Catalytic co-pyrolysis of yellow poplar and HDPE using MOF-incorporated HY zeolite catalysts

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Abstract:

Catalytic co-pyrolysis of yellow poplar and high-density polypropylene (HDPE) was conducted using metal oxide on hydrogen y-type (HY) zeolite to selectively produce monoaromatic hydrocarbons. The reaction was investigated using a tandem micro-reactor connected to a gas chromatography–mass spectrometry (GC–MS) system, encompassing both in-situ and ex-situ studies. Fe oxide/HY and Cu oxide/HY catalysts, prepared via a metal–organic framework (MOF)-incorporated technique, demonstrated excellent metal dispersion and enhanced electron density. The Cu oxide/HY catalyst showed significant production of benzene, toluene, ethylbenzene, and xylene, reaching up to 28% in in-situ studies. Owing to its strong acid sites, this catalyst facilitated the formation of aromatic compounds. In ex-situ studies, furan and acetaldehyde were consumed through the Diels–Alder reaction. The increase in aromatic compounds was highlighted by a synergistic effect percentage as high as 175%. The mechanism of aromatic formation was elucidated through dealkylation, Diels–Alder, and aromatization reactions. The Cu oxide/HY catalyst, combined with the MOF-incorporated preparation technique presents a promising system for catalytic co-pyrolysis of biomass and HDPE. This approach will facilitate efficient and sustainable aromatic hydrocarbon production from renewable and plastic waste sources.

Frontier Labs Products used:

Tandem micro-Reactor (Rx-3050TR)