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EFFECT OF CATALYST PORE SIZE ON THE CATALYTIC UPGRADING OF POLYPROPYLENE PYROLYSIS VAPOURS

Aim

To investigate the effect of catalyst pore shape and size on the catalytic upgrading of PP pyrolysis vapors with the micro-pyrolyzer facility to understand better the correlation between pore size and light olefin selectivity.

Justification

The accumulation of plastic waste is an environmental hazard and warrants an efficient recycling process. Polyolefins (polyethylene, polypropylene, and polystyrene) are accountable for two-thirds of the plastic in municipal solid waste, and reuse or recovery from plastic waste is crucial for a carbon-neutral economy. Landfilling and incineration are the traditional approaches for plastic waste disposal, but they suffer from several environmental drawbacks. Conventional mechanical recycling is widely employed, leading to down-cycling and producing lower-quality products. Meanwhile, chemical recycling processes, such as pyrolysis, have become an attractive topic in recent years as they can thermo-chemically convert plastic waste to valuable base chemicals (light olefins (C_2-C_4), benzene, toluene).

Catalytic pyrolysis of polypropylene (PP), either ex-situ or in-situ, has been reported in the literature, yet detailed online analysis of pyrolysis products was limited. Besides, the effect of pore shape and size on the catalytic upgrading of PP pyrolysis vapors was not intensively investigated. The micro-pyrolyzer facility combined with comprehensive two-dimensional gas chromatography with flame ionization detector and time-of-flight mass spectrometer (GC x GC-FID/TOF-MS) allows online qualitative and quantitative analysis of catalytic pyrolysis products. This project aims to investigate ex-situ pyrolysis of PP over ZSM-5 (Si/Al = 11.5) and Al-MCM-41 (Si/Al =12.5) in micro-pyrolyzer to understand better the correlation between catalyst pore size and light olefin selectivity.

Program

1. Literature review on the efficacy of microporous and mesoporous catalysts on upgrading PP pyrolysis vapors.
2. Experimentally determine the pyrolysis products of PP at various pyrolysis temperatures and residence times.
3. Characterize the catalysts' surface area, pore volume, and acidity (N_2 physisorption and NH_3-TPD).
4. Investigate the effect of ZSM-5 and Al-MCM-41 on upgrading PP pyrolysis vapors.