at certain time intervals and to draw the curves VB – T of wear variation VB depending on endurance – cutting time. If a chip of constant section is submitted to various cutting rates. The curves t – ν can be drawn showing endurance variation with the cutting rate.

Table 1 shows the values of wear depending on time, for plates coated with titanium carbide 6µm and 10µm thick, respectively.

<table>
<thead>
<tr>
<th>Plate type</th>
<th>Processed material</th>
<th>Cutting rate [m/min]</th>
<th>Number of passing</th>
<th></th>
<th></th>
<th></th>
<th>Time [min]</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wear VB [µm]</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Plate coated with TiC thick 6µm</td>
<td>Plate coated with TiC thick 10µm</td>
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<td></td>
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<tr>
<td>P 30</td>
<td>OLC 45</td>
<td>197</td>
<td>1</td>
<td>2.84</td>
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<td>4.40</td>
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<td></td>
<td></td>
<td>3</td>
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<td></td>
<td>215.5</td>
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<td>4.08</td>
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<td></td>
<td></td>
<td>3</td>
<td>5.98</td>
<td>10.15</td>
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<td>K20</td>
<td>White cast iron</td>
<td>122.5</td>
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<td>2.93</td>
<td>4.35</td>
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<td>3</td>
<td>5.75</td>
<td>9.70</td>
<td>17.4</td>
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</table>

The cutting testing equipment has to be endowed with sensitive and accurate apparatus to record all cutting values and parameters and all the changes.
3. CONCLUSIONS
The shape of wear curves VB, depending on time is normal, especially for low cutting rates and when using plates coated with TiC.
The curves T- v, showing endurance variation as function of cutting rate have been drawn for the plates TiC coated and uncoated for steel type OLC45 processing. These diagrams show better endurance for coated plates than for uncoated plates at the same cutting rate.
The endurance of coated plates is 2.2 times higher than that of uncoated plates, when processing steel type OLC45 with cutting rates of 140m/min and 2.4 for cutting rates of 200m/min. Therefore, coated plates behave much better than those uncoated with increase in cutting rate, which justifies once again use of coated plates instead of uncoated ones, especially for hard duty processes.
The thicker the coating layer, the less resistant the plate is in the cutting process. Layer thick between 4 – 8 µm is the best, over these values the layer tenacity decreases and it becomes fragile.

REFERENCES