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# Influence of coatings on edge milling quality

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**Abstract:** *Influence of coatings on edge milling quality*. The present paper is aimed at examining an influence of coatings improvers (laminates and lacquers) on the quality of edge milling. For this study the grooves were milled with a 40mm diameter milling cutter. The research was conducted with use of new tools VBmax=0,0mm, and tools having significant degree of wear equal VBmax=0.2mm. The study involved raw wood based panels and wood based panels with improved surface (laminate and laquereed HDF). The studies determined edge defects occurring on the groove edge (chipping laminate).

*Keywords:* machining quality, machining, milling, wood based panels

## INTRODUCTION

The aspect of quality of the machining processes of wood based materials with (lub coatings) improved surfaced (laminates or lacquers) is important in the furniture components production. Coatings improvers are designed to increase the mechanical properties and realize stylistic issues. In terms of mechanical properties coating are designed to increase resistance to:

- Abrasion
- Scratches
- Shock
- Variation of temperature
- Liquids

Considering the meaning of thickness (usually laminates have a thickness of 0.1 to 0.3 mm) and purpose of coatings, both have an impact on the course of milling and its quality effect. Coatings refining is characterized by increased hardness. The variability of environmental conditions and functional requirements entail the use of coatings improvers. The consequence is a need to take into account their impact on the treatment and its effects. The high hardness coating affects the growth of cutting forces [Szymanowski et al. 2015] as well as the durability of cutting tools [Szymanowski et al . 2012]. It is also necessary to consider possible edge damage after treatment in the context of its quality (aesthetic and assembly). The quality aspect and damage laminate is particularly important for the furniture industry [Dawim et al. 2008].

## METHODOLOGY

Tests were carried out on an industrial CNC milling center BUSELLATO model JET 130 (ITALY 2004). The study used a single point milling head ( FABA , Poland ) with a diameter of 40 mm with blades made of cemented carbide with the symbol KRC08. Basic properties of the cemented carbide KRC08 are shown in Table 1. The tests were carried out using constant parameters: cutting speed of 37,68m/s, feed per tooth 0.15 mm and a constant milling depth of 6mm . In the materials were milled a straight grooves with a length of 30 cm, then the quality of the resulting edge was determined. Determining the quality of the edge was to designate the maximum defect edge. Size of defects - chipping was read on the microscope Mitutoyo workshop TM505 (Japan 2010). The value of frittering was determined according to the diagram shown in Figure 1. and was determined on 1cm stretch. The quality indicator value was specified separately for conventional and climb processing .

**Table 1.** Basic properties of the cemented carbide KRC08

| Carbide type | Binder content [%] | Density g/cm$^3$ | Hardness | | | Bending strength [MPa] |
|---|---|---|---|---|---|---|
| | | | HV10 | HV30 | HRA | |
| submicron chrome | 3,2 | 15,2 | 1920 | 1885 | 93,4 | 2300 |

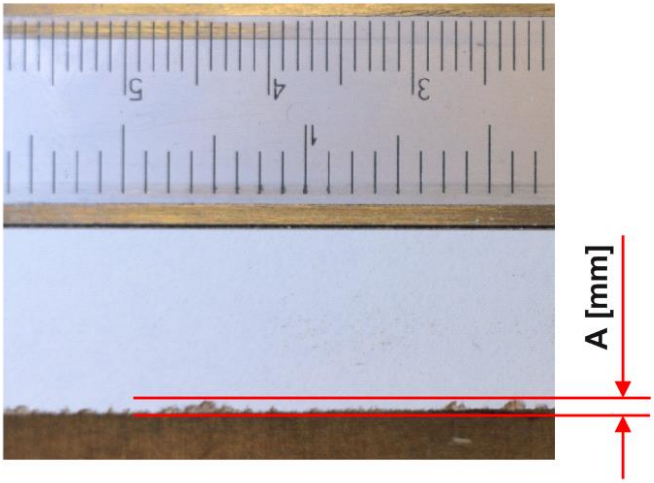


**Figure 1.** The method of determining the A-type quality indicator

The study involved six commercial wood-based materials and their basic characteristics are shown in Table 2

**Table 2.** The basic properties of the tested wood-based materials

| Material | Density [kg/m3] | IB [N/mm2] | MOE [N/mm2] | The ability to maintain screws [N/mm] | MOR [N/mm2] | Hadrness: Brinell method [HB] | Sand content [%] | Swelling after 24h [%] | Water absorption 24h [%] |
|---|---|---|---|---|---|---|---|---|---|
| Particleboard | 740 | 33,9 | 4180 | 97,3 | 0,48 | 2,6 | 0,18 | 19,1 | 29,4 |
| Laminated particleboard | 670 | 15,4 | 2950 | 81,5 | 0,39 | 2,1 | 0,23 | 25,6 | 61,8 |
| MDF | 750 | 33,9 | 4180 | 97,4 | 0,48 | 4,0 | 0,0021 | 19,1 | 29,4 |
| Laminated MDF | 760 | 33,5 | 4230 | 110,7 | 0,43 | 5,0 | 0,0083 | 7,0 | 12,8 |
| HDF | 860 | 50 | 5500 | 63,7 | 0,38 | 5,6 | 0,0021 | 63,8 | 72,8 |
| lacquered HDF | 800 | 40,5 | 4390 | 60,4 | 0,36 | 5,4 | 0,0069 | 63,2 | 116 |

## RESULTS

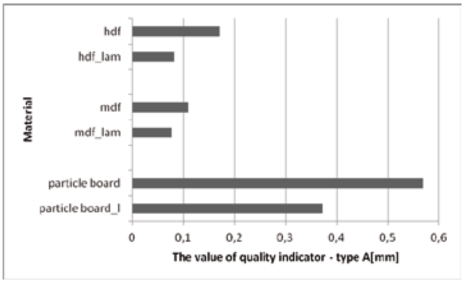


**Figure 2.** The value of type A quality indicator for the treatment of counter-carried by new tool

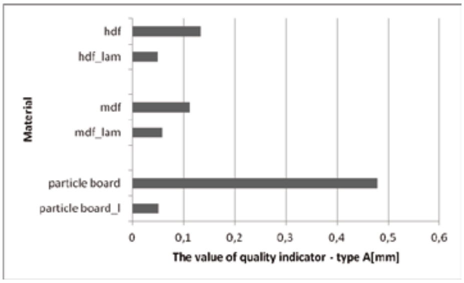


**Figure 3.** The value of type A quality indicator for the treatment of counter-carried by new tool

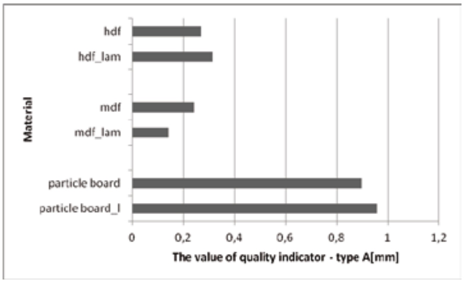


**Figure 4.** The value of type A quality indicator for the treatment of co-rotating by new tool

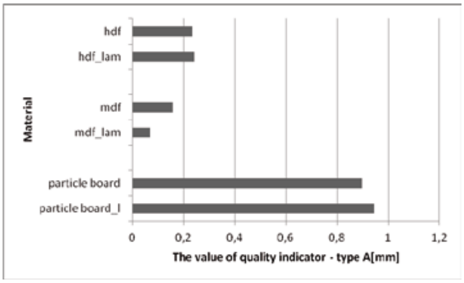


**Figure 5.** The value of type A quality indicator for the treatment of co-rotating by worn tool

As shown in Figures 2 and 3 wood-based materials covered by coatings are less (better) type A quality indicator. This applies to all the material, both laminated and HDF varnish. Particularly noteworthy is the low value of type A quality index for the treatment horizontal milling conducted using new three different tools. Figures 4 and 5 show the outcomes obtained during the processing performed with spent tools (VBmax - 0.2 mm). As it could be seen ratios derived by worn tools significantly differ from those obtained with new tools. There is no characteristic correlation for the new tools. It can be presumed that chipping coatings improvers are much larger than defects in the material. The reason is the difference in properties of the base material ( shavings or wood fibers ), and the coating ennobling, wherein the layer has a greater density and hardness, and also fragility than the base material. Consequently, the damage to the coating ennobling measured in a perpendicular direction to the course of the tool path are deeper than damage to the base material.

## CONCLUSIONS

Coming up to conclusion it has been stated on the base of obtained results, that:

1. The state of tool wear is a key factor determining the state of edge quality obtained in the milling process .
2. With increasing wear of the milling tools positive effect on the quality of coatings refining edge of the workpiece decrease.

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**Streszczenie**: *Wpływ powłok uszlachetniających na jakość frezowanej krawędzi.* W artykule określono wpływ powłok uszlachetniających (laminatów oraz lakierów) na jakość frezowanej krawędzi. W badaniach frezowano rowki przy użyciu głowicy trzpieniowej o średnicy 40mm. Badania prowadzono z użyciem narzędzi nowych VBmax=0,0mm jak i narzędzi o znaczącym stopniu zużycia na wynoszącym VBmax=0,2mm. Badaniom poddano materiały nieuszlachetnione (tzw. surowe) jak również pokryte laminatem oraz lakierowaną płytę HDF. W badaniach określano defekty krawędzi występujące na krawędzi rowka (wykruszenia laminatu)

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