Integrated production of olefins and jet fuel from waste polypropylene

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Polypropylene is a thermoplastic that is used in the packaging, textile and automotive industries. It is also a significant source of plastic waste. The cracking of the PP separated waste is a promising route for the feedstock recycling of this polyolefin. Partly into the starting monomer propylene, a highly valued isobutene for the production of ETBE and for the production of alternative aviation fuel component and also gasoline and diesel fuel components.
Waste polypropylene from food packaging containing inorganic fillers (3.8 wt.%) was thermally and thermo-catalytically cracked to a mixture of gases, a C5+ liquid fraction and a solid residue in a two-reactor setup. Thermal decomposition (390-450°C) produced a 20 wt.% fraction of C1-C4 hydrocarbons and hydrogen. In thermo-catalytic decomposition, the fraction of the gaseous fraction was higher depending on the acidity of the catalyst used (up to 40 wt.%). The main components of the gaseous fraction from the cracking of the waste PP were propylene (40-46 wt.%) and isobutene (13-24 wt.%). In thermo-catalytic cracking, the yield of isobutene was higher. The liquid fraction contained a mixture of highly branched C_5-C_{30} alkanes (di-, tri-, tetra-, penta-, hexamethylated alkenes with a C=C bond in position 1) with a bromine number of 75-94 mg KOH/g. It contained a large proportion of aviation kerosene fraction of about 40 wt. %. The hydrogenation of the sample was carried out on a 5%Pd/C catalyst at 100°C and 18 bar hydrogen pressure. The product had a freezing point below -36°C. The hydrogenated and rectified cracking and hydrotreating product of the C5+ fraction can be a component of sulphur-free and sustainable fuels within the circular economy.

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