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Thermo-chemical Depolymerisation Technologies to Recover Olefins

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Abstract
Plastic waste is increasingly perceived as a problem by the public because it often gets into the environment in an uncontrolled manner. In addition, limited availability of raw materials and climate change are driving the idea of a circular economy. Legislations therefore demand higher recycling rates which, however, can hardly be met today by way of physical recycling as with each use of plastic as a recyclate the purity and product parameters get worse. In addition, the diversity of plastics is increasing (specialty plastics, plastic composites and additives), in which even the increasingly improved separation technologies are less and less effective. Due to this, thermo-chemical conversion technologies like the depolymerisation of polyolefins into their olefins and naphtha provide an interesting solution to circumvent the qualitative and economic limits of physical recycling. Although the conversion of plastics into chemical raw materials or fuels has been pursued for 40 years, conversion technologies have not been established successfully. This reflects the share of chemical recycling of only 1% in the total recycling of plastic waste as a reducing agent.

The project *"Evaluation of thermo-chemical depolymerisation technologies for the recovery of plastic waste"*, currently funded by the *Deutsche Bundesstiftung Umwelt (DBU)*, has the aim to clarify whether and under which conditions a true circular economy for polyolefin plastics is possible. A current overview of the state of development of depolymerisation technologies in plastic recycling and the state of scientific evaluation is given.

Up to now, two routes seem to be promising. The first route is to produce oils by thermal decomposition (e.g. pyrolysis, stirred tank reactor) which can be converted into monomers in a steam cracker again. The second route is to produce olefins (propene and butenes) and aromatics as main products directly by catalytic cracking. Both technologies were tested in a laboratory scale, product yields were determined and compared. The depolymerisation techniques have their advantages and disadvantages, especially regarding the site and the integration. Unfortunately, the crucial question is the quality of the polymer feedstock, its influence on the downstream and the measures for product refining, respectively. The main contraries are chlorine, acids, nitrogen components and solids coming from impurities (bad sorting, fillers, additives, lacquers, compound materials and bake-on). To apply chemical recycling, it seems unavoidable to find suitable solutions to provide sufficient amount of plastic waste with a defined quality to keep the investment and process costs acceptable.

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