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Yields and Composition of the Gas, Liquid and Solid Fractions Obtained by Conventional Pyrolysis of Different Lignocellulosic Biomass Residues

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Abstract : Nowadays, fossil resources are main precursors for fuel production. Due to their contribution to the greenhouse effect and their future depletion, there is a constant search for environmentally friendly feedstock alternatives. Biomass residues constitute an interesting replacement for fossil resources because of their zero net CO_2 emissions. One of the main routes to convert biomass into energy and chemicals is pyrolysis. In this work, conventional pyrolysis of different biomass residues highly available such as almond shells, hemp hurds, olive stones, and Kraft lignin, was studied. In a typical experiment, the biomass was crushed and loaded into a fixed bed reactor under continuous nitrogen flow. The influence of temperature (400-800 ºC) and heating rate (10 and 20 ºC/min) on the pyrolysis yield and composition of the different fractions has been studied. In every case, the mass yields revealed that the solid fraction decreased with temperature, while liquid and gas fractions increased due to depolymerization and cracking reactions at high temperatures. The composition of every pyrolysis fraction was studied in detail. The results showed that the composition of the gas fraction was mainly CO, CO_2 when working at low temperatures, and mostly CH_4 and H_2at high temperatures. The solid fraction developed an incipient microporosity, with narrow micropore volume of 0.21 cm^3/g. Regarding the liquid fraction, pyrolysis of almond shell, hemp hurds, and olive stones led mainly to a high content in aliphatic acids and furans, due to the high volatile matter content of these biomass (>74 %wt.), and phenols to a lesser degree, which were formed due to the degradation of lignin at higher temperatures. However, when Kraft lignin was used as bio-oil precursor, the presence of phenols was very prominent, and aliphatic compounds were also detected in a lesser extent.

Keywords : Bio-oil, biomass, conventional pyrolysis, lignocellulosic
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