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HydroCycling – Chemical recycling of plastic waste into petrochemical base and raw materials

Resource-efficient Circular Economy – Plastic Recycling Technologies (KuRT)

The "HydroCycling" project team is developing an integrated, petrochemical value-added cycle for various mixed plastic wastestreams. Catalytic treatment of waste plastics with hydrogen produces petrochemical raw materials and basic chemicals. "HydroCycling" thus complements current technical solutions such as pyrolysis or gasification processes.

The project is being funded as part of the funding initiative "Resource-efficient Circular Economy – Plastic Recycling Technologies (KuRT)". "KuRT" is part of the BMBF research concept "Resource-efficient Circular Economy" and is aimed at high-quality recycling of plastics.

Raw material utilization of plastic waste

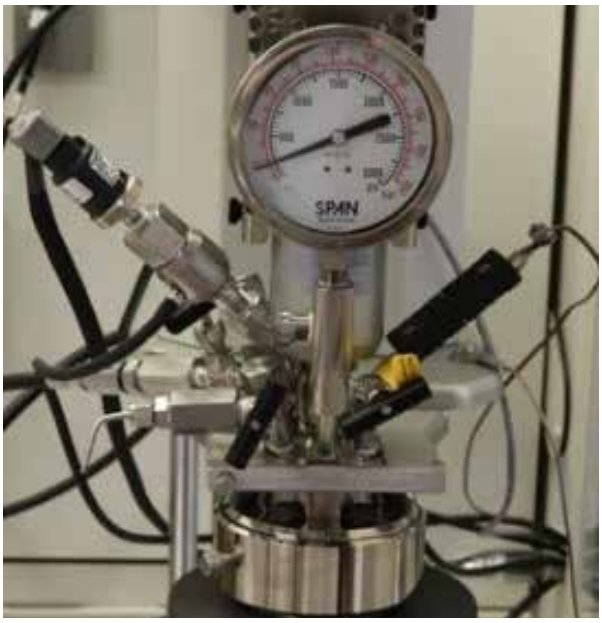
In the mechanical recycling of plastics materials, polymer damage, the combination of several polymers into "blends" and composite materials such as multi-layer films, or non-polymer substances including fillers, dyes, plasticizers and product adhesives limit the number of recycling cycles.

An innovative addition is, thus, feedstock or chemical recycling – the chemical decomposition into small molecules and their subsequent conversion into new polymer products. Chemically recycled used plastics can be utilized as raw materials to produce new plastic articles. The combination and complementarity of raw material and mechanical processes can significantly increase the quantity of recycled used plastics and the quality of the recyclates.

Chemical recycling processes can be applied to e. g. by-products of scrap metal recycling, so-called shredder light fractions. Waste plastics from the construction sector, e.g. bromine-containing expanded polystyrene, or fractions from the recovery of waste electrical and electronic equipment may also be chemically recycled. For these and other fractions, the "HydroCycling" project is developing concepts for their mechanical processing and subsequent catalytic conversion into petrochemical raw materials and basic chemicals.

HydroCycling – from laboratory to demonstrator

The industry currently favors two chemical recycling routes: One is via the pyrolysis of used plastics and the use of the pyrolysis oils as petrochemical raw materials. The second route is gasification and the production of petrochemical polymer building blocks from synthesis gas. "HydroCycling" also attempts to largely preserve the molecular structures of used plastics and use hydrogenation to obtain petrochemical raw materials and basic chemicals.



Lab autoclave for hydrogenation tests on plastic waste and model mixtures.

Catalytic hydrogenation of polymers has been scientifically described many times. Depending on the catalysts used and the operating conditions, different polymers have been converted in pure form or in mixtures, e. g. with refinery streams. In "HydroCycling", the influence of the composition of available, real plastic waste on hydrogenation will also be investigated. Pre-processing steps will be developed experimentally. The aim is to

remove interfering foreign substances from the plastic waste to obtain usable input materials for the "HydroCycling" process. These will be converted into hydrocarbon mixtures by catalytic hydrogenation on a laboratory scale. Product work-up and utilization will be simulated in combination with a commercial "HydroCycling" plant at a refinery or petrochemical site. An important objective is to develop a concept for a demonstrator in a follow-up project. The process developed in individual steps at laboratory scale could be combined, its operation could be demonstrated and first product samples be produced.

Realization and holistic assessment

In addition to this work, a comprehensive assessment of the "HydroCycling" concept from a techno-economic, ecological, regulatory, and patent law perspective is being carried out as part of the project. This is a prerequisite for industrial implementation of the new process.

"HydroCycling" starting material.

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HydroCycling – Chemical recycling of plastic waste into petrochemical raw materials and base chemicals

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