Catalytic Copyrolysis of Cellulose and Thermoplastics over HZSM-5 and HY

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Abstract:

Catalytic pyrolysis with HZSM-5 is a promising method for the production of renewable aromatic hydrocarbons directly from biomass, even though the aromatic yields are still very low. Recent studies have shown that cofeeding of biomass with plastic significantly improves the aromatic yield due to high hydrogen content in plastic. In an effort to determine the influence of the zeolite pore size and the molecular diameter of cofeeding plastic on the aromatic production, catalytic copyrolysis of cellulose and thermoplastics, including random polypropylene (PP) and linear low density polyethylene (LLDPE) was conducted over HZSM-5 and HY catalysts. Thermogravimetric (TG) results showed that maximum decomposition temperature of PP was shifted to the higher temperature when PP was copyrolyzed with cellulose over HZSM-5 because the diffusion of PP molecules was hindered by the cellulose-derived coke and char. This hindering effect was attenuated by employing LLDPE as the cofeeding plastic due to its smaller molecular diameter than PP, and/or applying HY due to its larger pore size than HZSM-5. Heart-cut-evolved gas analysis (EGA)-GC/MS and flash pyrolysis-GC/FID were used to monitor the detailed product distribution and yields. The synergistic aromatic formation was easily achieved over HY catalyst for both PP and LLDPE, demonstrating the effectiveness of the larger pore zeolite for the catalytic copyrolysis. In contrast, HZSM-5 was very effective for the enhancement of aromatic production under severe reaction conditions, such as high catalyst to feed ratio (i.e., 10:1) or high pyrolysis temperature (i.e., 600ºC).

Frontier Labs Products used:

Multi-Shot Pyrolyzer (EGA/PY-3030D), UA-5, MJT-1030E, F-Search