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Possibilities of single-stage pressing of veneered particleboards

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Abstract: *Possibilities of single-stage pressing of veneered particleboards.* Following work describes possibility of single-stage pressing of veneered particleboards. Three variants of the 16mm thick boards of 620kg/m3 density were manufactured for the test: (1) single-layer particleboard, (2) single-layer double-stage pressed veneered particleboard (3) single layer single-stage pressed veneered particleboard. Manufactured particleboards were tested against density distribution, MOR, MOE, IB, Stell and absorbability after 24h soaking in water. Possibility of single-stage pressing of veneered particleboards was established, it was also determined that mechanical properties of such boards are mainly dependent on grain direction in the outer veneers. Veneered particleboards have usually better physical properties, such as swell and absorbability.

Keywords: particleboard, veneer, mechanical properties

INTRODUCTION

Production of layered wood based materials with veneers such as plywood and blockboards, does not loose its popularity over the years. Especially last mentioned blockboards can be made of poor quality material but perfectly finished with high quality veneers (Holzhacker i in. 1967, Starecki i in. 1994). Difficulties with obtaining of high quality wood stock and continuously lowering quality let assume, that layered material market May gain especially in production of various wood-based boards of high quality surfaces finished with veneer. Additionally, such boards may be produced within the framework of developing lightweight wood based materials segment (Borysiuk and others 2005). Internal layer of the particleboard may be made of waste material (Gökay and Gűrsel 2005, Czechowska and others 2008, Dziurka and Łęcka 2010). Effectiveness of boards production increases, if whole manufacturing process (especially pressing stage) will be optimized down to limited number of operations. Following work tests possibilities of single-stage pressing of veneered particleboards.

MATERIAL AND METHODS

Within the framework of the research, three 16 mm trick board types of 620 kg/m^3 density were produced:

- variant I – single-layer particleboard,
- variant II – single layer veneered particleboard produced in two stages, first 14 mm board was pressed, and then finished by veneer.
- variant III – single layer veneered particleboard, manufactured in single operation.

For production of the board industry grade internal layer chips of 6% moisture content and 1,4 mm pine veneers were used. Boards were bonded with UF resin based glue (Unitary formula: resin – 100 part by weight, hardener – 10% $(NH_4)_2SO_4$ solution – 4 p.b.w., water – 10 p.b.w.) In case of veneering (variant II) glue was filled with rye flour at 10 p.b.w. Following pressing parameters were used (variant I, III and particleboard of II variant): glue load – 10 %, pressing temperature 180oC, maximal unit pressure 2,5 MPa, pressing factor 18 s/mm. In case of veneering of the particleboards (variant II) parameters used were as

follows : glue load – 160 g/m^2, pressing temperature – 120^{o}C, maximal unit pressure 1,0 MPa, pressing time180 s.

Produced boards were conditioned by 7 days in laboratory conditions (20 ± 2^{o}C, 65 ± 5% humidity). MOR and MOE (along major and minor axis of outer veneers) according to EN 310:1994, IB according to EN 319:1999, swelling and absorbability after 2 and 24h on soaking in water according to EN 317:1993 and density profile have been examined for the manufactured boards. Ten specimens selected according to density have been used for determination of each of the examined features. Statistic significance of the differences has been determined on the basis of T-Student test for confidence level of 95%.

RESULTS AND DISCUSSION

Test results are presented in tables 1 and 2. Manufactured boards, independently of the variant, showed similar density ranging from 629 up to 639 kg/m^3. Boards varied although at density distributions presented on figure 1. In case of single-layer particleboards (variant I), typical U-shaped distribution was noticed. In case of veneered particleboards pressed in two stages (variant II), internal layer again show typical U-shaped density distribution, but outer veneer layers showed visible density drop down to 550-650 kg/m^3. This was caused by relatively low compression ratio of the veneers when pressing (around 10%). Veneered particleboards pressed with one-stage process (variant III) showed more regular and uniform density distribution. This testifies about uniform compression of all layers (chips and veneers) during pressing.

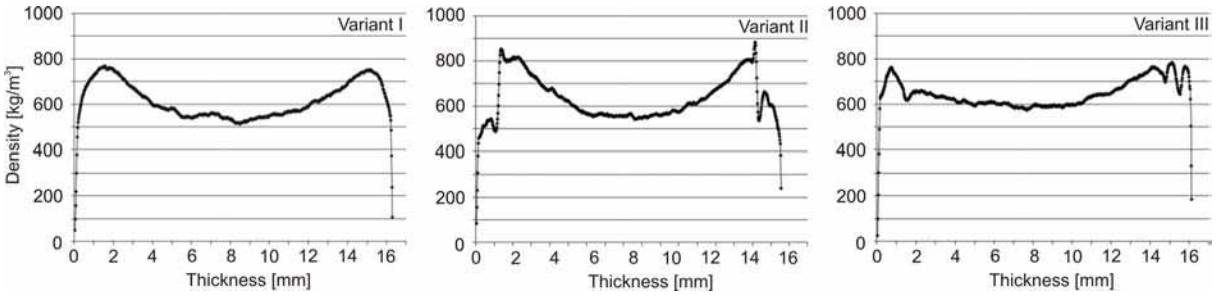

Fig. 1. Density distribution of tested boards

Table 1. Strength properties

Variant	Density	MOR				MOE				IB	
		major axis		minor axis		major axis		minor axis			
	[kg/m^3]	[N/mm^2]	x*	[N/mm^2]	x*	[N/mm^2]	x*	[N/mm^2]	x*	[N/mm^2]	x*
I	639	16,9	11	16,9	11	2028	6	2028	6	0,78	10
II	629	49,1	19	11,9	12	6506	10	1468	9	0,71	17
III	639	49,2	8	13,0	10	7118	6	1520	6	0,60 **	25

* variation coefficient [%]

** all samples fractured between board and veneer

Produced boards showed variable MOR and MOE parameters in dependence on testing direction (along or across the outer layer veneers). Application of veneers to outer layers strengthened the boards in major axis (MOR and MOE gained around 65 ÷ 72 %) with simultaneous drop in minor axis (by around 23 ÷ 30 %). Obtained results were statistically important at 95% confidence level. They were caused by variable wood strength (along and cross the grain) standing for outer layer of the boards (variant II and III), the rother cause was lowered density of the external layers of the boards, which is shown on density distributions on fig. 1. Lowered density of outer layers affects strength properties (MOR and MOE) of the

two-stage pressed veneered particleboards (variant II) in comparison to single-stage veneered particleboards (variant III). It is necessary to remark, that differences are statistically important only with MOE in the major axis direction (along the grain of the outer veneer layers).

Considering IB it is necessary to conclude that obtained strengths in variant I and II are similar (differences not statistically important). Strength drop in variant III was caused by weak bonding of veneers with the board – fracture showed up in this area. One has to remark, that in comparison to variant I difference was statistically important, but in comparison to variant II is not.

Table 2. Absorbability and swell of the boards

Variant	Swell				Absorbability			
	after 2h		after 24h		after 2h		after 24h	
	[%]	x*	[%]	x*	[%]	x*	[%]	x*
I	19,0	7	21,6	7	67,1	8	80,1	6
II	10,5	30	15,5	15	48,0	20	68,5	7
III	15,7	15	20,8	9	56,3	11	75,4	3

* variation coefficient [%]

Veneered particleboards produced in two stages (variant II) showed lower swell and absorbability results in comparison to other tested variants (I and III). This phenomena was connected with low compression of outer layer veneers, which again causes low tendency to recompression. Veneered particleboards (variant II and III) show statistically important lowering of absorbability in comparison to regular particleboards (variant I).

CONCLUSIONS

Basing on the performed tests one may conclude that:

1. It is possible to produce veneered particleboards in single technological operation;
2. Veneered particleboards produced in single operation show increased strength properties (in major axis, along the grain of outer veneers) in comparison to regular particleboards with similar thickness and density;
3. Veneered particleboards produced in single operation hale similar MOR and MOE parameters as two-stage pressed veneered particleboards;
4. Veneered particleboards produced in single or double operation show increased physical properties in comparison to regular particleboards;
5. Veneered particleboards produced in single operation have more uniform density profile in comparison to two-stage pressed veneered particleboards and regular particleboards.

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Streszczenie: *Badanie możliwości jednoetapowego wytwarzania płyt fornirowo-wiórowych.* Praca opisuje możliwość jednoetapowego wytwarzania płyt wiórowych fornirowanych. W ramach pracy wykonano 3 warianty płyt o grubości 16mm i gęstości nominalnej 620kg/m3: (1) płyta wiórowa jednowarstwowa, (2) płyta wiórowa jednowarstwowa fornirowana w dwóch etapach, (3) płyta wiórowa jednowarstwowa fornirowana w jednym etapie. Dla wytworzonych płyt zbadano profil gęstości, MOR, MOE, IB spęcznienie i nasiąkliwość po 24h moczenia w wodzie. Ustalono, że istnieje możliwość wytwarzania płyt wiórowych fornirowanych w 1 operacji, przy czym ich parametry wytrzymałościowe uzależnione są na ogół od kierunku przebiegu słojów w fornirach. Płyty fornirowane charakteryzują się równocześnie korzystniejszymi parametrami fizycznymi (spęcznienie i nasiąkliwość).

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