# POPCORNBOARD – CHIPBOARD MODIFIED WITH POPCORN.
## Part 2 Machining tests

**Marcin Zbieć – Joanna Czechowska – Andrzej Mazurek**

**Abstract**
*Paper deals with milling tests of chipboard modified with popcorn. Promising material, especially in case of greater thickness lightweight board production, was thoroughly tested machineability-wise, especially with machining surface temperature, wear ratio and forces in milling, and then compared to regular chipboard.*

**Key words:** *popcorn, particleboard, machining, milling*

## INTRODUCTION

Particleboards use, especially chipboard show high usage increase year by year. Almost all furniture, home furnishings, and even latest building constructions such as of relatively inexpensive particleboard materials. Trends of particleboard usage show increasing popularity of light type boards, designed to fulfill insulation needs or constructional elements of increased thickness. This is especially visible in contemporary furniture design, Unfortunately chipboard does not really provide material valuable in higher thicknesses, it needs filling of some insulating material or making a complicated honeycomb designs, which except higher price has problematic application in technological processes because of special tooling requirements. One of the solution to this problem may be modification of classic chipboard with popcorn, creating lightweight and ecologically friendly structure. Following paper presents machining-wise test of modifications of chipboard with popcorn.

## MATERIAL AND METHODS

During the experiment three types of the boards were used:

- Regular reference chipboard
- Chipboard modified with 30% popcorn addition in the internal layer
- Chipboard modified with 50% popcorn addition in the internal layer

All boards were made of coniferous industrial chips with classic urea-formaldehyde resin. Density of all the boards equaled 500 $kg/m^3$
All three board types showed similar density distribution, showed at fig.1

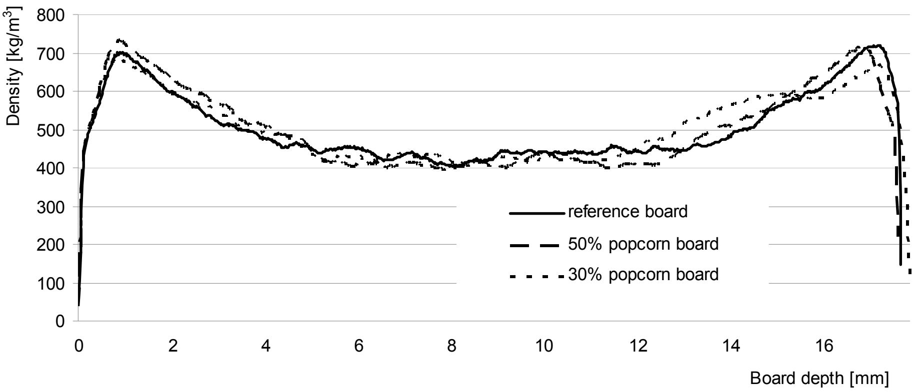


Fig.1 Density distribution of the machined boards

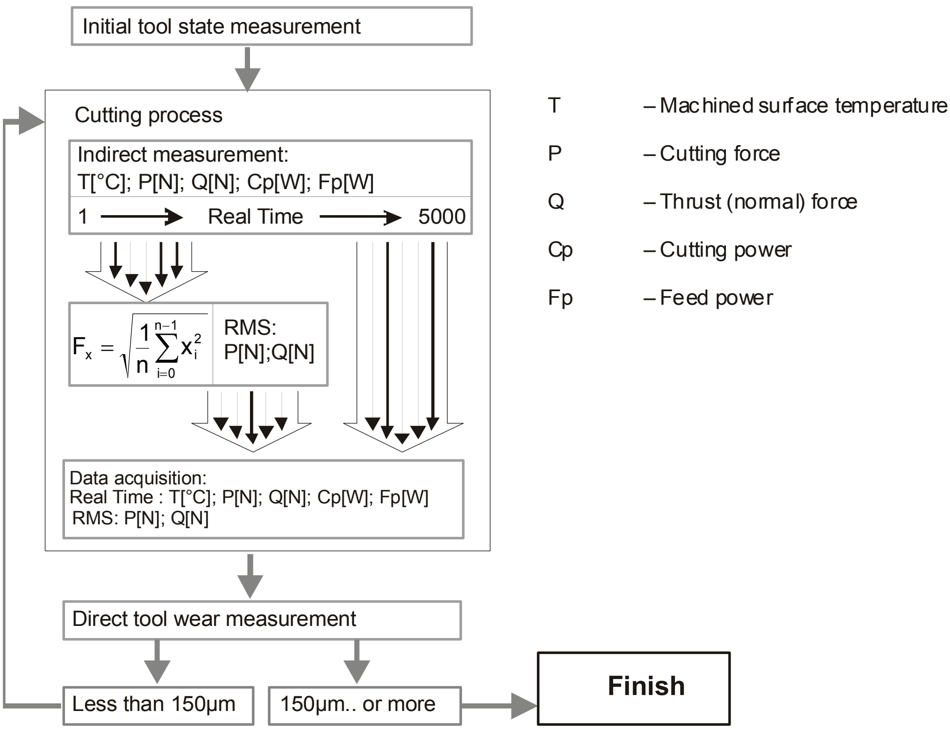


Fig.2 Machining test procedure, with simple edge milling.

## RESULTS

Machining tests of the popcorn-modified boards and control reference boards are presented on the following figures:

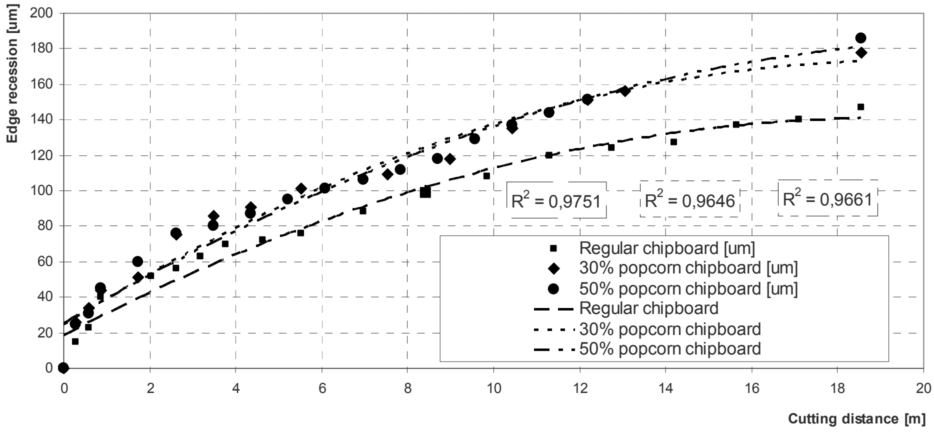


Fig.3 Tool wear in dependence on cutting distance.

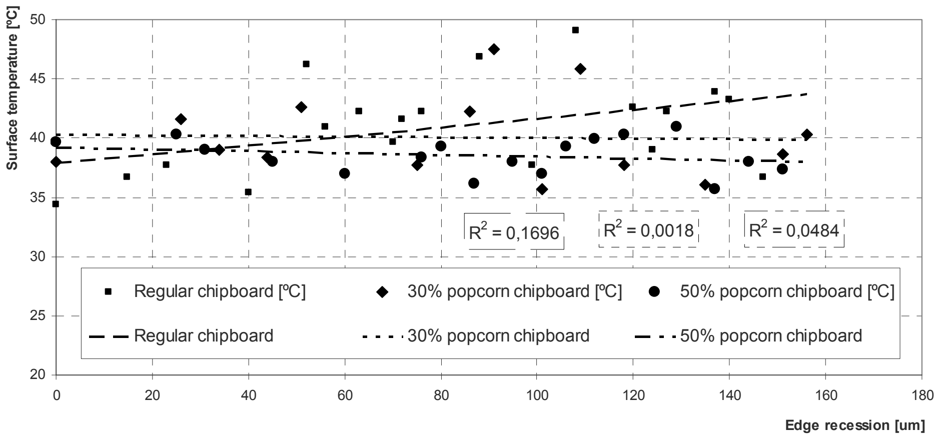


Fig.4 Machined surface temperature in dependence on tool wear.

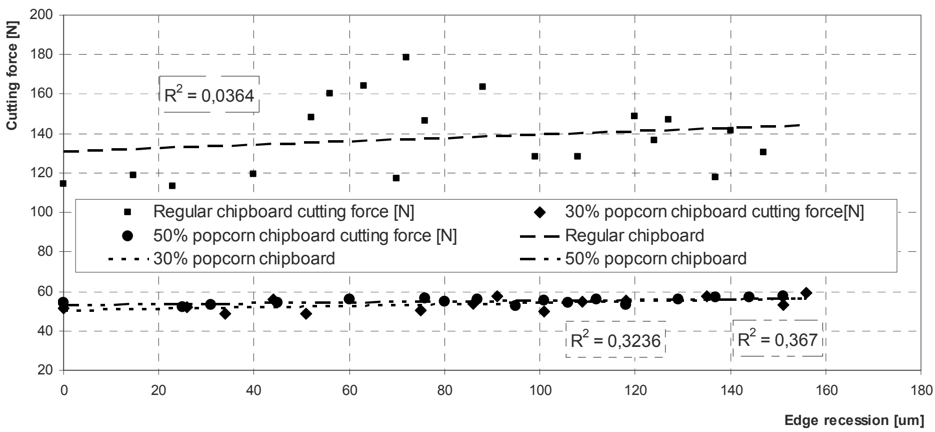


Fig.5 Cutting forces in dependence on tool wear.

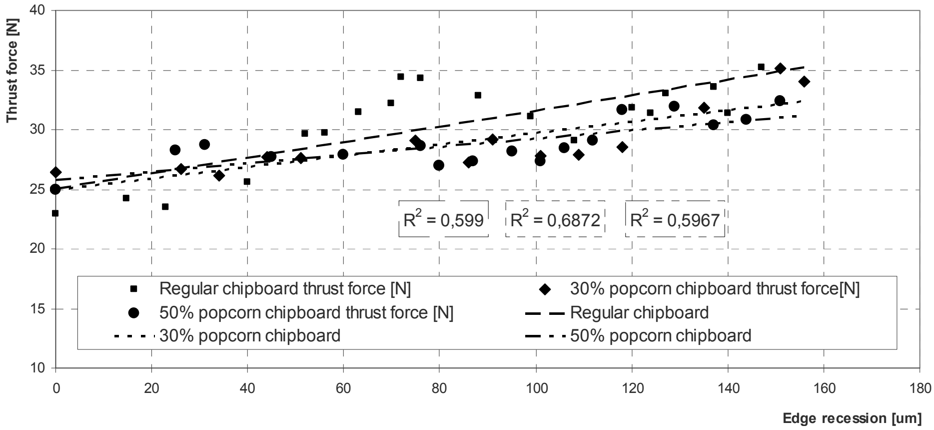


Fig.6 Thrust (normal) forces in dependence on tool wear.

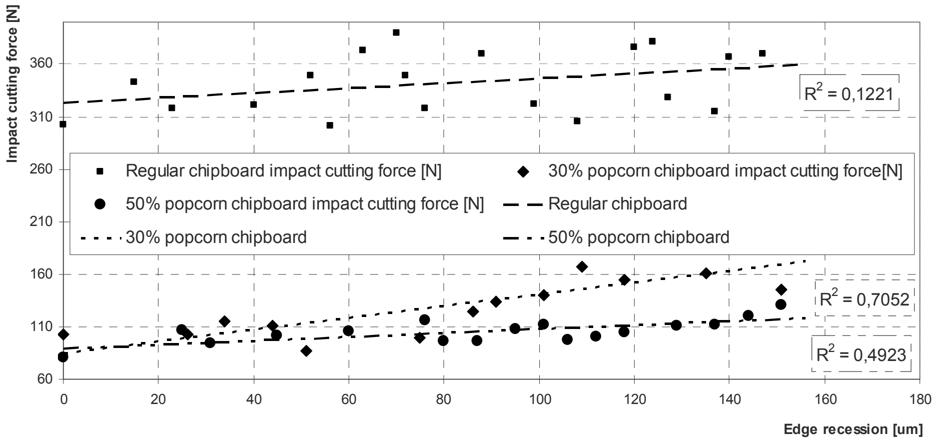


Fig.7 Impact cutting forces in dependence on tool wear.

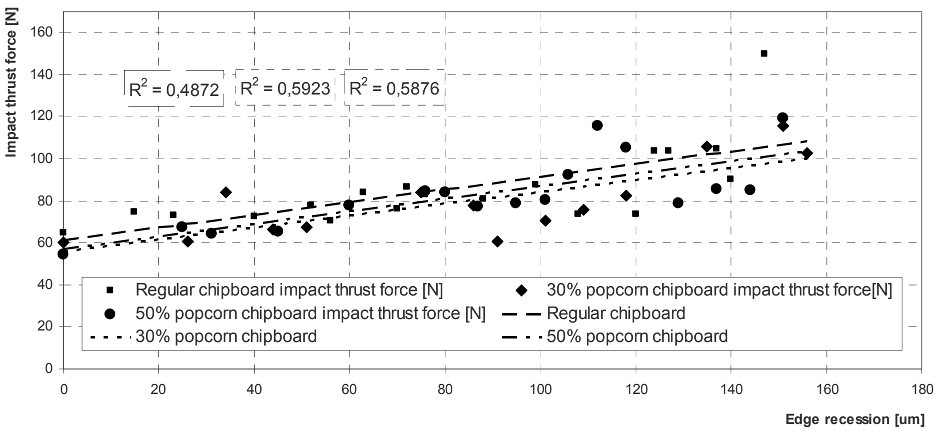


Fig.8 Impact thrust (normal) forces in dependence on tool wear.

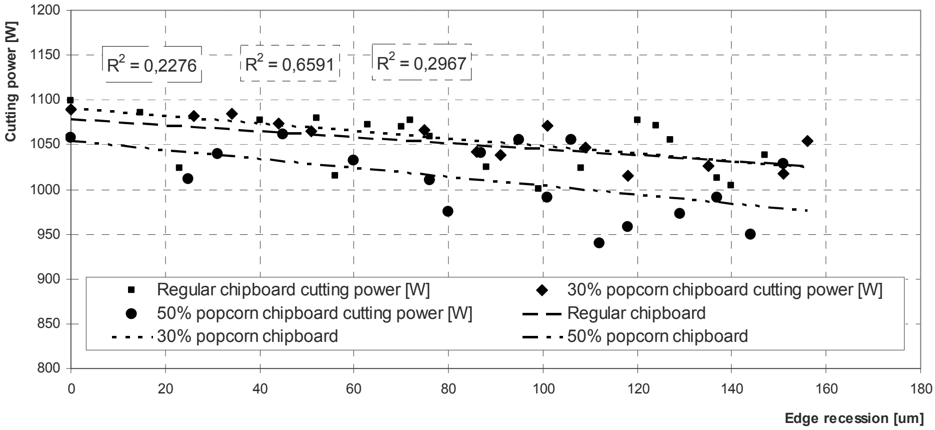


Fig.9 Cutting power in dependence on tool wear.

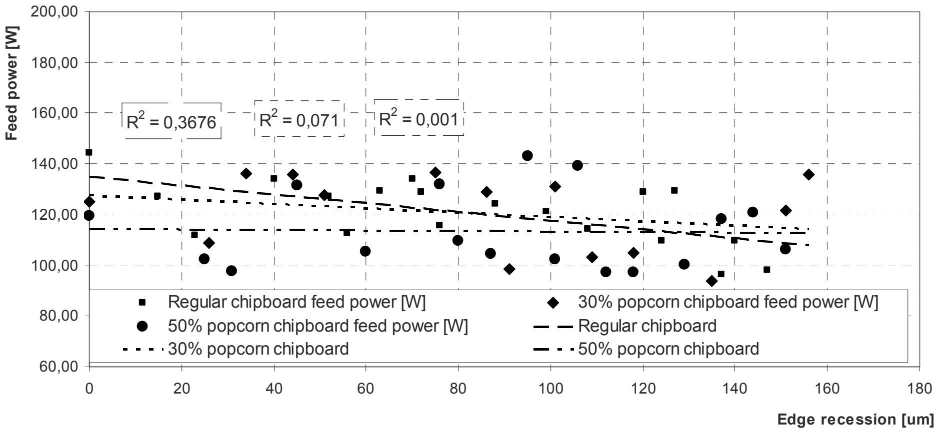


Fig.10 Feed power in dependence on tool wear.

## DISCUSSION

During the tests, main point of the interest was to determine basic tool wear properties. As shown on figure 3, tool wear characteristics do not really differ between modified and control boards. Tool wear in milling of popcorn-modified boards is only slightly higher, probably due to almost identical density distribution, presented on figure 1. Machined surface temperature, does not show any significant changes with introduction of the popcorn into internal layer of the boards, in fact dependence is not realy visible partially because of relatively low correlation.

Cutting forces, in both RMS and impact values show significant drop with modified boards, reaching 50%, which can be profitable in manufacturing conditions. Thrust forces, cutting and feed power, when compared to results achieved with regular chipboard, did not show any significant changes in milling of popcorn-modified boards, independently on corn percentage.

## CONCLUSION

Basing on the performed tests, one may withdraw following conclusions:

- Application of the popcorn chipboard filling does not significantly change tool lifetime in the regular usage range (0-150µm of edge recession)
- Temperature, thrust forces and power consumption when milling of popcorn modified chipboard do not show any significant differences when comparing with regular chipboard.
- Cutting forces when milling of popcorn modified chipboard show significant drop in comparison to unmodified samples.
- Popcorn modified chipboard seems to be comparable with regular chipboard and does not show any properties causing technological process in case of machining.

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