Three layer particleboards properties effected by addition of sub-dimensional particles from OSB production

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This work → oriented on experimental verification, of sub-dimensional particles from OSB production added to the core layer particle board, how they affect selected particleboards properties.

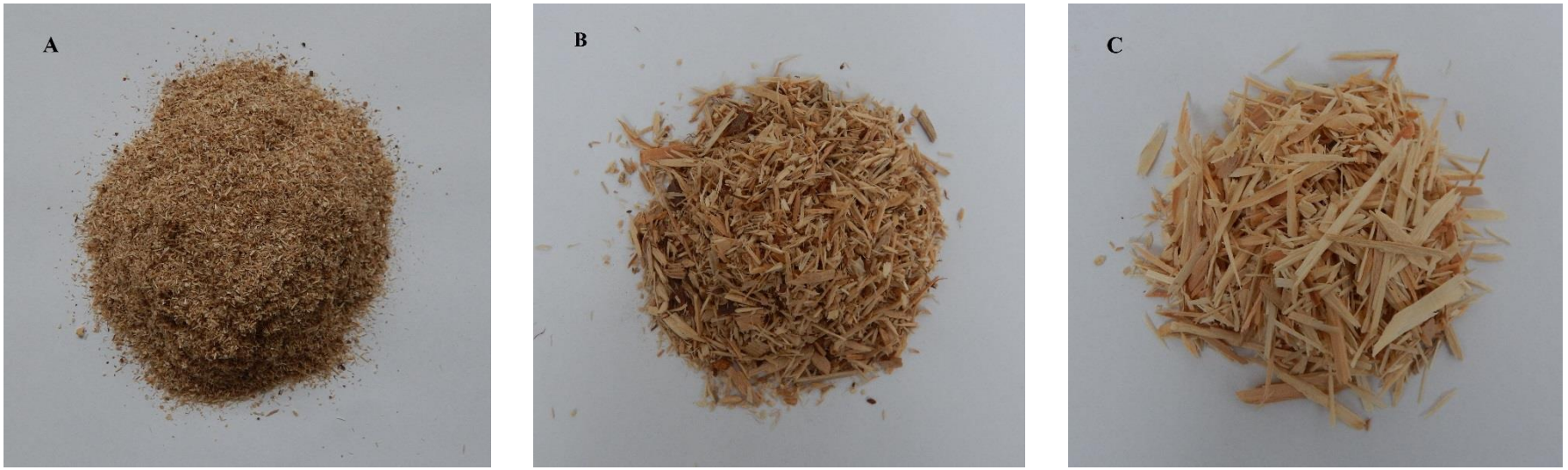

Figure 1 Particle used in particleboard.
A – surface particle,
B – core particle (normally used in PB),
C – sub-dimensional particle from OSB production used in core layer

Experimental methods

In laboratory conditions - produced boards

- dimensions of 400x300x16 mm
- density 613-626 kg.m^{-3},
- four variants with - OSB particles (sub-dimensional) – addition levels to core layer – 0, 10, 30 and 50 w/w %
- resin – urea formaldehyde

Conclusions

The modified 3-layer PBs,

- had positive effect on bending strength (increased maximally about 11.9 %),
- other application properties - did not significantly change - density, thickness swelling, water absorption, internal bond strength.

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Introduction

The size and shape of particles → influence the mechanical properties, appearance, and machinability of particleboard (PB). Since its inception the strength-to-weight ratio of particleboard has been greatly improved through the adoption of a 3-layer structure - smooth high density surface (consists of finer and more uniform particles) and lower density core (composed of larger and coarser particles of variable sizes and shapes) and advances in resin and press technology. (Sackey et al. 2008).

This work → oriented on experimental verification, of sub-dimensional particles from OSB production added to the core layer particle board, how they affect selected particleboards properties.

Materials and Methods

Particleboard:
- dimensions of laboratory prepared boards 400 mm x 300 mm x 16 mm,
- board density 613-626 $kg.m^{-3}$

Particles (Fig. 1):
- industrially produced particles from mixture of softwood and hardwoods (5 %) species
- MC of particles - surface particles 5.2 %
  - core particles 3.5 %
- OSB particles (sub-dimensional) – addition levels to core layer – 0, 10, 30 and 50 w/w %

Resin:
- urea formaldehyde (UF) glue (solids 67 %)
- the glue amount - 11 % for the surface particles
  - 7 % for the core particles
- additional additives - hardener (55 % solution of ammonium nitrate)
  - paraffine emulsion (35 % solid content)

Pressing process:
- by the standard three stage pressing diagram in Fig. 2
  - temperature of the pressing plates 210 °C
  - pressing factor 12 s

The standardized procedures according to EN 323, 317, 310 and 319 were used to determine the physical and mechanical properties of the pressed boards.

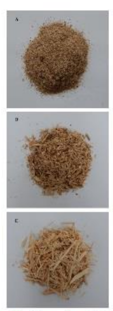

Figure 1 Particle used in particleboard.
A – surface particle,
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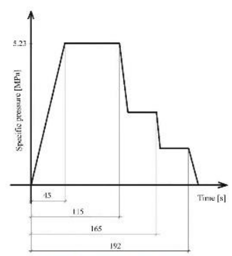

Figure 2 Standard three stage diagram

Results

Selected physical and mechanical properties of the modified particleboards with particles from OSB production are present in Table 1 and Table 2.

Table 1: Physical and mechanical properties of the modified PB with particle from OSB production

Properties of particleboard		Sub-dimensional OSB particle (w/w in the core layer of PB) [%]			
		0	10	30	50
Moisture content (MC)	[%]	8.4 (0.25)	8.2 (0.13)	8.1 (0.15)	8.2 (0.15)
Density	[$kg.m^{-3}$]	624 (36)	613 (42)	620 (31)	626 (31)
Thickness swelling (TS) after 2 h	[%]	4.32 (0.67)	3.37 (0.27)	3.47 (0.32)	4.04 (0.58)
Thickness swelling (TS) after 24 h	[%]	13.27 (1.47)	13.36 (2.01)	15.53 (1.49)	13.18 (1.29)
Water absorption (WA) after 2 h	[%]	15.86 (2.25)	16.61 (1.63)	16.02 (1.23)	16.44 (1.59)
Water absorption (WA) after 24 h	[%]	44.90 (3.98)	55.79 (3.78)	54.37 (9.01)	42.75 (3.45)
Internal bond (IB) strength	[$N.mm^{-2}$]	0.541 (0.06)	0.447 (0.09)	0.484 (0.03)	0.507 (0.05)
Bending strength (BS)	[$N.mm^{-2}$]	9.62 (1.06)	9.76 (0.96)	10.21 (0.88)	10.92 (0.57)

Notes:
- Mean values of MC from 30 samples, of density from 70 samples, of TS from 20 samples, of WA from 20 samples, of IB from 20 samples and of BS from 15 samples.
- Standard deviations are in the parentheses.

Table 2: Linear correlation analysis of the sub-dimensional particle from OSB production addition in core layer three layer particleboard on the properties of modified PB

Properties of PBs		N	R	R^2	T	P	y = a + b*x
OSB particle (% in core layer)	Moisture content	120	-0.34	0.12	-3.89	0.00	8.29 - 0.00*w/w
	Density	280	0.05	0.00	0.96	0.34	618 + 0.11*w/w
	Thickness swelling after 2 h	80	-0.04	0.00	-0.39	0.69	3.83 - 0.00*w/w
	Thickness swelling after 24 h	80	0.09	0.00	0.82	0.41	13.63 + 0.00*w/w
	Water absorption after 2 h	80	0.04	0.00	0.35	0.73	16.20 + 0.00*w/w
	Water absorption after 24 h	80	-0.20	0.04	-1.83	0.07	51.35 - 0.08*w/w
	Internal bond strength	80	–0.04	0.00	–0.31	0.76	0.50 – 0.00*w/w
	Bending strength	60	0.49	0.24	4.29	0.00	9.54 + 0.03*w/w

The density of the modified PBs (613–626 $kg.m^{-3}$) was a very similar to the control PBs (624 $kg.m^{-3}$) – see Table 1.
The bending strength of modified PB with sub-dimensional particle from OSB production had an increasing tendency with an increasing amount of sub-dimensional particle from OSB production in core layer of PBs (BS = 9.54 + 0.03 × w/w; R2 = 0.24), and maximally increased about 11.9 % – see Table 1, Table 2 and Figure 3.

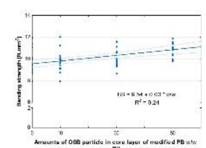

Figure 3 Bending strength of the modified PBs (core layer treated with 0 to 50% of sub-dimensional particle from OSB production)

Conclusions

The modified 3-layer PBs, due to a presence of sub-dimensional particle from OSB production added into core layer of PB in the amounts of 0, 10, 30 or 50 w/w %:
- had positive effect on bending strength (increased maximally about 11.9 %),
- other application properties - did not significantly change - density, thickness swelling, water absorption, internal bond strength.

References
Sackey, E.K., Semple, K.E., Oh, S.-W., Smith, G.D. 2008. Improving core bond strength of particleboard through particle size redistribution. Wood and Fiber Science. 40(2), 214-224.

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