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EXPERIMENTAL ANALYSIS OF CHIP REMOVING SYSTEM IN CIRCULAR SAWING MACHINE

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Abstract

Paper presents analysis of the process of removing the wood chips generated during the cutting of the material on the circular sawing machine. The attention is focused on the upper cover of the chip removing system. Within the framework of the work a systematic experimental study of pressure distribution in the cover during operation of the selected rotational speed of saw blade with a diameter of 300 mm and 450 mm was carried out. Analysis of the results allowed to predict the areas with insufficient vacuum pressure hindering the organized transport of chips. In addition the effect of a 20% change in the fan speed on the pressure range in these areas has been investigated. The obtained results will be used by the authors in the process of optimizing the shape of the cover to improve the process of chip extraction. It will also be helpful in interpreting the results of numerical analyzes conducted in parallel.

Key words: *circular sawing machine, chip removing system, experimental study*

INTRODUCTION

The development of woodworking machines design, the introduction of new technologies, and above of all the machining and feed speed result in the need to provide more effective wood wastes (chips) removing systems. The manufacturers of machines quite freely approach to the problem of chips removing from the workspaces of their machines. Ideas used in some devices for shapes and dimensions of the suction system, linking these suctions to common, interior collectors, separators, moving suctions, etc. do not always work well in practice. It is possible to give tens of examples of machines manufactured by well-known and less well-known companies, whose sucking arrangements are ineffective during daily operation. In operation manuals there are often presented essential parameters of the extraction installation for the given machine. i.e. the necessary air velocity, its amount and the vacuum pressure value. However, in the area around the tool even higher vacuum pressure is usually required. A modern machine, which operates without connection to a properly designed extraction installation loses immediately its performance and service life.

The area around the tool is usually surrounded by narrow or wide cover, connected with fan using partially flexible pipes. Chips removing systems have shape and dimensions especially designed for specific machine demands.

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In this paper experimental investigations of such system for circular sawing machine was performed and the attention was focused on its upper extraction cover.

METHODOLOGY OF EXPERIMENTS

Experimental tests consisted of measuring relative pressure distribution zero-referenced against ambient air pressure in a number of points on the wide and narrow cover of chip removing system (points 1-2, 4, 6, 8, 10, 12, 14 on the upper part and 16-17, 19, 21, 23, 25-26 on the side part of the wide cover and points 41-45 on the side of narrow cover). Locations of individual measuring points are shown in Fig. 1 and Fig. 2 respectively. Marking points shown below are not continuous. During preliminary measurements it was found that not all points must be taken into consideration because of the small difference in pressure value between those points, which are situated close to each other.

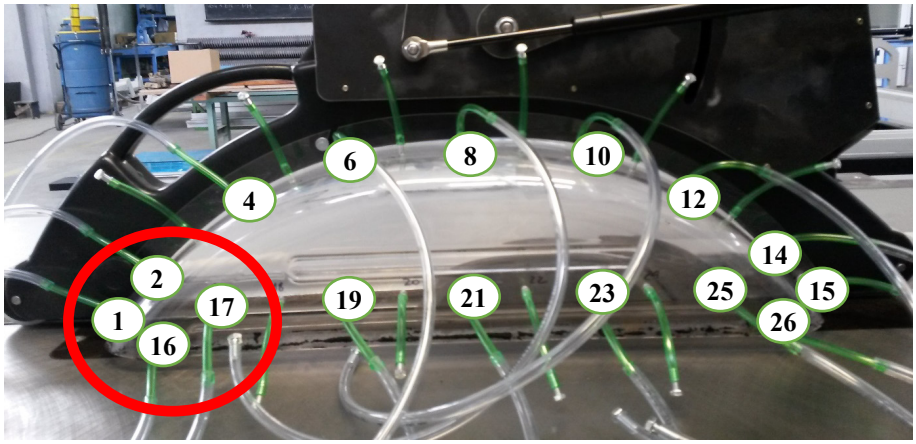

Figure 1. Location of measurement points on a wide cover. Red circle - critical points.

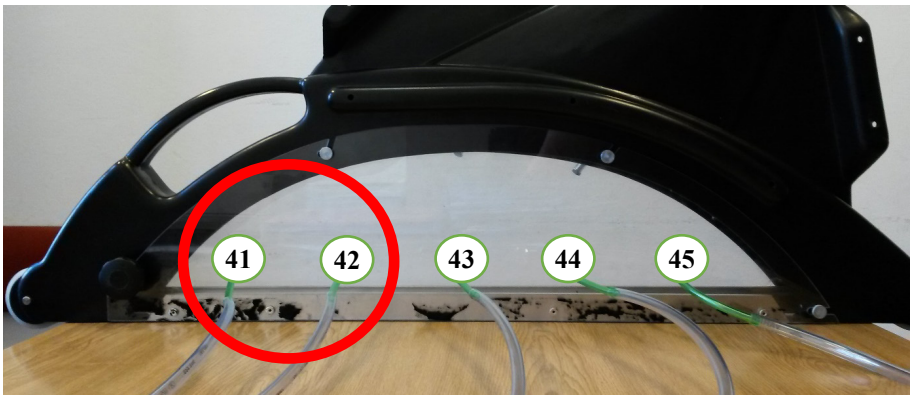

Figure 2. Location of measurement points on a narrow cover. Red circle - critical points.

The measurements were performed using the wide and narrow cover, the saw blades of different diameter and rotational speed as well as variable fan speed. For saw blade of ∅ 300 mm two of its extreme rotational speed, i.e. 3500 rpm and 6000 rpm, and for saw

blade ∅ 450 mm, its nominal rotational speed i.e. 3500 rpm were considered respectively. Relative pressure was measured using digital multi-function measuring instrument TESTO 480 and results were averaged for 10 seconds in each point. Measuring range was from -100 to +100 hPa, resolution 0.001 hPa and acuracy ±0.3 Pa +1% of measured value in lower range.

RESULTS AND DISCUSSION

Results of gauge pressure measurements for wide and narrow cover are shown in Fig. 3 and Fig. 4 respectively. In most of the measurement points there is a vacuum pressure existence, as was expected. However there are some locations, where very low vacuum pressure or even gauge pressure was observed, especially with the use of saw blade ∅ 450 mm. These are points 1-2 and 16-17 for wide cover and 41-42 in case of narrow cover. They are located in the zone of the highest influence of air stream created by rotation of the saw blade. This area is marked by a red circle in Fig. 1 and Fig. 2.
In order to determine the effect of fan speed on gauge pressure in critical areas, 20% change in fan speed was introduced using three frequencies of fan motor, i.e. 40, 50 and 60 Hz.The measurement results for saw blade ∅ 300 mm are shown in Fig. 5.
In the case with reduced fan speed a very large decrease in vacuum pressure, and even the transition to gauge pressure was noted. On the other hand, increasing fan speed improved dramatically pressure distribution and in consequence improved performance of chip removing system.

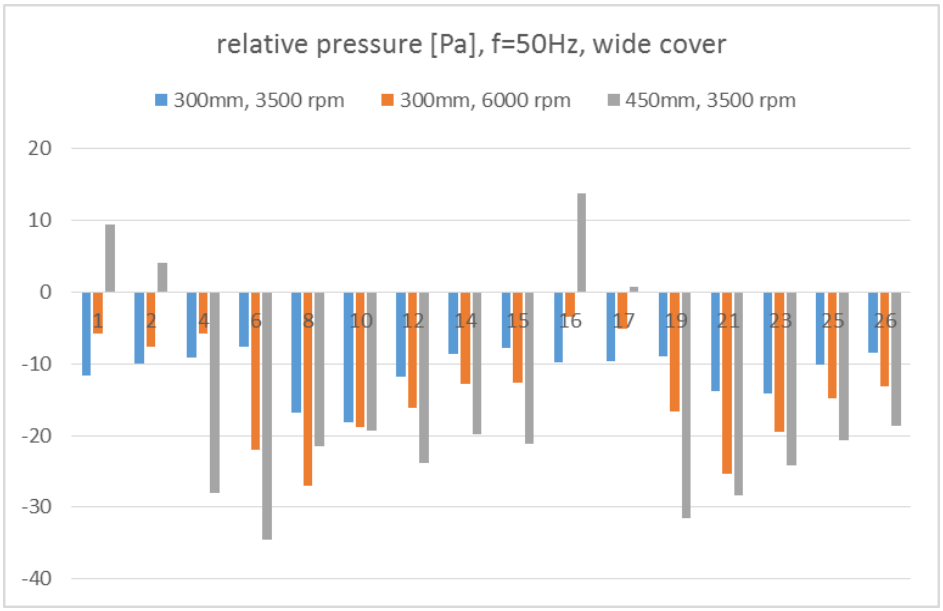

Figure 3. Relative pressure distribution depending on the saw blade diameter and rotational speed. Wide cover and fan motor frequency 50 Hz.

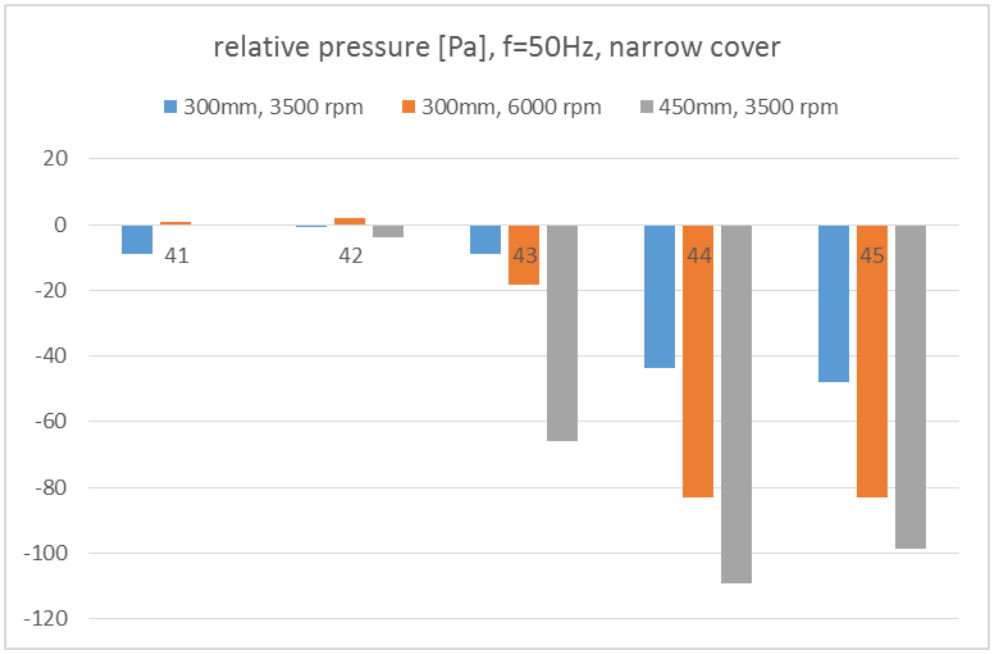

Figure 4. Relative pressure distribution depending on the saw blade diameter and rotational speed. Narrow cover and fan motor frequency 50 Hz.

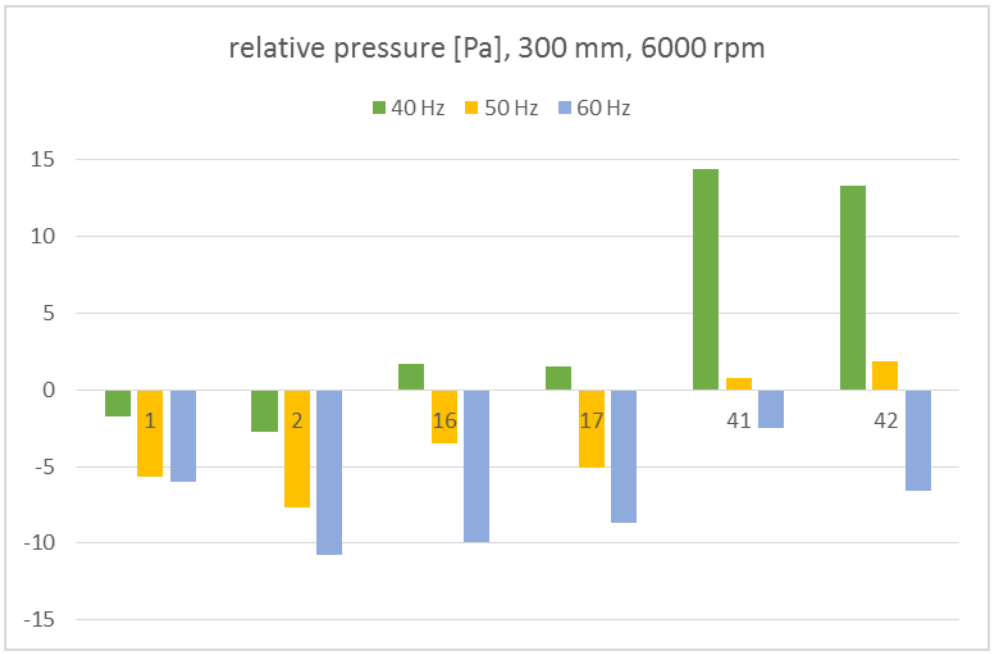

Figure 5. Relative pressure in critical measurement points depending on the frequency of fan motor. Saw blade diameter 300 mm and rotational speed 6000 rpm.

CONSLUSIONS

Existing systems in woodworking machines do not always provide sufficient chip removing from the working area. Authors attempted to assess the performance of such system in circular sawing machine. It was proved, that in the area around the tool the insufficient vacuum pressure can occur hindering the organized transport of wood wastes. The obtained results together with conducted in parallel numerical investigations will enable the optimization of the chip extraction process.

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