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Influence of cutting blade projection over the milling cutter body on kickback velocity during chipboard machining

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Abstract: *Influence of cutting blade projection over the milling cutter body on kickback velocity during chipboard machining.* The article presents results of the kickback experimental investigations made during chipboard milling process. Milling cutters with various cutting blade projection and different cutting velocities were applied. During tests which were performed the kickback velocities of the machined chipboard test pieces were determined.

Keywords: kickback, milling, cutting blade projection

INTRODUCTION

The unexpected movement of the workpiece or parts of it opposite to the direction of feed during wood processing is named kickback. It is one of the main reasons of fatal and dangerous woodworking accidents. Kickback velocity is a measure of the occupational hazard caused by the kickback phenomenon. One of the most popular wood processing where kickback occurs is milling and besides single spindle vertical moulding machines are well-known as very dangerous. Therefore the experimental investigations concerning influence of cutting conditions during milling of wood-based materials on kickback velocity were begun.

The presented here data are the piece of the above mentioned wider empirical investigations, which may help to work up less danger cutting conditions for hand fed milling wood-based materials.

METHODS AND MATERIALS

The test stand built in CIOP-PIB according to the requirements of EN-847-1:1997, designed at first for testing of milling tools for voluntary tool certification purposes were used for the investigations under discussion.

The test stand was adapted to carry on experimental investigations concerning influence of cutting conditions during milling of wood-based materials on occupational hazards caused kickback phenomenon. The modernized test stand allows for testing kickback with use of bore mounted milling tools both cutters and cutter heads which may have different diameters and shapes. Cutting velocities can be precisely adjusted in wide range by means of a frequency converter.

Test pieces used in experiments have standard thickness 18 mm and during tests the narrowest 18 mm high sides are machined, therefore test pieces could be easily made from the most popular wood-based materials as well as from solid wood.

The test pieces applied in kickback tests were dry, i.e. the chipboard test pieces were stored in the testing laboratory over two years in the same conditions together with those made from solid wood. The measured humidity of the wooden test pieces was under 12%.

The experiments consisted in performing 10 repetitions of tests in the same cutting conditions. The following parameters of material and machining were applied:

- cutting velocities: V_c = 17, 31 i 45 m/s
- cutting depth: 10 mm

- test pieces dimensions: 18 x 40 x 500 mm
- test pieces material: chipboard manufactured by KRONOPOL Sp. z o.o. Żary

Each test flow was recorded from the top by the high-speed camera and these movies with help of the formula elaborated for this purpose allowed to very fine kickback velocity calculations.

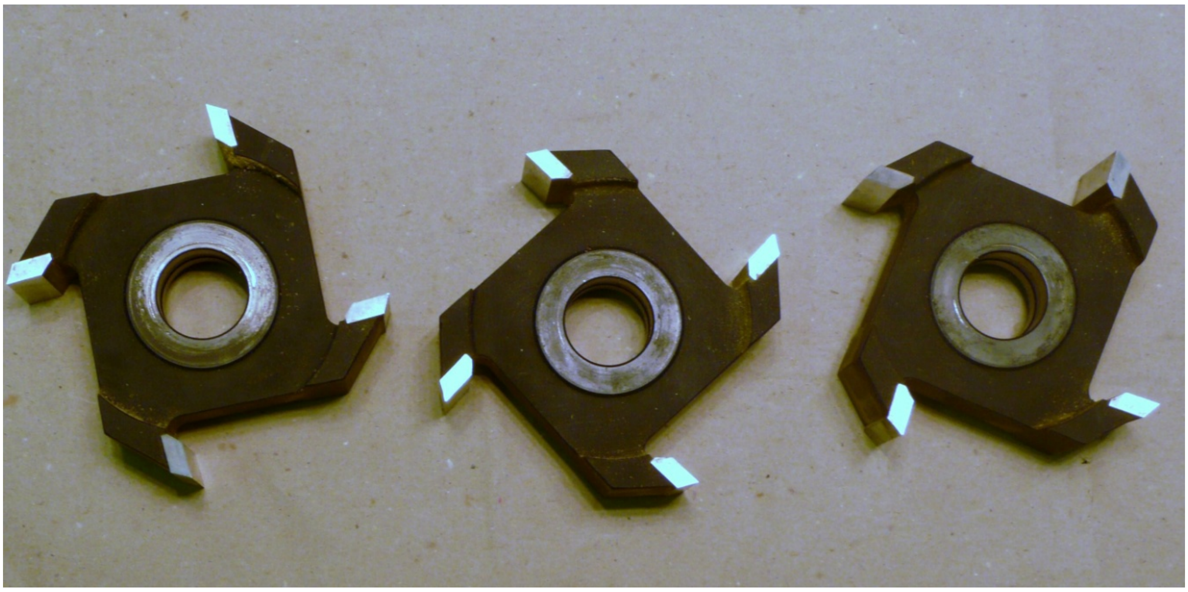


Fig. 1 Milling cutters FABA 3110 s.4 HS. Cutting blade projection (from left): 2,5; 1,75 and 3,5 mm

Four teeth milling cutters with brazed high-speed steel tips type FABA 3110 s.4 (Fig.1) with different cutting blade projections specified in Tab.1 were used in the kickback tests.

Tab. 1 Milling tools

Number of tool	**Tool marking by the manufacturer**	**Cutting diameter [mm]**	**Cutting blade projection [mm]**
1.	125x45/30s.4.0 korpus D= 121,5 F11-09663BS	125	1,75
2.	125x45/30s.4.0 korpus D= 120 F11-09663S	125	2,50 (standard)
3.	125x45/30s.4.0 korpus D= 118 F11-09663AS	125	3,50

Cutting blade projection in round-form tools is the difference between the radius of the cutting circle and the radius of the back supporting circle. In this case the tool was not round form, so a cross section of its body was not circular and chip thickness limitation was not performed by a deflector. Therefore cutting blade projection meant here the difference between the radius of the cutting circle and the maximum outer dimension of the tool body.

The total number of tests which were taken into consideration was 90 in all possible configurations of tool and cutting velocity.

Environmental conditions in the laboratory were as follows: air temperature 20 ± 1˚C and humidity 40 ± 5%.

RESULTS

The test results presented in Fig.2 clearly show, that influence of cutting blade projection over the cutter body on kickback velocity cannot be confirmed independently from cutting velocities applied during tests. These can be also observed on the machined surfaces of the test pieces (Fig.3), which are very similar for different cutting blade projections but the same cutting velocities.

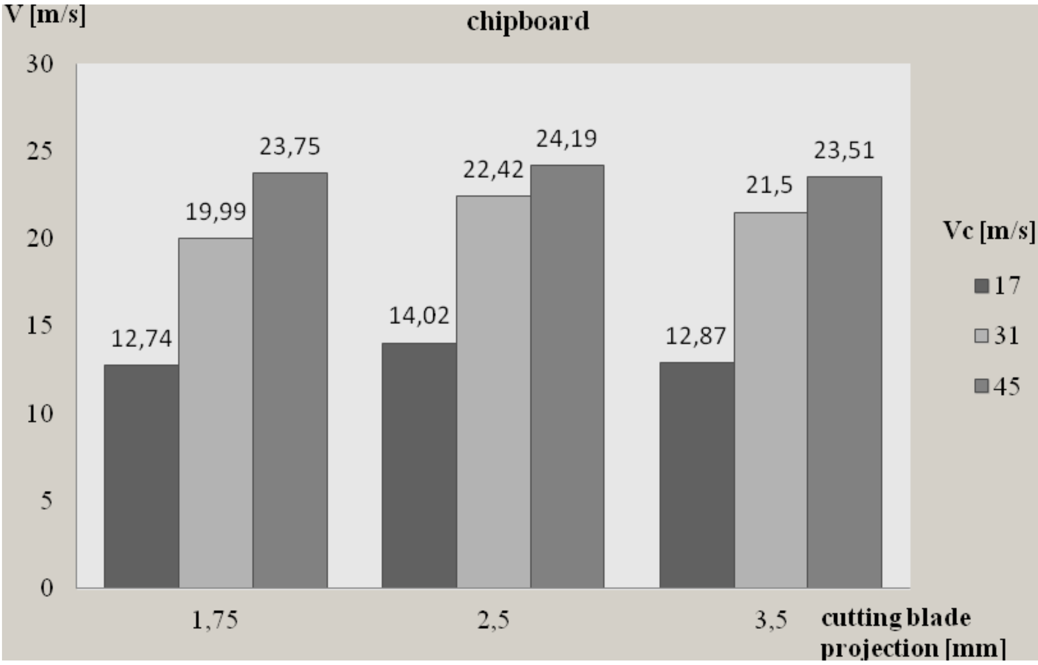
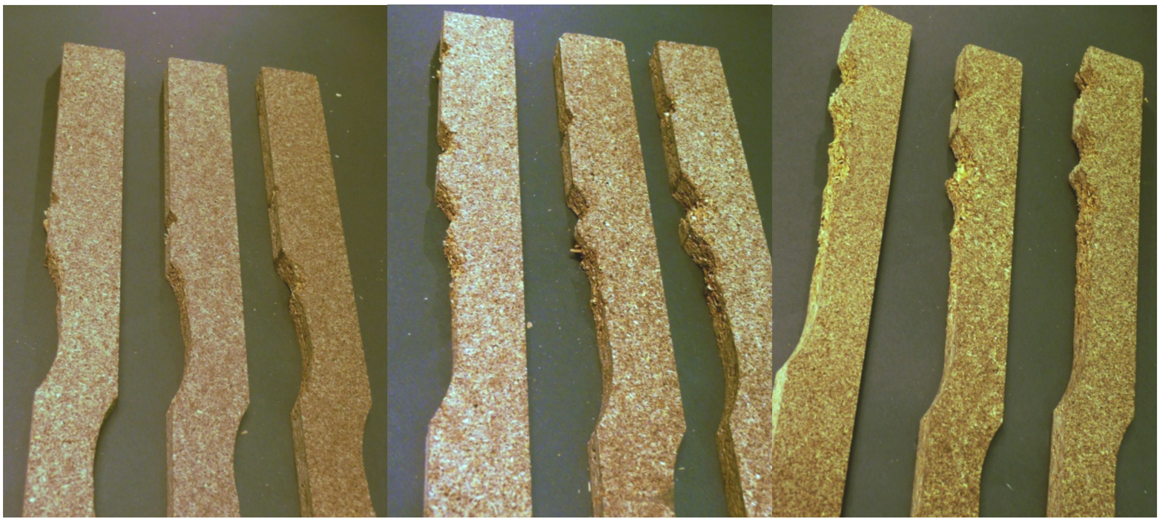


Fig. 2 Kickback velocity during milling chipboard with cutters having different cutting blade projection over tool body reached for different cutting velocities

However serious differences may be observed comparing average kickback velocities obtained during milling chipboard with different velocities. In this case the kickback velocity grows together with cutting velocity and this is the pronounced tendency.



a) Vc = 17 m/s b) Vc = 31 m/s c) Vc = 45 m/s

Fig. 3 Look of the test pieces after kickback tests carried out with use of milling cutters having cutting blade projections (from left): 1,75; 2,5 i 3,5 mm

Dints of cutters teeth which are well visible on photographs of the test pieces (Fig.3) were deeper and there were more of them when cutting velocities were higher. Therefore higher accelerations of test pieces and consequently higher kickback velocities were feasible in these experiments.

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Streszczenie: *Wpływ wystawania zębów poza korpus freza na prędkość odrzutu podczas obróbki płyty wiórowej.* W artykule przedstawiono wyniki badań doświadczalnych odrzutu podczas frezowania płyty wiórowej. Stosowano frezy o różnym wystawaniu zębów poza korpus oraz różne prędkości cięcia. Podczas przeprowadzanych prób wyznaczano prędkości odrzutu próbek z płyty wiórowej.

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