Simultaneous veneers incising and lower pressing temperatures—the effect on the plywood pressing time

A. Kurowska, P. Borysiuk, M. Ł. Mamiński

► To cite this version:

A. Kurowska, P. Borysiuk, M. Ł. Mamiński. Simultaneous veneers incising and lower pressing temperatures—the effect on the plywood pressing time. *European Journal of Wood and Wood Products*, 2010, 69 (3), pp.495-497. 10.1007/s00107-010-0460-8 . hal-00615328

HAL Id: hal-00615328

<https://hal.science/hal-00615328>

Submitted on 19 Aug 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Simultaneous veneers incising and lower pressing temperatures
- the effect on the plywood pressing time

A. KUROWSKA^a(✉), P. BORYSIUK^a, M.Ł. MAMIŃSKI^a

*^aWarsaw University of Life Sciences - SGGW, Faculty of Wood Technology,
ul. Nowoursynowska 159, 02-776 Warsaw, Poland*

Email: agnieszka_kurowska@sggw.pl

Abstract

It was shown that incising of veneers ($60 - 15 \text{ m/m}^2$) prior to plywood bonding allowed reduction of pressing time by 8 - 9% for a pressing temperature of 90°C when compared to the controls. Nevertheless, with pressing temperatures lower than normal and shortened pressing times the shear strengths of the plywood met the requirements of the respective standards.

1 Introduction

For plywood, total pressing time is determined by the time necessary to achieve the sufficient temperature in the most internal glueline (stack core). Chow and Steiner (1975) stated that gelling of a urea-formaldehyde resin was initiated at 75°C . Curing at the lowest possible and technologically acceptable temperature of $90 - 105^\circ\text{C}$ improves dimensional stability of the plywood (Baldwin 1995). During pressing at temperatures above 100°C , the steam generated in the system may disintegrate the glueline when the press is being opened too fast. Thus, it seems that simultaneous veneer incising and lower pressing temperatures result in reduced pressing times.

Veneer incising - also called “wood tenderizing” (O'Brien 1972, Hasegawa 1980, Masaru et al. 1984, Walser and Clarke 1991) - has been known for decades. Initially, it was realized prior to drying and was aimed at shortening the drying time, improving wood susceptibility to machining as well as - in case of veneers - uniforming their strength parameters avoiding plywood twist and delamination (Walser and Clarke 1991).

The studies by Troughton and Lum (2000) showed that veneer incising followed by steam injection provided reduction of pressing time by 27% for 21-mm thick

7-ply plywood and by 32% for 40-mm thick 13-ply LVL when compared to standard technology. On the other hand, Dai et al. (2003) stated that veneer incisions in 13-ply LVL manufacturing did not significantly affect pressing times nor mechanical performance of the product.

2 Materials and methods

Rotary-cut pine (*Pinus sylvestris*) veneers of dimensions 350 x 350 x 1.4 mm³ and 4% moisture content were used. 15-mm long incisions were made along the fibers on the tight face of a veneer. Five series of 15-ply 20-mm plywood with various incisions length (60, 45, 30, 15, 10 m/m²) were prepared. In order to avoid glue leaks, the face veneers were non-incised. The control plywood was made of non-incised veneers. Glue rate was 160 g/m² (UF 100 parts, wheat flour 16 parts, 10% - solution of ammonium nitrate 3.5 parts, water 23 parts), pressing pressure 1.2 N/mm² and platens temperature 130 ± 2°C. The manufactured plywood was conditioned at 20 ± 2°C, 65 ± 5% RH for 7 days.

Total pressing time (t_p) was calculated from Equation (1):

$$t_p = t_g + t_o \quad (1)$$

where: t_g - gelling time at a given temperature, t_o - time of heating the most internal glueline (stack core) to a given temperature. Three temperatures were examined: 80°C, 90°C, 100°C.

For the plywood prepared at the shortest pressing time, the shear strength of the gluelines and wood failure percentage were determined according to EN 314-1 and EN 314-2. Twenty specimens were tested in each batch.

3 Results and discussion

Gelling times (t_g) of the glue at 80°C, 90°C and 100°C were 315, 186 and 80 s, respectively. Times of heating the most internal glueline to a given temperature (t_o) and total pressing times are shown in Table 1.

Table 1

From the data presented in Table 1, it is clear that incising of veneers ranging from 15 to 60 m/m² allows reduction of total pressing time by 4 - 7% at 80°C, 8 - 9% at 90°C and 11 - 13% at 100°C when compared to controls.

Series with incisions length of 10 m/m² exhibited no significant alternation in heat transfer dynamics.

As the data in Table 1 indicate, the shortest pressing times were determined for 90°C. Moreover, from Table 2 it is obvious that veneer incising does not significantly affect the dry shear strength of the resultant plywood. On the contrary to the dry strength, it occurred that the wet strengths were strongly affected by the incision length and the lowest values were observed for the plywood bearing 60 m/m². The incised plywood exhibited increased wood failure percentage when compared to the control, which can be explained by the weakened cohesion of the veneers and subsequently higher susceptibility to fracture propagation. However, it must be stressed that all the series studied met the requirements of EN 314.

Table 2

References

Baldwin RF (1995) Plywood and veneer - based products: manufacturing practices. Miller Freeman Books, San Francisco

Dai C, Troughton GE, Wang B (2003) Development of a new incising technology for plywood/LVL production. Part 2. Effect of incising on LVL strength properties. Forest Prod J 53 (11/12): 99-102

Chow S, Steiner PR (1975) Catalytic exothermic reactions of urea-formaldehyde resin. Holzforschung 29 (1): 4-10

EN 314-1 (2007) Plywood - Bonding quality - Part 1: Test methods

EN 314-2 (2001) Plywood - Bonding quality - Part 2: Requirements

Hasegawa K (1980) Method of and apparatus for tenderizing veneer. U.S. Pat. No. 4,219,060

Masaru K, Hasegawa Y, Shimosaka S, Aoyama N, Yoshizumi T (1984) Method and apparatus for drying veneer sheet. U.S. Pat. No. 4,486,963

O'Brian J C (1972) Veneer tenderizing apparatus. U.S. Pat. No. 3,678,974

Troughton GE, Lum C (2000) Pilot plant evaluation of steam - injection pressing for LVL and plywood products. Forest Prod J 50 (1): 25-28

Walser D, Clarke MR (1991) Wood tenderizing apparatus and method. Canadian Patent No. 1,292,925. 28 pp.

Table 1. Pressing conditions and reduction of pressing time

Tabelle 1 Pressbedingungen und Verkürzung der Pressdauer

Table 2. Shear strengths of the plywood pressed at 90°C (values in parentheses are standard deviations)

Tabelle 2 Scherfestigkeit von bei 90 °C gepresstem Sperrholz (Werte in Klammern sind Standardabweichungen)

Table 1.

Temperature in the stack core	Series of the plywood	Incision length	Gelling time (t _g)	Time of heating the most internal glueline (t _o)	Reduction of t _o	Total pressing time (t _g + t _o)	Reduction of total pressing time
°C		m/m ²	s	s	%	s	%
80	control	-	315	402	0	717	0
	incised	65	315	362	10	677	6
		45	315	365	9	680	5
		30	315	355	12	670	7
		15	315	372	7	687	4
		10	315	387	4	702	2
90	control	-	186	494	0	680	0
	incised	65	186	433	12	619	9
		45	186	437	12	623	8
		30	186	431	13	617	9
		15	186	443	10	629	8
		10	186	466	6	652	4
100	control	-	80	656	0	736	0
	incised	65	80	564	14	644	13
		45	80	568	13	648	12
		30	80	577	12	657	11
		15	80	578	12	658	11
		10	80	636	3	716	3

Table 2.

Series of the plywood	Incision length	No. of glueline	Dry shear strength	Wood failure	Wet shear strength	Wood failure
	m/m ²		N/mm ²	%	N/mm ²	%
control	-	1	3.44 (0.27)	60	2.73 (0.18)	40
		7	3.59 (0.50)	70	2.81 (0.30)	50
incised	65	1	2.82 (0.24)	90	1.97 (0.19)	30
		7	2.67 (0.40)	70	1.90 (0.19)	50
	45	1	3.43 (0.30)	80	2.51 (0.24)	30
	30	1	3.26 (0.26)	90	2.10 (0.22)	50
	15	1	3.35 (0.23)	90	2.27 (0.22)	50
	10	1	3.34 (0.31)	90	2.37 (0.26)	50