

# Synthesis of bio-oil-phenol-formaldehyde resins under alkali conditions: Physical, chemical and thermal properties of resins and bonding performance

## Abstract

In the present study, bio-oil produced from vacuum pyrolysis of woody biomass has been investigated as a source of chemical feedstock. Bio-based resins were produced using the bio-oil with phenol substitutions ranging from 10 to 30 wt%. The conventional GC/MS analysis was carried out for the evaluation of the chemical composition of bio-oil. TGA, DSC and FT-IR analyses were used in order to characterize the bio-oil-phenol-formaldehyde (BPF) resins. The bonding quality of wood samples bonded with the BPF resins was investigated under different pre-treatment conditions. The highest shear strength was observed for the control samples bonded with the laboratory PF resin. As the amount of bio-oil was increased up to 30 wt%, the shear strength of the samples decreased from 12.08 to 11.76 N/mm<sup>2</sup>. The bonding performance was not negatively affected by the combination of bio-oil under dry conditions. According to TS EN 12765 standard, the relevant performance requirements for bonded samples under dry conditions must be at least 10 N/mm<sup>2</sup>. Relating to the standard, all samples bonded with BPF resins obtained the requirements for durability class C1. Under wet conditions, the bonding performance was negatively affected by the addition of bio-oil. However, the BPF resins fulfilled the durability requirements for C1, C2, and C3 specified in EN 12765 (2002).

## Keywords

Bio-phenol; Bonding performance; Phenol formaldehyde resin; Shear strength