Influence of Thermal Modification of Poplar Veneers and Plywood Construction on Shear Strength

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Background

- There is limited research about thermal modification of wood based panels.

- First approach: Thermal modification of wood after panel production (Del Menezzi et al. 2009).

- Second approach: Thermal modification of wood before panel production (Zdravković et al. 2013, Fioravanti et al. 2013) - established gluebond strength is not weakened by additional thermal treatment during the plywood pressing.
Objective

- To obtain information about how different treatment temperatures and combinations of treated and untreated veneers in plywood constructions influence on physical and mechanical properties, and specially on gluebond strength.
Material and methods

Plywood samples and experimental flow chart

POPLAR VENEERS (Populus x euroamericana I 214)
1000mm x 800 mm x 3.5mm

HEAT TREATMENTS (1 hour in water steam)
- 190°C
- 200°C
- 210°C
- 215°C

PLYWOOD HOT PRESSING (78 plywoods, 15mm thick)
T=100°C, P=1MPa, t=15min MUF resin 200g/m²

PLYWOOD QUALITY TESTING
Density, MC, MOR, MOE, WBP glue line shear testing, ASE
Material and methods

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- plywood for dry conditions: **EN 636-1**
- plywood for high humidity conditions: **EN 636-2**
- plywood for outdoor conditions: **EN 636-3**
Results and discussions

![Graph showing shear strength comparison between different veneer treatments and temperatures.]

- 5U-only untreated veneers
- 5T-only treated veneers
- T3UT-outer layers of treated veneers, core of untreated veneers
- TUTUT-alternately stacked treated and untreated veneers

Shear strength (MPa) vs. Temperature (°C):

- 190°C
- 200°C
- 210°C
- 215°C
Results and discussions

- Gluebond strength drop, apart from decreasing of mechanical properties of wood, was probably caused by weakening of glue-wood relation.

- The decrease of wood failure percentage from 62.37% (plywood for dry conditions: EN 636-1) to 16.56% (plywood for high humidity conditions: EN 636-2) and 13.31% (plywood for outdoor conditions: EN 636-3) supports this statement.

- These results are in agreement with Fioravanti et al. (2013) who reported that gluebond strength of MUF adhesive decreased 64% in plywood for high humidity conditions, as compared to plywood for dry conditions.
Conclusions

Increased gluebond strength may be achieved by better adhesive penetration into the wood before glue setting by using lower pressing temperature and longer pressing time. In addition to better plywood dimensional stability and more attractive appearance, such plywood would be of higher quality.
Thank you for your attention!