ADHESIVES FROM BIOMASS PYROLYSIS

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Key Words. Biomass, pyrolysis, fractional condensation, dry bio-oil, phenol substitution, wood adhesives

Fast pyrolysis of waste biomass with high lignin content, such as birch wood, birch bark, hydrolysis lignin, kraft lignin or low-cost digestate from biogas production, provides oils that can be substituted for phenol in phenol-formaldehyde resins. Biomass fast pyrolysis was performed in a dedicated fluidized bed pyrolyzer that incorporated two crucial innovations: a fractional condensation train provided dry bio-oils with ~1% of moisture and much reduced acidity; autothermal pyrolysis with partial oxidation reduces operating and capital costs, as well as increasing the quality of the dry bio-oil. Dry bio-oil obtained from autothermal fast pyrolysis of kraft lignin can be used to substitute up to 80% of phenol in reacting with formaldehyde to produce wood adhesives that met International Standards, including specifications on the dry and wet mechanical strength and formaldehyde emission (Figure 1). With dry bio-oils from the low-cost residues (birch wood, birch bark, hydrolysis lignin, or digestate), the substitution level can be 50~65%. In addition, there is no need to change the hot press temperature or curing time from the current settings for pure phenol resin. The mechanical strength and formaldehyde emission levels of the bonded plywood are affected by the phenol substitution ratio, and the concentration and molecular weight of the phenolics in the dry bio-oil.

Figure 1 – Plywood panels bonded with bio-phenol adhesives (80% of phenol substitution by kraft lignin pyrolysis bio-oils).