



Contents lists available at ScienceDirect

Journal of Industrial and Engineering Chemistry

journal homepage: www.elsevier.com/locate/jiec

Specialized fractionation combined with deep analytics of waste plastic cracking oils for petrochemical operations

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ARTICLE INFO

Keywords:

Waste plastic cracking oil
 Fractionation
 Naphtha
 Petrochemistry
 Distillation

ABSTRACT

Waste plastic cracking oils (WPCO) are currently being considered as potential green feedstock for petrochemical/refinery industries in order to promote chemical recycling. However, the WPCO is a very complex material that does not meet the limits of petrochemical processes. In order to assess the possibility of using WPCO as raw material, a comprehensive analytical characterization and distillation of two wide-boiling WPCO samples from the industry was performed. Fractions boiling in typical ranges were prepared: naphtha (30–180 °C), heavy naphtha (30–250 °C), middle distillate (180–350 °C), and atmospheric residue (> 350 °C). Moreover, other distillation cuts were prepared by distilling every 10 wt% as a separate fraction. We performed a study on the distribution of parameters in narrow fractions. The content of aromatics increased with the boiling temperature in the cases of WPCO-1, but decreased for WPCO-2. WPCO-2 had lower alkanes and final boiling point (FBP) compared to WPCO-1. None of the distillation cuts are suitable for “stand-alone” processing on the steam-cracker without additional treatment. However, some of the obtained fractions could be co-processed with a standard feedstock. This study brings an understanding of WPCO material and the possibilities and limitations of its use as petrochemical input.

Introduction

In recent times, the global predicament of plastic pollution has sparked an intense quest for sustainable solutions. With conventional

waste management strategies proving inadequate to cope with the astonishing volumes of plastic waste generated annually, innovative approaches are imperative. Among these, plastic pyrolysis stands out as a promising avenue, offering the potential to transform discarded

Abbreviations: BH, Benzina Heavy; BM, Benzina Medium; BW, Benzina Wide; FBP, Final Boiling Point; FCC, Fluid Catalytic Cracking; FID, Flame Ionization Detector; GC–MS, Gas Chromatography–Mass Spectrometry; GOHT, Gas Oil Hydrotreater; HCVD, Homogeneous Chemical Vapor Deposition; HDPE, High-density Polyethylene; HGO, Heavy Gas Oil; HPLC, High-Performance Liquid Chromatography; HTL, Hydrothermal Liquefaction; HWO, Heavy Wax Oil; IBP, Initial Boiling Point; LOD, Limit of Detection; MBP, Middle Boiling Point; MCRT, Micro Carbon Residue Test; MF, Middle fraction; PIONA, Paraffins, Iso-Paraffins, Olefins, Naphthenes and Aromatics; POX, Partial Oxidation Unit; PP, Polypropylene; SARA, Saturates, Aromatics, Resins, Asphaltenes; SimDis, Simulated Distillation; TAN, Total Acid Number; VBU, Visbreaking Unit; WPCO, Waste Plastic Cracking Oil.

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<https://doi.org/10.1016/j.jiec.2025.05.012>

Received 11 February 2025; Received in revised form 30 April 2025; Accepted 6 May 2025

Available online 8 May 2025

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