Selective Upgrading of Bio-Oil from Co-Pyrolysis of Plastic Waste and Rubber Seed Cake over a Copper-Doped Mesoporous Alumina Catalyst

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Abstract

Several thermal technologies such as pyrolysis, torrefaction, combustion and gasification have been explored to convert biomass materials into renewable energy. Among them, the traditional pyrolysis process can be considered the most promising technology for facile production of bio-oil with high product yield. In this research, catalytic production of bio-oil consisting of monoaromatic hydrocarbons (MAHs) such as benzene, toluene and xylene was investigated through the co-pyrolysis of plastic waste (polyethylene terephthalate: PET) and rubber seed cake (RSC). The copper-doped mesoporous alumina (Cu/MA) was applied as an active catalyst for bio-oil upgrading, which was easily prepared via cationic quaternary ammonium surfactant-assisted hydrothermal synthesis followed by the impregnation method. The synergistic effect of co-pyrolysis between PET and RSC at different mass ratios was preliminary studied in detail under a temperature range of 400-700 °C. It was found that the highest yield of bio-oil (74.5%) before the upgrading process was obtained at a pyrolysis temperature of 600 °C using a mass ratio of PET to RSC (3/1). For bio-oil upgrading results, the 5%Cu/MA catalyst exhibited the highest catalytic activity for selective production of MAHs with a maximum relative amount of 87.3% via specific reactions such as cracking, deoxygenation and aromatization. The surface area (153 m^2/g) and pore size (7.7 nm) of green bio-char derived from the co-pyrolysis of PET and RSC were achieved under optimum conditions. This research offers a green way for catalytic upgrading of bio-oil with high product yield, which could be expected for further application in practical pyrolysis processes.

Keywords: *monoaromatic hydrocarbons, co-pyrolysis, bio-oil, plastic waste, rubber seed cake*