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AN EXPERIMENTAL DENSIFICATION METHOD BY COMPRESSING THIN VENEERS (0,3-1,2 MM)

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Abstract: *Thin plywood with special destinations is one of the wood based composites used in any application that needs high quality wooden sheet material. They are composed from thin veneers (0.3 mm-1, 20mm), which must meet certain requirements to compose these laminated wood assortments, functionally suited. This paper presents an original experimental method of densification by compression of veneers made of aboriginal wooden species.*
Finally, this method improves the quality of plywood.
Keywords: *compression, veneers, thickness, density, plywood.*

1. INTRODUCTION

Thin plywood is defined as a layered product, 1 ÷ 3 mm thick, made of technical veneer with thickness of 0.3 ÷ 1.2 mm in aboriginal species of wood with homogeneous structure, glued with phenolic resin films.
Since our country does not manufacture these types of plywood, it was necessary their experimental production, in order to use them for determining the physico-mechanical characteristics. The technology for these types of plywood is similar to the production technology for outer plywood, however, presents a number of specific parameters, among them, very important being the choise of the correct veneer thickness whithin the plywood plate structure.
In order to determine correct veneer thickness, thickness of which depends in the end plate thickness of plywood, this paper presents an original experimental method of densification by compression of veneers during the pressing process, the method contributes to improve the quality of the plywood boards.

2. THE METHOD USED FOR EXPERIMENTAL TESTS

The phenomenon of wood densification under the action of heat and pressure is due to plastic properties of wood. Moisture in wood and water intake in the layers of veneer coming from adhesive, in liquid or vapor phase, contribute to wood lamination. Another reason for maintaining the compressed state is the adhesive, especially in the interface wood - glue. The adhesive penetrates into the wood structure, especially in the pores and intercellular spaces after polymerization and keeps wood in deformed state. This phenomenon is particularly noticeable as the wood density is lower and the pressure is higher.
The plywood density is greater than or about the same as wood species from which it comes, when the humidity is the same. The reason is represented by the share of the adhesive in the plywood weigth as well as the wood densification effect under the action of temperature and pressure required to achieve the layered structure.
The treating of veneers by compression (mechanical pressure), was experimentally made on an universal machine type WE-10, for strength determining, available in "Transylvania" University of Brasov, the Faculty of Wood Industry.
The specimens used were cut in square shape with sides of 60 mm and veneers of beech, birch, alder and lime were taken, for which indicatives were assigned.
Five samples of veneer were used for each analyzed wood species.

Figure1. Universal testing machine WE-10A, equipped with two flat plates to compress veneers

How:
- each specimen was 0.01g accurately weighed;
- initial thickness of each specimen was measured in five points, as shown in Figure 1.
- initial density was calculated for each specimen;
- each specimen was set between flat plates of the testing machine, as in Figure 1.
- each specimen was compressed, with appropriate forces following the compression values: 0.4, 0.6, 0.8, 1.0, 1.2 N/mm^2. The duration of maintaining each pressure value was 3 minutes;
- specimen thickness values were measured after each cycle of compression in the initial established points;
- the final density of each specimen was calculated, after the last cycle of compression, ie 1.2 N/mm^2.

The calculation
- start and end density of each was calculated with the relationship:

$$\rho = \frac{m}{L \cdot b \cdot h} \cdot 10^6 \quad [\text{ kg/m}^3] \tag{1}$$

- the compression force F were calculated by the relation:

$$F = PS \cdot A \ [daN] \tag{2}$$

where:
PS - compression pressure = (0.4 ÷ 1.2) N/mm^2
A – compression area = 36 cm^2
- the arithmetic mean of initial and final density of specimens of the same type was calculated.

Veneers densification was calculated with the formula:

$$c = \frac{h_i - h_f}{h_i} \cdot 100 \qquad [\%] \tag{3}$$

where:
h_i - initial thickness of the veneer, in mm
h_f - final thickness, after the last cycle of compression, 12daN/cm^2 in mm.

3. EXPERIMENTAL RESULTS

Summary results on densification veneers, are shown in Figure 2 and Figure 3.

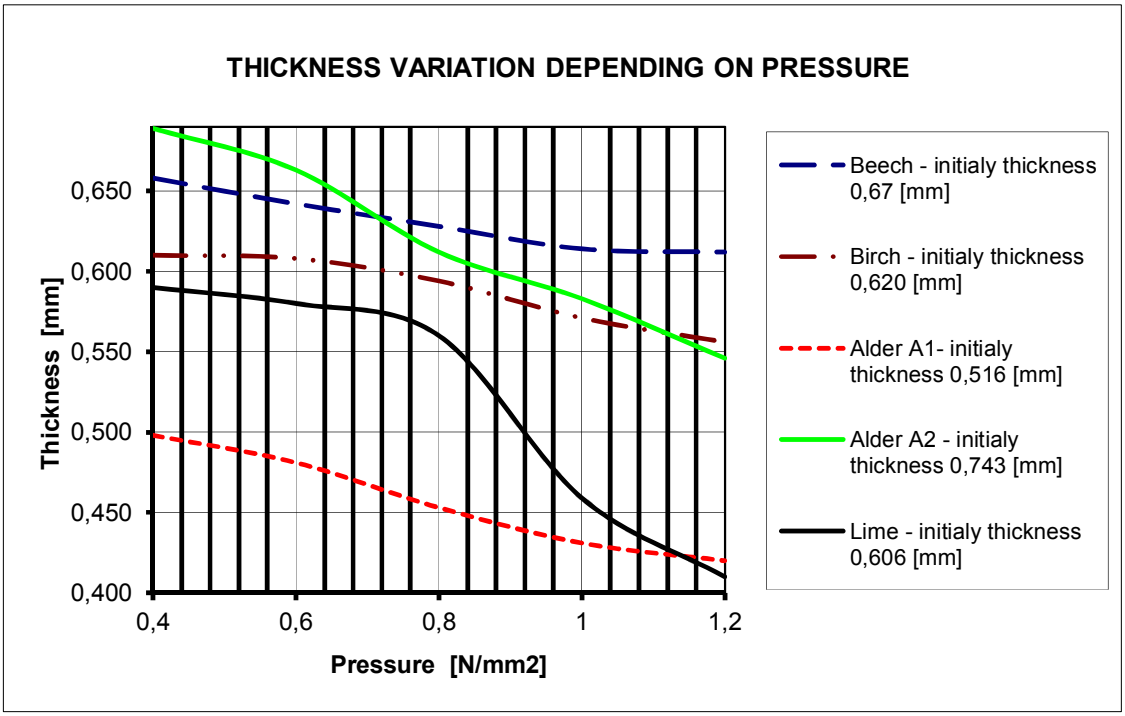

Figure 2. Thickness variation

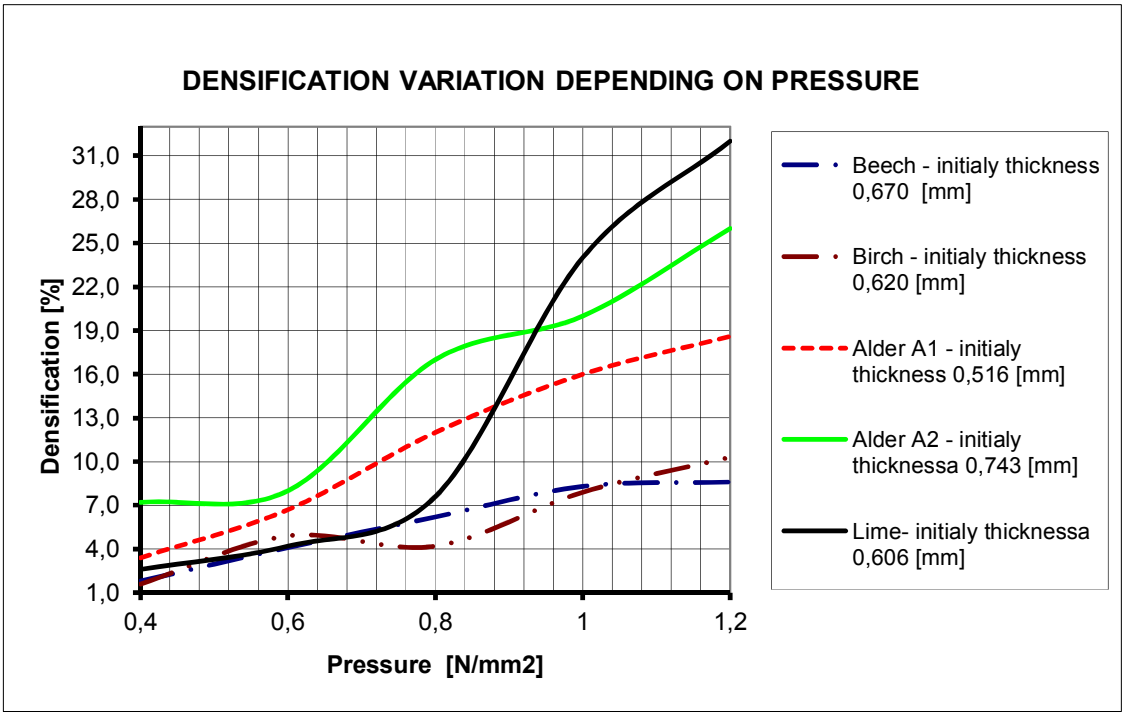

Figure 3: Densification variation

Measurements on densification by compression of the veneers, also served to the establishing of the influence that densification has on the volumic mass (apparent density) of plywood. Results regarding the density growing after densification, are summarized in Table 1.

Table 1: Density growing after densification

No.	Species	Volumic mass [kg/m^3]		Density growing [%]
		initially	finaly	
1	Alder	322	456	1,41
		337	479	1,42
2	Birch	435	480	1,103
3	Beech	604	666	1,09
4	Lime	328	492	1,44

Veneers compression results in a density increase with values that depend on the density of each species of which are cut.

3. CONCLUSION

Analyzing data from the summary Figure 2 and Figure 3:
- Wood species that compresses the least is beech (8.6% to 1.2N/mm2), closely followed by birch, which compresses only 2% stronger than beech, this result is due to close values of their mass displacement, it fits in the category Hardwood;
- The highest percentage of compression is for veneers lime, due to the low density value (540-610kg/m3) at a pressure of 1.2N/mm^2, degree of compression is 32%, thus exceeding the limit value. According to the literature, the range of variation of the veneer thickness by compression should not exceed 25% of its thickness, losses of more than 25%, being incompatible with the economicity conditions required by practice;
- Veneer thickness variation under the effect of compression was 39% lower at the beech and birch veneers than alder and lime.
Analyzing summary data in Table 1:
- Lime and alder veneers suffer a sharp increase in density, between 1.41 ÷ 1.44%, due to a low initial density, making them part of the soft species. In time, the density of beech and birch veneers increases much less that is between 1.09 ÷ 1.10%, which makes them part of the hardwood category.
In practice, plywood made from compressed veneers have a density of about 3% higher than standard plywood, the degree of densification of compressed veneer plywood is 0.92% comparing to 0.67% as the usually manufactured plywood have;
- Preliminary compression of veneers affects one of the most important property that decides the quality of plywood, that is the shear strength of gluing. Thus, the resistance of plywood gluing obtained from individually compressed veneer is about 37% higher than that of the playwood in the current production. The fact is explained by the improved quality of gluing surfaces, resulting in a continuous adhesion of the film of glue.
- Another advantage of the preliminary compression of the veneer is the influence on the roughness of the plywood faces, reduced with about 19%. The compression of the face veneers may replace the plywood grinding operation for certain uses.

REFERENCES

[1] Istrate V., Mitişor A., Gligor A., Paraschiv N., The manufacturing of beech plywood with compressed veneer, „Industria Lemnului" Magazine, no. 1, 1976.
[2] Neamţu M., Research to establish the optimal structure and thickness for the formwork plywood, glued with phenoplac, „Industria Lemnului" Magazine, no.12, 1968.
[3] Mitişor A., Istrate V., Technology of Veneer, plywood and wood fibre boards, Editura Tenhnică, 1985, Bucureşti.
[4] Sava, R., Study regarding the physical, mechanical and technological features of the thin plywood (1-3 mm) in aboriginal wooden species, Doctorate thesis, 2005, Brasov.
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