CUSTOMIZED CATALYTIC HYDROPYROLYSIS OF BIOMASS TO HIGH-QUALITY BIO-OIL SUITABLE FOR CO-PROCESSING IN FCC REFINING UNIT

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This study aims to investigate the critical elements of the biomass ex-situ catalytic hydropyrolysis concept to improve the quality of pyrolysis oil (bio-oil) for further co-processing in an FCC refining unit. Generally, the high oxygen and low hydrogen contents of biomass result in a bio-oil with low quality, necessitating its upgrading which can be performed as integrated in the pyrolysis process via in-situ or ex-situ configuration. In this work, the quality of stem wood-derived pyrolyzates (500 °C) was improved via ex-situ catalytic hydropyrolysis (400 °C) using a bench-scale drop tube furnace pyrolyzer, and then the produced bio-oil was co-processed with fossil oil using a lab-scale FCC unit (525 °C). Catalytic hydropyrolysis of stem wood was carried out using different metal-acid catalysts, such as Ni/HZSM-5, Ni/HBeta, Mo/TiO2, and Pt/TiO2 at atmospheric pressure. FCC runs were performed using Spent FCC catalyst and conventional fossil FCC feedstock co-fed with stem wood-derived bio-oil in a fluidized bed reactor. Co-feeding the non-upgraded bio-oil with fossil oil into the FCC unit increased the coke yield and decreased the yield of gasoline/naphta, indicating that bio-oil needs to be upgraded for further co-processing in the FCC unit. Experimental results showed that different catalysts significantly affected the products composition and yield; Ni based catalysts were strongly active tending to generate a high yield of gas, while Mo and Pt based catalysts seemed better for production of liquid with improved quality. The quality of bio-oil was improved by reducing the formation of reactive oxygenates through the atmospheric catalytic hydropyrolysis process. The composition of oil obtained from hydropyrolysis also showed that the yield of phenols and aromatic hydrocarbons was relatively improved.