PARTICLE BOARDS WITH BARK PARTICLES ADMIXTURE

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GOAL

The research deals with the production of single-layer particleboards containing spruce bark particles, which are added to the wooden particles mix with a step of 10% until the representation is 50 : 50 (bark : wooden particles). The result of the project is he determination of the impact of bark particles on physical and mechanical properties: bending (MOR & MOE), internal bonding (IB), moisture content (MC), thickness swelling (TS), water absorption (WA).

MATERIAL & METHODS

The bark chips were desintegrated into leaf particles used a DIEFFENBACHER knife ring flaker MRZ/MSF 1400. The particles were dried in a conventional chamber oven at a temperature of 70°C to a moisture content of 6% and sieved on a screen sorter for the required fractions 2 – 5 mm.

Fig. 1: desintegration flaker MRZ/MSF 1400

Fig. 2: drying

Fig. 3: screening

Particle boards were manufactured in the laboratory. The MUF resins (Silekol) were applied by nozzle in a rotary blander. Bark particle mats were formed by hand into a mold with dimensions of 600 × 600 mm and pressed to a thickness of 12 mm at a temperature 180 °C. The pressing process has been 240 seconds at a pressure of 3.5 MPa, and then the pressure was reduced by 0.5 MPa in four steps of 20 seconds.

Table 1 List of abbreviations of experimental boards with explanations.

NAME	DESCRIPTION OF EXPERIMENTAL PARTICLEBOARD
REF	Particle board with 100% wooden particles bonded with 7% of MUF resin.
PB 10	Particle board with 10% bark particles admixture bonded with 7% of MUF resin.
PB 20	Particle board with 20% bark particles admixture bonded with 7% of MUF resin.
PB 30	Particle board with 30% bark particles admixture bonded with 7% of MUF resin.
PB 40	Particle board with 40% bark particles admixture bonded with 7% of MUF resin.
PB 50	Particle board with 50% bark particles admixture bonded with 7% of MUF resin.

The pressed experimental boards were cut into test specimens according to the European standards for bending EN 310 and EN 319 for internal bonding tests. The samples were placed in an air-conditioned chamber and conditioned at 20 °C and 65% RH. Mechanical testing was carried out on a Zwick®Z050 universal testing machine.

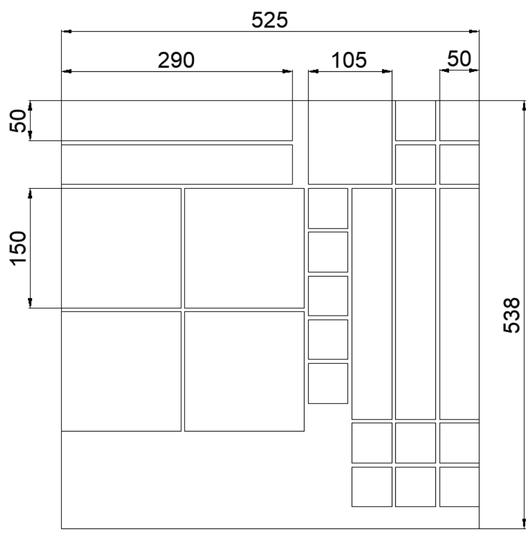

Fig. 4: Cutting plan for test specimen production (dimensions in mm).

Fig. 5: Image of samples with different amounts of bark particles

Fig. 6: bending

Fig. 7: internal bonding

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RESULTS

Table 2 Average values of density and equilibrium moisture content of particleboards at 20 °C and 65% RH.

	Density (kg/m³)	Tukey´s test	MC (%)	Tukey´s test
REF	636 (43)	A	9.2 (0.7)	A
BP 10	638 (29)	A	8.5 (0.6)	B
PB 20	639 (31)	A	7.4 (0.5)	C
PB 30	640 (24)	A	6.7 (0.6)	D
PB 40	645 (30)	A	6.5 (0.6)	D
PB 50	654 (29)	A	6.7 (0.6)	D, C

Means with the same letter in column do not differ statistically by the Tukey´s test (α=0.05). Numbers in parentheses represent standard deviation

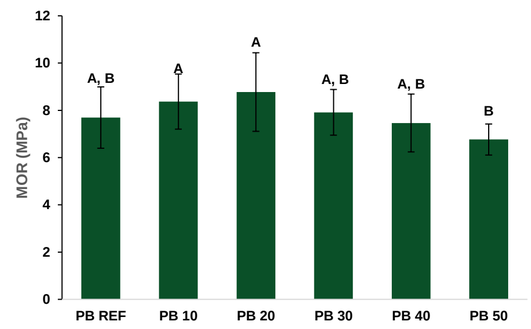

Fig. 8: Comparison of modulus of rupture testing samples – same letter do not differ statistically by the Tukey´s test (α=0.05). Error bars represent standard deviation.

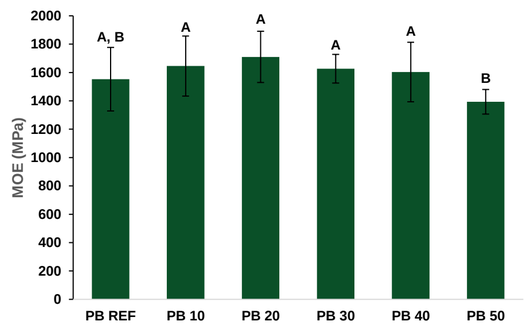

Fig. 9: Comparison of modulus of elasticity testing samples – same letter do not differ statistically by the Tukey´s test (α=0.05). Error bars represent standard deviation.

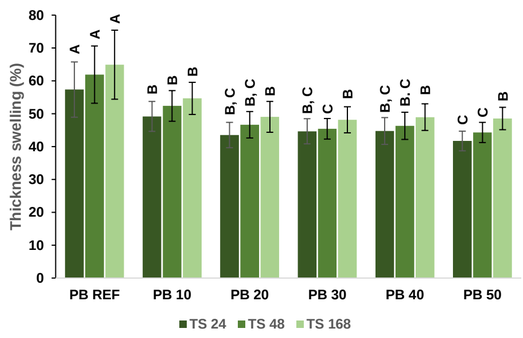

Fig. 10: Thickness swelling by EN 317 – same letter do not differ statistically by the Tukey´s test (α=0.05). Error bars represent standard deviation.

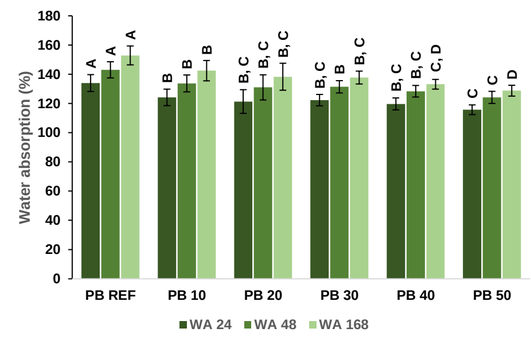

Fig. 11: Water absorption by EN 317 – same letter do not differ statistically by the Tukey´s test (α=0.05). Error bars represent standard deviation.

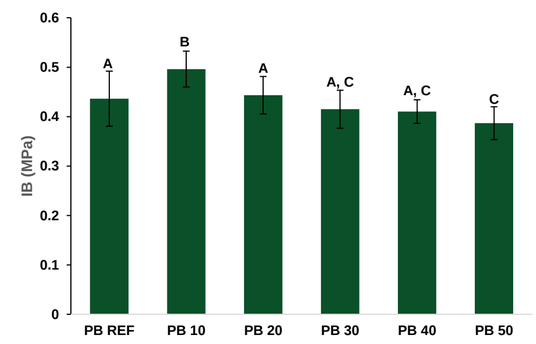

Fig. 12: Internal bond strength of particleboards - same letter do not differ statistically by the Tukey's test α=0.05). Error bars represent standard deviation.

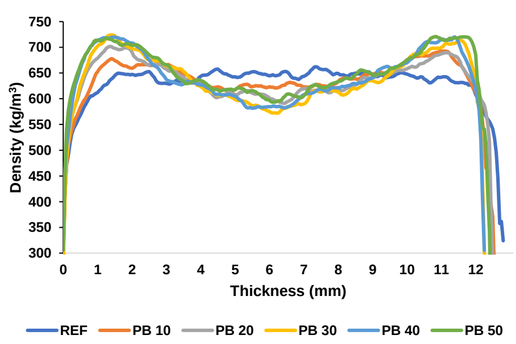

Fig. 13: Density profile of particleboards at 20 °C and 65% RH

CONCLUSION

The density of the reference board and the other experimental particleboards shows that there was no significant difference between them. With an increased in the proportion of bark particles, an equilibrium moisture content decreased. With an increased the proportion of bark particles more than 30%, the equilibrium moisture content was not changed. The proportion of bark particles in experimental particleboards has no significant effect on the modulus of rupture and modulus of elasticity except for boards containing 50% bark and 50% wood particles. The results from testing the thickness swelling of samples according to EN (Fig. 10,) standard proved a significant increase in the thickness of the reference samples (100% wooden particles). The addition of bark particles increased the dimensional stability, but the Tukey HSD test showed that the addition of more bark particles than 10% had no significant effect. Adding 10% bark particles to the mixture already caused the samples soaked in water for 168 h to swell less than the reference samples soaked for 24 h. From (Fig. 11) it is possible to observed a gradual decreased of water absorption with an increased volume of bark particles in the mixture, but Tukey test again showed a low influence of the amount of bark on water absorption, except for the reference samples. The shape of the density profilefor particleboards with bark particles corresponds to a typical “U-shape”, which means the higher density was in surface layers and lower density was in the core layer. Except for the reference samples, the shape was flat, meaning the same density within the cross-section.

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