Chemical Recycling of Plastic Waste - Opportunity for a Better Circular Economy

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Abstract

A circular economy that is as efficient and complete as possible is a declared goal for all raw materials. But in the case of plastic waste, in Germany only about 12 percent of plastic waste is reused as plastic material again. The majority of plastic waste is used thermally. The aim of a study funded by the DBU [1] was to clarify under which conditions the depolymerization of polyolefins as a part of chemical recycling technologies can contribute to the closure of material loop. For this purpose it was examined what quantities and what qualities of polyolefin waste are available for depolymerization, so that, in accordance with the waste hierarchy, there is no competition for material recycling. It was considered how pyrolysis products are to be assessed with regard to their marketability as a chemical feedstock, how depolymerization technologies can be assessed and what opportunities and risks exist. Important was to clarify which framework conditions and measures would be necessary for changes in recovery cascades and cycle paths in plastics recycling with regard to depolymerization. In order to validate certain statements, laboratory tests and tests on pilot plants were carried out. Catalysts were tested for oiling and pyrolysis. As a feedstock pure PE-HD with different impurities such as polyamide, polyester and PVC and real plastic waste fractions were used.

As a result, it could be determined that depolymerization technologies can contribute as a useful addition to plastic recycling because they enable the material reuse of contaminated plastic waste as new plastic. They are therefore not a competition to material recycling, but a supplement. Only through chemical recycling contaminated plastics be converted in virgin plastic again, which exhibits the same quality like fossil-based plastic. Using depolymerization technologies it possible to increase the amount of material recycling. Nevertheless, the success and the efficiency of the depolymerization technologies also depend on the quality of the input materials, similar to material recycling. Certain contaminants such as PVC, PA and PET should be minimized or avoided entirely in the input material, so that subsequent processing steps are less complex. The entire plastic cycle must therefore be designed with regard to plastic design, collection and sorting in such a way that the purest possible plastic fractions are accessible for material but also for chemical recycling such as depolymerization. If more mass can be kept in the material cycle in this way, the costs for the overall system can also be reduced and more climate-friendly products can be manufactured.

[1] M. Seitz, V. Cepus, M. Klätte, D. Thamm, M. Pohl, Evaluierung unter Realbedingungen von thermisch-chemischen Depolymerisationstechnologien (Zersetzungsverfahren) zur Verwertung von Kunststoffabfällen, Steinbeis-Edition, Stuttgart, 2020.