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STUDY ON THE QUALITY OF THE SURFACE IN CASE OF MIXED WOOD PANELS

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Abstract: *The paper presents the quantitative assessment of the surface quality in case of new structures (decorative) of panels obtained from finger-jointed panels made of mixed wood lamellas. The particularity of the research is that the assessment of the quality is made on the cross-cut section of the wood lamellas. Consequences of using some of the actual composite materials have occurred because of the binding materials properties, namely the formaldehyde emission, which has proved to be dangerous for health. On the other hand, the behavior of some of these materials in aggressive environment has been proved to be unsatisfactory and of a reduced durability. In order to scan the topography of the panels' surfaces, the contact-less method was used to analyze the representative roughness parameters of wood: Ra, Rz, Rk, Rpk and Rvk. The measurements were performed in the frame of the Laboratory of Testing the Processing Accuracy in Wood Industry. The present paper is an experimental study that focuses on the evolution of surface quality in case of mixed decorative panels, made of wood lamellas randomly arranged in the structure of the panels, having the crosscut section on the panels' faces. The grit sizes used for sanding operation are the most usual ones for a technological process, namely 80, 100 and 120 ones.*

Keywords: *mixed panels, crosscut section, roughness, surfaces quality, wood species, light beam.*

1. INTRODUCTION

From the architectural point of view, the simple lines imposed by the processing technology of the composite materials as melamine faced or veneered boards have limited the creative work of the designers, so finally, people have reached the conclusion that ecological materials with their natural jointing solutions are required. That's why, a great importance was given to the use of small sized wood for wooden panels, in order to increase the utilization rate of wood into the product, obtaining thus finger – jointed and edge – jointed panels.

Within the present background of attempting to use and reuse the ecological materials by specialists, various concepts of approaching techniques and technologies of using wood waste were developed by specialists. Branches resulted from wood exploitation process were used to design new panels with aesthetical functions (Cionca et al., 2006:35-42), different hardwood species as beech, oak, maple, cherry, ash and nut wood were mixed and used as wood lamellas in finger-jointed panels in order to obtain new design of the panels together with good properties as: stiffness, stability, flatness and liability (Coşereanu et al. 2009/2010).

Due to the fact that composite panels proposed in the present paper contain in their structure various species of wood, randomly arranged in the panel and having the crosscut section of wood on their faces, it can be said that the results of sanding operations (including calibration) are reflecting in the quality of surfaces.

The research work on the milled surfaces, performed so far (Brenci et al. 2008:67-74), (Brenci et al., 2009:0413-0415), (Salcă et al., 2008:57-68) and on the sanded surfaces (Fotin et al., 2009:45-52), had as results the optimum processing work parameters, so that the sanding operation to be removed, obtaining thus a lower manpower and electric power consumption. But these studies were performed on the longitudinal section of wood and the particular thing of the decorative panels studied in this paper is the appearance of wood crosscut section on the faces of the panel. The presence of two different species of wood in the same panel (nut and cherry wood on a panel and poplar and spruce wood on the other one, as proposed in the present paper) brings also new variables to be study.

In order to scan the topography of the panels' surfaces, the contact-less method (light beam method) was used to analyze the representative roughness parameters of the wood: Ra, Rz, Rk, Rpk and Rvk. The measurements were performed in the frame of the Laboratory of Testing the Processing Accuracy in Wood Industry

The experimental study presented herein is focused on the evolution of the quality of the surface in case of mixed decorative panels made of wood lamellas randomly arranged in the structure of the panels, having the crosscut section on the panels' faces.

The grit sizes used for sanding operation are the most usual ones for a technological process, namely 80, 100 and 120 ones.

2. MATERIAL AND METHOD

The composite panels are made of lamellas of two different wood species each (nut-cherry wood for the first panel and spruce-poplar wood for the second one). First, the lamellas are finger-jointed on length and than rotated with 90º, as can be seen in Fig. 1, for the first stage of the process.

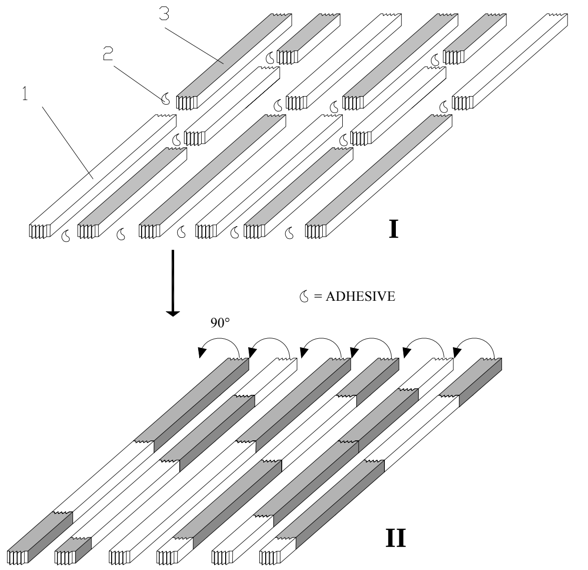


Fig. 1. The first stage: mixed finger –jointed lamellas; 1 – cherry - spruce wood, 2 – adhesive, 3 – nut - poplar wood

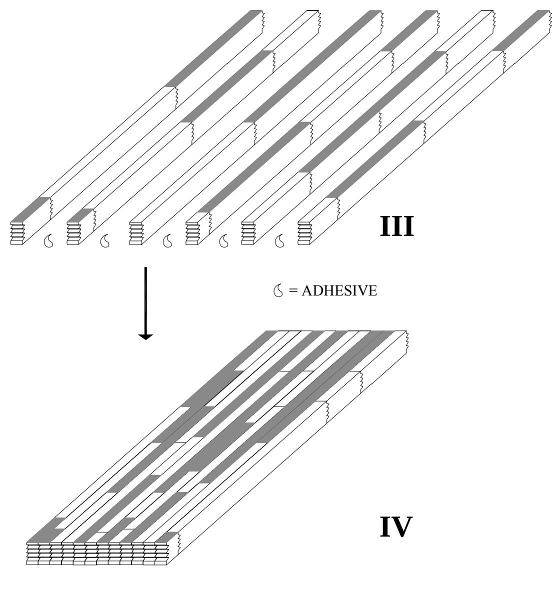


Fig. 2. The second stage: mixed finger –jointed panels

On the second stage of the process, the finger-jointed lamellas are glued together on their faces and mixed panels are obtained, as seen in Fig. 2.

The arrangement of the lamellas in the structure of the panels is random, just for their innovative design. The wood strips obtained after finger-jointing the lamellas are machined on the four faces and than edge-jointed into the panel shape. After drying the adhesive, the panels are calibrated to a constant thickness.

On the third stage of the process, several mixed panels are overlapped and glued together in order to obtain a wooden block, as seen in Fig. 3. The panels resulted in this way are glued on their faces and overlapped so a "reconstructed block" is obtained, or better said, a "reconstituted core of rectangular section" is obtained.

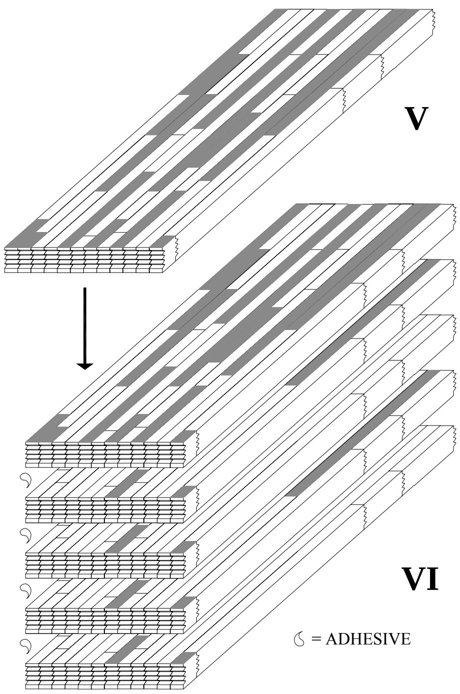


Fig. 3. The third stage: obtaining of wooden "reconstructed blocks"

On the fourth stage of the technological process of obtaining the decorative panels proposed in the present study, the wooden block will be transversally cut (Fig. 4). After the adhesive is dried, the core is cross-cut, so to obtain panels with crosscut structure of wood on the panel's faces. The design of the panel is defined by the participation rate of the two constitutive species of wood and by their placement into the panel.

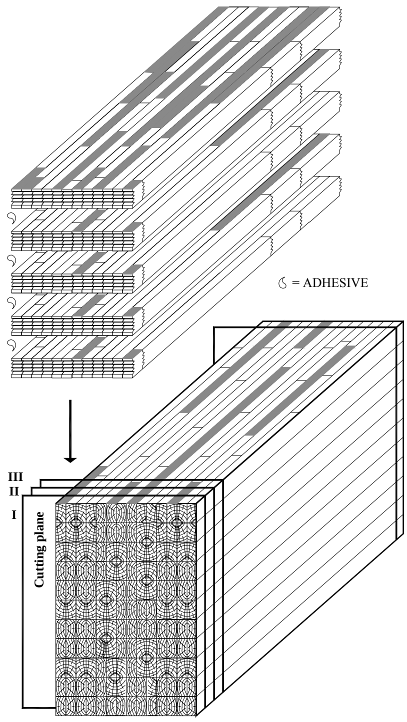


Fig. 4. The fourth stage: obtaining of "wooden structural tiles" which are the samples studied in the paper

The panels obtained this way are than calibrated and sized to the final dimensions, resulting "wooden structural tiles" that can be used as industrial floors or floors for civilian buildings, where high traffic is required. The final calibration of the panels brought them to 22 mm thickness, resulting thus the mixed panels presented in Fig. 5, studied in the present paper from the quality of the surface point of view.

Fig. 5. Processing and roughness measuring directions

Being made of lamellas of two different materials (two species of wood with different structure and properties) glued together, they form composite materials with new properties and new quality of the surface after calibrating and sanding the faces.

The panels were subjected to a sanding process, where grit sizes of 50, 80, 120 and 150 were used. The roughness measurements were done perpendicular to the sanding direction (Fig.5), in order to obtain the accurate values of the roughness parameters Ra, Rk, Rpk and Rvk.

The roughness of the surface was investigated using MicroProf FRT German equipment with light beam, which scaned the samples. Each sample was measured on five areas in order to calculate the average values.

The work parameters of the equipment set by the user in the measurement software, were as follows:

- scan speed of 750 µm/s;
- 10.000 scanned points on a line;
- measured length of 50 mm ;
- cut-off of 2.5 mm;
- resolution of 5 µm.

The roughness profile was obtained after filtering the data with Gaussian filter, automatically applied by the software. The roughness parameters analyzed in this paper are Ra and Rz according to ISO 4287 :2001), Rk, Rpk and Rvk according to ISO 13565-2:1999 (Gurău, 2007). The Ra roughness parameter is considered to be the most common one used for the assessment of the surface quality, but for a more accurate analysis it will be accompanied by Rz parameter. The other three roughness parameters are used as follow:

- Rk is a parameter that assesses the processing roughness;
- Rpk is a parameter that assesses the raised fiber of wood;
- Rvk is a parameter that assesses the anatomic structure.

3. RESULTS AND DISSCUSSION

Because the section of the jointed lamellas is smaller than 50 mm (which is the length of the scanned square), the assessment process detected either segments of the same species of wood and different species of wood, or different orientation of the wood grains.

In Fig. 6 and Fig. 7 the diagrams of roughness variation against the grit size are presented. The results are obtained after sanding operation applied on each type of composite panel.

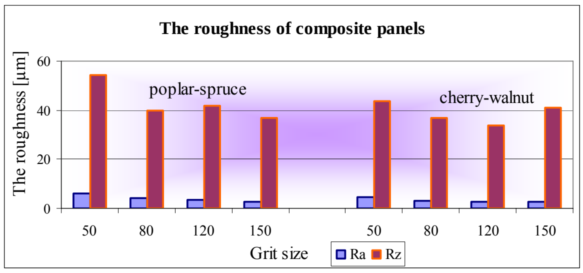


Fig. 6. The influence of grit size upon the average roughness parameters Ra and Rz, for the poplar-resinous and cherry-walnut composite panels

From Fig. 6 the following issues are noted: values of Ra roughness parameter decreases for the two types of panels with the increasing of grit sizes used for sanding operation; the most significant differences are recorded for Rz roughness parameter.

For the composite panel made of mixed poplar and resinous wood, when sanded with 120 grit size, the roughness value increases compared with the situation when sanded with 80 grit size. It can be explained by the wood grain orientation depending on the perpendicular scanning direction and also by the anatomic structure of poplar wood.

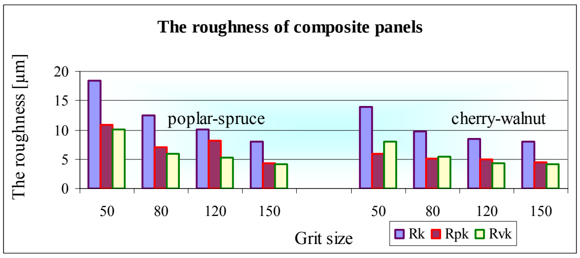
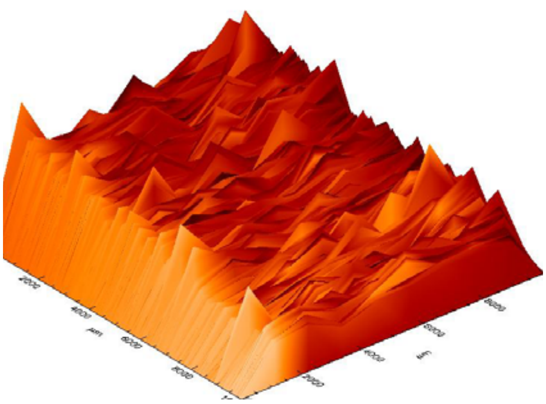


Fig. 7. The influence of grit size upon the average roughness parameters Rk, Rpk and Rvk, for the poplar-resinous and cherry-walnut composite panels

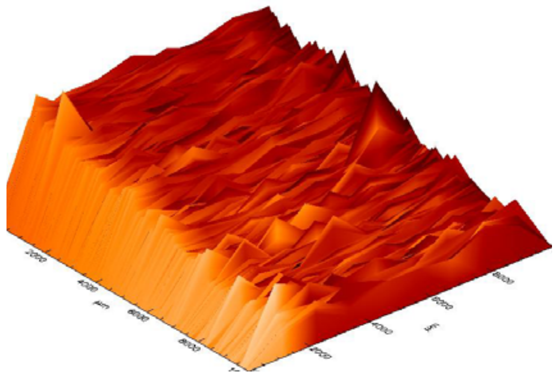
In Fig. 7, Rk, Rpk and Rvk parameters decrease with the increasing of grit size used for sanding operation. The presence of pile fibers in the resinous-poplar wood composite panel is shown by Rpk parameter which increases when sanding with 120 grit size, compared with 80 grit size.

Rk roughness parameter decreases when the grit size is higher. For the cherry-walnut wood composite panel the recorded values of Rk, Rpk and Rvk roughness parameters are lower than those of poplar-resinous wood composite panel, fact that leads to a better behavior of the first one when finishing it.

In order to highlight the differences in the quality of the resinous - poplar wood panel surface, sanded with 80 and 120 grit sizes, a 3D scan of the surface was done (Fig. 8).



a)



b)

Fig. 8. The 3D scan for resinous-poplar panel sanded with: a –80 grit size; b –120 grit size

4. CONCLUSIONS & ACKNOWLEDGMENT

The results show that the roughness parameters are not in the range of the recommended values for the transparent finishing of panels (Rz=10-16µm). With the increasing of grit size used for sanding operation, the decreasing of roughness is observed, but different for the two types of panels (more for the poplar-resinous wood panel). The results of measuring Rz roughness parameter after the final sanding (36.76µm for poplar-resinous wood panel when sanding with 150 grit size and 33.92µm after sanding the cherry-walnut wood panel with 120 grit size) lead to the conclusion that an extra-sanding operation is needed. The final sanding system used for the longitudinal structure of wood is not valid for the studied panels that have a transversal structure of wood on their faces.

The future research directions on these types of decorative panels will go to the study of the final sanding technology of the transversal structure of wood on the faces of these composites, by introducing, eventually, a "wet" sanding method that allows the Rz roughness parameter to be at the required values for the transparent finishing of wood.

REFERENCES

1. Brenci L., Cismaru I., Boeriu C. *The roughness of wood surfaces interpreted through two measuring*. Pro Ligno. Issue 4(3):67-74 (2008).
2. Brenci, L., Cismaru, I., Cosereanu, C., Curtu, I., Lica, D., Fotin, A. *The influence of the profiled milling parameters to the Quality of the surfaces*. Proceedings - 20th International DAAAM Symposium Intelligent Manufacturing & Automation: Theory, Practice & Education", Viena, Austria. Katalinic, B. (Ed.):0413-0415 (2009).
3. Cionca, M., Badescu, L., Zeleniuc, O., Gurau, L. Panels made of crosscut branches. Pro Ligno no. 2(4): 35-42 (2006).
4. Cosereanu, C., Brenci, L., Lica, D. *Testing the flatness of some composite panels designed for furniture manufacturing.* Pro Ligno. Issue 5(1): 31-46 (2009).
5. Cosereanu, C., Lica, D., Curtu, I., Lunguleasa, A., Cismaru, I., Brenci L.M., Fotin, A. *Mechanical testing of beech veneer sandwich composites.* Proceeding of the 7th International Conference of DAAAM Baltic Industrial Engineering, 22-24th Aprilie 2010, Tallinn, Estonia. ISSN 978-9985-59-982-2. p. 0417-0422. (2010).
6. Fotin, A., Cismaru, I., Salcă, E.A., Cismaru, M. *Influence of the Variable Parameters of the Machining Regims upon the Surface Quality obtained by straight milling.* Pro Ligno. Issue 5(4): 45-52 (2007).
7. Gurău, L. *Quantitative evaluation of the sanding quality in furniture manufacturing*. Editura Univesrsitații Transilvania Braşov. (2009).
8. Salca, E.A., Fotin, A., Cismaru, I. *Evaluation of surface quality after profiled milling of alder and birch wood.* Pro Ligno. Issue 4(2): 57-68 (2008).