COMPARISON OF CHEMICAL WOOD MODIFICATION PROCESSES OF CARBOXYLIC ACID ANHYDRIDES AND ESTERS IN GAS AND LIQUID PHASE

Beránek Štěpán, Baar Jan, Brabec Martin, Daniels Geoffrey

Mendel University in Brno, Zemědělská 3, 613 00 Brno / Faculty of Forestry and Wood Technology

e-mail: *stepan.beranek@mendelu.cz*

GOAL:

The main goal of the project was to compare chemically modified wood processing processes in different phases – gaseous (GP) and liquid (LP), and to find out under which reaction conditions GP can compete with or surpass the properties of wood modified by LP. We used permeable (European beech) and extremely poorly permeable (Norway spruce) wood species for the experiments. Durability, mechanical properties in bending test and changes in the microscopic structure of the wood were tested.

MATERIAL & METHODS:

Acetic (AA) and propionic anhydride (PA) were used in the project for the chemical reaction. In both chemical reactions in gas phase, the same reaction parameters were used (T = 125 °C; t = 2, 4 and 6 hours; without the use of a catalyst or dilution). The project methodology was divided into individual parts:

- *chemical modification of wood (Fig. 1);*
- *resistance to wood-decay fungi white and brown rot (Fig. 2);*
- *change of mechanical properties in bending (Fig. 3);*
- *microscopic structure changes (Fig. 4).*

RESULTS:

Chemical modification of wood:

At the longest reaction time of the gas phase AA reaction, the Weight percent gain (WPG) results were comparable to the liquid phase AA reaction (Fig. 5). In other cases, the gas phase always reached higher values. Similar dependencies were obtained when comparing the values of the Bulking coefficient (BC – Fig. 6).

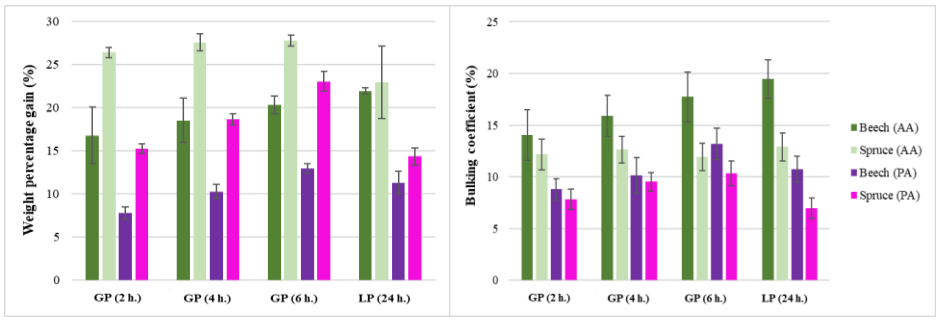

Fig. 5 – Comparison of WPG values between methods of modification and type of wood

Fig. 6 – Comparison of BC values between methods of modification and type of wood

Durability tests of chemical modified wood:

The resistance to the action of wood–decay fungi was increased many times after the chemical modifications compared to the reference samples in both phases of the chemical reaction (Fig. 7).

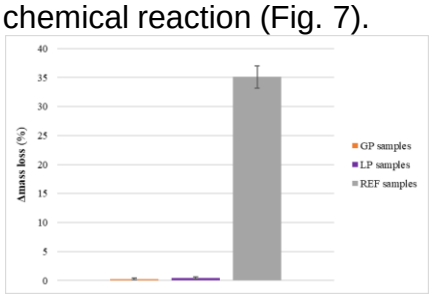

Fig. 7 – Comparison between the values of mass loss after exposure to wood–decay fungi among the investigated samples.

Bending test:

As part of the chemical modification, the mechanical properties were not significantly affected (Fig. 8). However, when attacked by wood decay fungi, they were significantly preserved compared to the reference samples (Fig. 9).

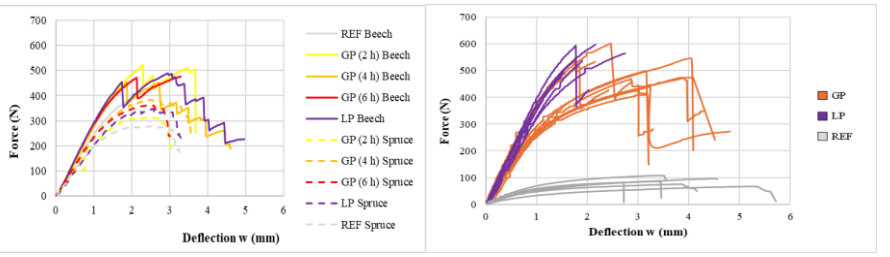

Fig. 8 – Comparison of force-deflection behavior of individual samples after modification.

Fig. 9 – Comparison of force-deflection behavior of individual samples after modification and fungal exposure.

Microscopic structure of modified wood:

Microscope slides show acetylated (GP and LP) and reference cell wall samples and occurrence of fungal hyphae in vessels (shown in blue). While in the REF samples the vessels were fully filled with fungal hyphae, in the acetylated samples (GP and LP) their occurrence was minimal (Fig. 10).

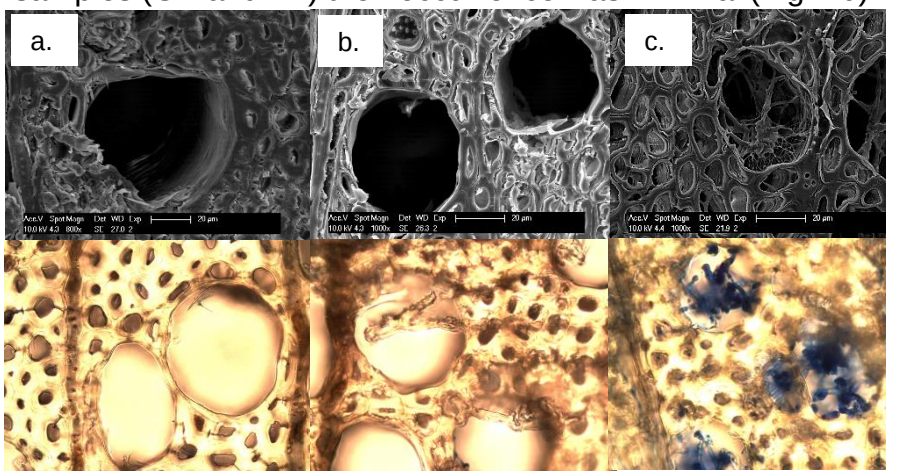

Fig. 11 – Microscopic structure with Scanning electron microscopy (SEM – top) and light microscopy (bottom) – gas acetylated (a), liquid acetylated (b) and reference samples (c).

ACKNOWLEDGEMENT:

This research was financed by funds provided by Internal Grant Agency MENDELU (Project No. IGA24- FFWT-IP-033)

https://www.ldf.mendelu.cz/

MENDELU Faculty of Forestry and Wood Technology

SLU