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Downstream Pathways from Plastic Waste Pyrolysis Products to High-Value Petrochemicals

Jonas Vogt[1]*, Carola Jendrzok[2], Zubair Riaz[3], Salar Tavakkol[1], Dieter Stapf[1]

[1]Institute for Technical Chemistry, Karlsruhe Institute of Technology (KIT)
[2]Institute of Catalysis Research and Technology, Karlsruhe Institute of Technology (KIT)
[3]Department of Chemical and Metallurgical Engineering, Aalto University
*Jonas.Vogt@kit.edu

Different plastic waste streams were pyrolyzed in a continuous kg-scale screw reactor at KIT, generating pyrolysis oils for downstream evaluation. The oils were fractionated by distillation to obtain boiling-range cuts relevant for petrochemical processing. Depending on feedstock composition and target application, fractions were either further distilled to obtain aromatic base chemicals (styrene and BTX) or hydroprocessed to produce naphtha and gas oil with low heteroatom content for integration into steam cracking, fluid catalytic cracking, or related refinery processes.
Comprehensive two-dimensional gas chromatography characterized the molecular structure of pyrolysis oils, its fractions and products. Analytical and experimental data were fed into a process model to evaluate various downstream strategies. This work links pilot-scale pyrolysis experiments with analytical characterization and process assessment to identify technically viable downstream pathways. For each feedstock, the most efficient downstream pathway was identified, demonstrating that optimal value creation requires matching the fractionation and upgrading strategy to both feedstock composition and target petrochemical application.