

# CO-PYROLYSIS OF BEECH WOOD AND POLYAMIDE-6 : EFFECT OF HZSM-5 CATALYST AND OF PLASTIC CONCENTRATION ON THE PROPERTIES OF PYROLYSIS OILS

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Biomass residues and waste can be converted into bioliquids by pyrolysis, which can contribute to both the production of renewable fuels and the recycling of waste. In this study, the pyrolysis of pure beech wood (BW) and of mixtures of BW + polyamide-6 (PA6), a nitrogen-containing plastic, was investigated to assess the effect of PA6 on the properties of bio-oils, obtained either by thermal pyrolysis or by pyrolysis with ex-situ catalytic treatment. The catalytic treatment is applied to the pyrolysis vapors that are driven across a HZSM-5 catalyst bed before their condensation into liquid products. The presence of 20 wt.% PA6 in the blend affected the pyrolysis products yields and distribution (gases, liquids, chars), but also the composition of the bioliquids. In absence of a catalyst, the production of phenolic compounds (guaïacol, syringol...), sugars, furans decreased significantly with the BW+PA6 blend compared to pure BW, and N-containing compounds derived from PA6 were found in the bioliquids. When HZSM-5 catalyst was applied for the treatment of vapors, the production of sugars and furans decreased and a small production of fully deoxygenated compounds was observed with pure BW. This effect was mitigated with BW+PA6 blends and the formation of deoxygenated compounds was almost totally suppressed, suggesting that the strong catalyst acid sites were poisoned. Caprolactam was by far the main product of PA6 degradation found in the bioliquids, but the N-containing by-products were different depending on the absence or presence of HZSM-5 catalyst. Notably, the formation of 5-cyano-1-pentene in a fairly large proportion was only observed in the presence of the catalyst.

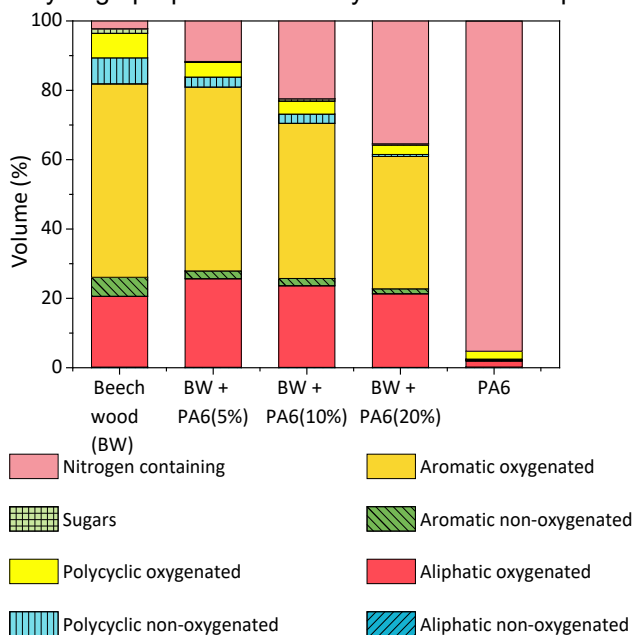


Fig. 1 - Relative compound families identified by GCxGC-MS in the organic phases obtained with HZSM-5 catalyst

Mixtures of BW and PA6 in different ratios were also co-pyrolyzed in the presence of the HZSM-5 catalyst. With increasing PA6 concentrations, less gaseous products were formed, evidencing a catalyst deactivation (less cracking activity). In the liquid phase products (Fig. 1), the production of oxygenated aromatic compounds and of fully deoxygenated compounds decreased with increasing PA6 concentrations, while the average molar mass of bio-oils and their N-content increased. The ratio between caprolactam and 5-cyano-1-pentene, the main products derived from PA6 pyrolysis, changed non-linearly with the PA6 concentration. The amount of coke deposited on the catalyst decreased as the PA6 concentration increased, but this coke contained more nitrogen.

Synergistic effects in the BW+PA6 pyrolysis were evidenced by the positive or negative deviation of different parameters (mass of gas, liquid, solid products, mass of coke on the catalyst, C, N, O composition of bio-oils) from a simple arithmetic combination of the same parameters for pure BW or pure PA6 weighted by their concentrations, in particular the N-content in the bio-oils was much higher than expected.

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