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Feed rate influence on feed force and cutting torque while drilling in MDF (Middle Density Fibreboard)

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Abstract: *Feed rate influence on feed force and torque while drilling in MDF (Middle Density Fibreboard).* The article describes influence of the feed rate on cutting resistance while drilling the raw MDF. A standard CNC Busellato Jet 130 machine was used for the test, with mounted single blade LEITZ 10 mm diameter drill. During examinations a piezoelectric KISTLER sensor fastened in the measuring platform was used to capture a signal of feed force and the cutting torque moment. Cutting resistances for five values of feed per revolution (0.1; 0.15; 0.2; 0.25 and of 0.3 mm) and three variants of the spindle speed (3000, 6000, 9000 rpm) were examined. For above parameters appropriate values of the feed rate [m/min] were calculated. Test results allowed formulating the conclusion that the feed rate has an influence on axial force and twisting moment while drilling the MDF.

Keywords: cutting resistance, MDF, feed force, cutting torque

INTRODUCTION

Drilling of wood-based materials, especially MDF is common technological process in wood industry. Influence of cutting parameters such as feed rate (or feed per revolution) on cutting resistance is well known problem [Staniszewska, Zakrzewski 2002; Orlicz 1988]. Knowledge of cutting resistance accompanying the process of drilling and its sensitivity to feed rate can be used to analysis of production efficiency and mac. Drill bits are working in difficult conditions (not effective cooling), cutting forces can deform the tool and for this reason the feed rate cannot be too high.

That is why the problem of feed rate influence on feed force and cutting torque while drilling in MDF was examined in this paper.

MATERIALS AND METHODS

Machining was realized by means of standard CNC machine BUSELLATO JET 130. Drilling was realized using brand new single bladed LEITZ drill (fig.1) with diamond polycrystalline cutting edge (ID NR:091193) .The holes were drilled in raw MDF using mentioned above tool.

Simultaneously during drilling took place registration of feed force and cutting torque by using measuring platform with mounted piezoelectric sensor (Kistler 9345A) as a part of this device (fig.2). Platform is modified version of the one used by Czarniak and Górski [2009].

Five variants of feed per revolution were assumed: 0,1 mm; 0,15 mm; 0,2 mm; 0,25 mm; 0,3 mm. Also three variants of spindle speed: 3000 rpm, 6000 rpm and 9000 rpm were assumed (for above parameters appropriate values of the feed rate [m/min] were calculated and used). However test showed no significant influence of cutting speed on registered signals so results were averaged (arithmetic mean). Each set of parameters was tested 20 times, that resulted in 300 recordings.

Fig. 1. Mounted LEITZ drill

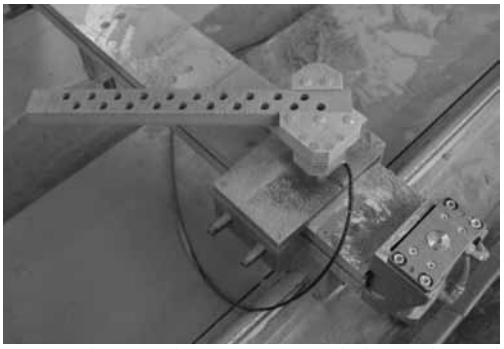
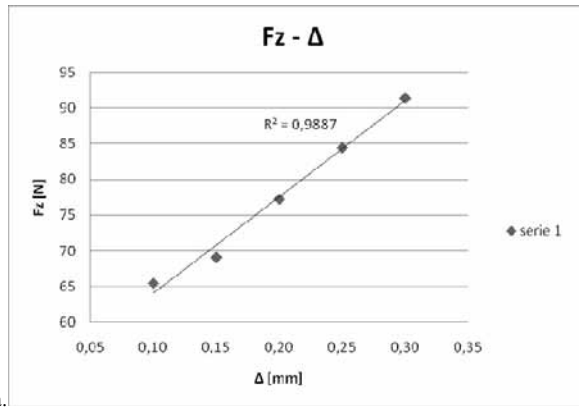


Fig. 2. Measuring platform with piezoelectric sensor and clamped sample

RESULTS AND DISCUSSION

Test showed that feed per revolution (Δ) has a linear influence on both feed force (Fz [N]) and cutting torque (M [Nm]). Doubling the feed per revolution from 0,1 mm to 0,2 mm causes increase of axial force for approximately 15 N, it raises the same amount when feed per revolution is set to 0,3 mm (fig.3a). Similarly reacts value of cutting torque, growing from 0,15 Nm for feed of 0,1 mm through 0,19 Nm for 0,2 mm to 0,23 Nm for 0,3 mm.

a.



b.

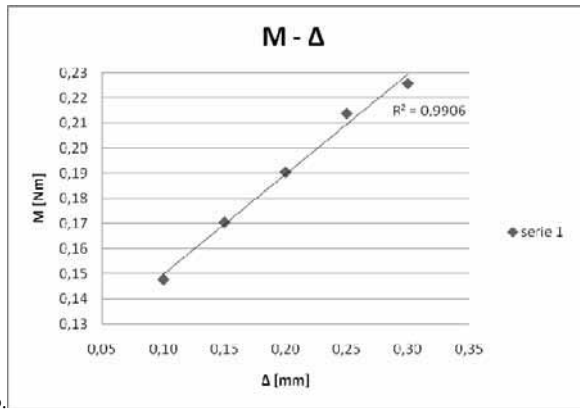


Fig. 3. (a) Influence of feed per revolution on feed force; (b) Influence of feed per revolution on cutting torque

CONCLUSION

Obtained results allow to formulate following conclusion: feed per revolution had a significant, linear influence on both feed force and cutting torque.

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Streszczenie: *Wpływ prędkości posuwu na siłę posuwową i moment obrotowy skrawania podczas wiercenia w płycie MDF.* W artykule opisano wpływ prędkości posuwu na opory skrawania podczas wiercenia surowej płyty MDF. Do badań wykorzystano standardową obrabiarkę CNC Busellato Jet 130. Wiercono przy użyciu wiertła jednoostrzowego marki LEITZ o średnicy 10mm. Podczas badań wykorzystano czujnik piezoelektryczny KISTLER zamocowany w platformie pomiarowej przy pomocy, którego, rejestrowany był sygnał siły osiowej oraz momentu skręcającego. Badano opory skrawania dla pięciu wartości posuwu na obrót (0,1; 0,15; 0,2; 0,25 oraz 0,3 mm) a także dla trzech wariantów prędkości obrotowej wrzeciona (3000, 6000, 9000 obr/min). Dla powyższych parametrów dobierane były odpowiednie wartości prędkości posuwu. Wyniki badań pozwoliły na sformułowanie wniosku, że prędkość posuwu wywiera wprost proporcjonalny wpływ na siłę posuwu i moment obrotowy skrawania podczas wiercenia płyty MDF.

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