HIGH TEMPERATURE FLUIDISED BED PYROLYSIS OF DIFFERENT POLYETHYLENE STRUCTURES TO INVESTIGATE THE GAS PHASE COMPOSITION

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The steady growth in global plastic production is accompanied by a vast increase in plastic waste streams, with polyolefins being the largest fraction. The complex sorting and cleaning of the similar but yet different polyolefin (PO) types and grades makes them the least recycled plastic in percentage of the waste stream. This fact poses a challenge to the environment and with that to the global society. High temperature pyrolysis of polyolefins offers the opportunity to generate high yield of gaseous products especially comprising the relevant monomers ethylene and propylene, strongly reducing the prior product complexity. The PO's high temperature pyrolysis offers the opportunity that at least parts of the petrochemical value chain will be retained in one process, which appears advantageous over lower temperature processes: these processes tend to produce a complex mixture of long chain hydrocarbons. Insights into the high temperature process are a prerequisite for estimating the effectiveness of the approach in terms of the valorization of polyethylenes in the context of a circular use of the carbon feed stock.

Polyethylenes with various molecular structures were thus pyrolyzed at a temperature of 750 °C in a newly designed fluidized bed reactor. The resulting solid, liquid and gaseous products were balanced in mass and individual components were identified by chromatographic analyses. The gas phase is the largest product fraction of more than 70 wt% of all studied polyethylenes. Ethylene is the main product, accounting for 31 % of the products by weight. Propylene and butadiene are other high value hydrocarbons making up to 14 % and 5 % by weight, respectively. A general mapping of the product distribution of the gas phase in dependence on the polyethylene structure was obtained for high temperature pyrolysis. It allowed to assess the opportunities of using combined polyethylene waste streams of various molecular constitution for creating a steam-cracker like product composition.