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Influence of surface pretreatment to bonding quality of thermally modified wood

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INTRODUCTION

Bonding quality of wood depends not only on the type and quality of the adhesive and parameters of the technological process, but on the condition of the wood material and specially of its surface. For optimal results adhesive should be applied to wood surface within 24 hours after the surface is prepared (by planing or sanding) for this ensures the removal of extractives and other physical and chemical contaminants from the surface (Vick, 1999). Surface wettability linearly reduces during 4 – 6 days period which may negatively affect bonding strength (Nussbaum, 1999). Thermal modification process also reduces the surface wettability and increases surface brittleness which then negatively affects bond performance on wood (Chu et al., 2016, Šernek et al., 2008, Kariž and Šernek, 2012, Uzun et al., 2016).

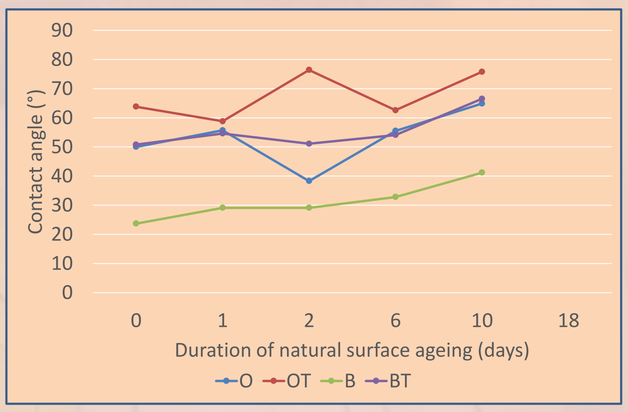
EXPERIMENTAL

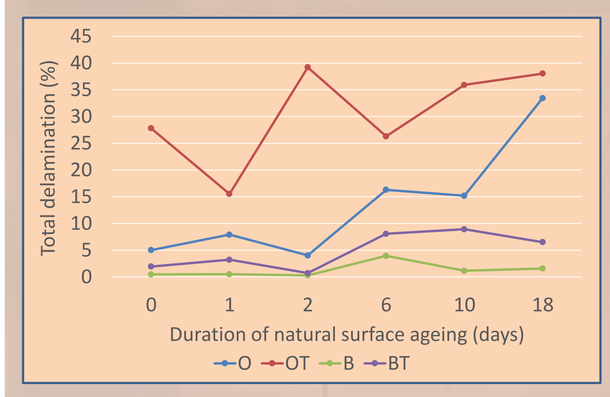
Thermally modified beech wood samples before (left) and after impregnation (right).

Two wood species were used for the experiment: oak (Quercus robur L.) and beech (Fagus sylvatica). Material for testing was commercially thermally modified for a local parquet manufacturer at 210 °C in water vapor atmosphere. Unmodified and modified samples of 1000 x 100 x 20 mm (L x T x R) were planed and glued with MUF adhesive 2 hours, 1, 2, 6, 10, and 18 days after planing. Each beam consisted of 5 lamellae. Application rate of the adhesive was 400 g/m^2. After curing of the adhesive beams were cut into 5 test pieces of 75 x 100 x 100 mm (L x T x R) for delamination tests and 10 test bars of 40 x 40 x 100 mm (L x T x R) for shear strength tests. One additional set of samples was used for contact angle measurements. The samples for the delamination test were prepared and according to EN 14080:2013 Annex C, method B. Tests for both the delamination and shear strength were conducted according to EN 14080:2013.

RESULTS

Contact angle continuously increased with surface ageing over the period of 10 days. At all the stages of ageing contact angle was lowest in the case of unmodified beech, then oak (50 – 65 °), thermally modified beech (50 – 65 °) and highest in the case of TM oak (64 – 76 °).



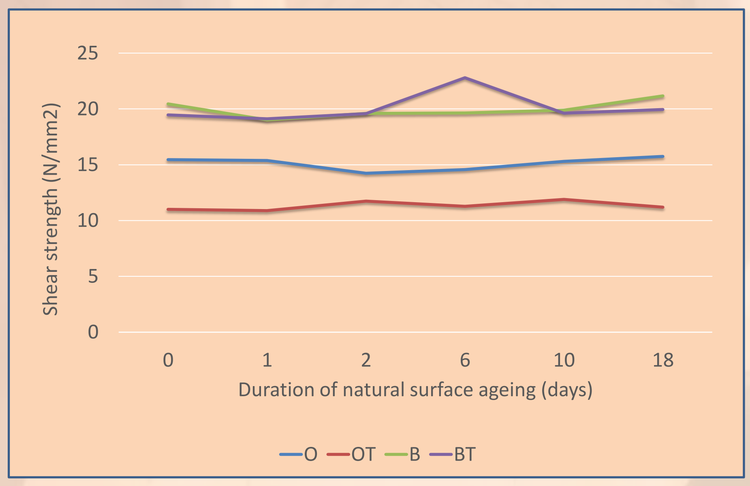


Extreme delamination of unmodified and thermaly modified oak wood samples.

Results of total *delamination* clearly show the influence of both wood species and thermal treatment as well as the time dependence of surface ageing (Figure 2). There is relative small delamination during the first 2 days of natural surface ageing in the case of unmodified and modified beech and unmodified oak. However, after that period delamination exceeds the maximum value set by EN 14080. At the same time, delamination of thermally modified oak is too excessive regardless the duration of surface ageing indicating that this species is not suitable for laminations under here presented conditions. Both unmodified and thermally modified beech may be successfully laminated at least up to 2 days after planing, whereas neither oak nor thermally modified oak are suitable for lamination process under here presented conditions.

Shear strength of glue lines did not depend on surface ageing, and the results for each set of samples for a specific species are in very narrow range. Shear strength is lowest in the case of thermally modified oak (~11 N/mm2) and unmodified oak (~15,5 N/mm2), whereas the shear strength values are very similar in case of unmodified and thermally modified beech (~20 N/mm2). Here presented results clearly show the following:

1. There is no influence of neither modification process nor natural surface ageing to shear strength of glue lines of beech wood.
2. Thermal modification process significantly influenced the reduction of shear strength of oak wood by 30%, but subsequent natural surface ageing had no effect to shear strength.
3. Both unmodified and thermally modified beech and oak may be used in laminations for timber structures because they meet the requirements as defined by EN 14080.



CONCLUSIONS

Both unmodified and thermally modified beech exhibited better results compared to oak and thermally modified oak. Results of the total delamination indicate a time dependence of surface ageing. Native and thermally modified beech may be successfully laminated at least up to 2 days after planing. Shear strength of glue lines did not show any influence of natural surface ageing. Average shear strength of glue lines indicates that both native and thermally modified beech and oak may be successfully laminated no matter the duration of natural surface ageing.

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