Upgrading and Stabilizing Pyrolysis Oil in Supercritical Alcohol

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Fast-pyrolysis bio-oil as one of the renewable energy resources still exhibits several unfavorable traits such as high moisture, oxygen, and acid content and low heating value which resulting in highly corrosive and thermally unstable oil. In this study, we investigate a recent method to upgrade bio-oil using supercritical fluids which have superior properties like faster rates of mass and heat transfer, liquid-like density, and a good dissolving power. Alcohol is being utilized because its decomposition generates hydrogen leading to deoxygenation and esterification reaction resulting in a more stable oil. Bio-oil, a specified alcohol, and a specified catalyst were loaded into the reactor and flushed with nitrogen under specified pressure for several times to remove the residual air. The reactor were heated to 400°C for a certain time reaction (0.5-1 h) with a stirring speed of 500 rpm. The liquid, gas, and solid products were separated and analyzed further. The results showed that the combination of ethanol and sodium carbonate (Na2CO3) gave the highest yield exceeding 100% and heating value of 35.38 MJ/kg with the lowest oxygen content of 11.75%-wt and TAN of 1.80 mg/g KOH. Upgraded oil properties indicated that supercritical alcohol is an effective method to upgrade and stabilize pyrolysis oil.