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Experimental and kinetic modelling study of ex-situ catalytic pyrolysis of waste polyethylene and polypropylene

Aim

To investigate ex-situ catalytic fast pyrolysis of waste polyethylene and polypropylene with micro-pyrolyzer unit and develop detailed kinetic model based on experiment.

Justification

As main disposal methods for disposal of waste plastic materials (WPM), landfill leads to ground water contamination, while incineration process generates large amount of toxic gases. As a new technology for waste plastic disposal, pyrolysis has attracted great attentions recently. Pyrolysis can deal with dispose WPM environmentally friendly, moreover, it can convert WPM into valuable chemicals or transportable fuels. Ex-situ catalytic pyrolysis is a promising method to increase the yields of targeted products. Polyethylene (PE) and polypropylene (PP) are typical and very important plastic in the world, they are widely used for many applications such as grocery bags, shampoo bottles, children's toys, packaging and labeling.

The pyrolysis mechanism of PE and PP has been studied in previous literatures, however, previous studies mainly utilized cold trap and gas bag to collect pyrolysis product for analysis, which would lead to substantial errors and the loss of some key intermediates or products. Besides, ex-situ catalytic pyrolysis study of PE and PP is rarely reported. At LCT, with the help of micro-pyrolyzer combined with comprehensive two-dimensional gas chromatography with flame ionization detector and time-of-flight mass spectrometer (GC x GC-FID/TOF MS), the qualitative and quantitative information of ex-situ catalytic pyrolysis products can be obtained online. Thus, this work mainly aims to investigate ex-situ pyrolysis of PE and PP in micro-pyrolyzer combined with GC x GC-FID/TOF MS and develop a more detailed model.

Program

1. The pyrolysis characteristic of PE and PP will be studied via micro-pyrolyzer setup at various experimental conditions, such as sample shapes, temperatures, flow rates, pressures and impurities.
2. Ex-situ catalytic pyrolysis experiments will be carried out to evaluate and compare the performance of catalysts (such as zeolite, aluminosilicates and neat kaolin).
3. Simulation modelling for ex-situ catalytic fast pyrolysis of PE and PP will be performed via Cantera software.