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pool-in-loop – depolymerisation process for polyolefin-containing plastic waste

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

The joint project "pool-in-loop" is working on the development of a sustainable chemical recycling process for a future-oriented carbon cycle economy. Specially formulated catalysts convert plastic waste, which has previously been thermally utilized, directly into short-chain olefins. This process can be used to produce the basic chemicals for new plastics without the need for complex intermediate steps.

The project is 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.

The innovation approach

The nine partners of "pool-in-loop" have joined forces to chemically recycle polyolefin plastic waste, which is currently being thermally recycled. The target products are monomers. These can be reused for the production of plastics immediately after the plastic waste has been converted, without the need for complex intermediate steps.

This recycling process is an innovation for waste management and plastics production. On the one hand, low-grade residual material fractions can be recycled as raw materials. On the other hand, low-carbon recycled base chemicals can be provided for plastics production. During the project, the technology maturity level will be increased from the current four - laboratory scale - to seven - operational prototype. The "pool-in-loop" research team will accompany this development by continuously analyzing possible development paths. The analyses also consider the economic and environmental conditions.

The degree of innovation

In order to develop this sustainable process, the researchers are developing a product-specific adaptation and a special formulation of these catalysts. Their use produces gases of varying composition, with short-chain olefins such as ethene, propene and butenes as the main components. These in turn can be easily purified from interfering heteroatoms such as chlorine, nitrogen, sulphur and oxygen components using suitable processes. The usual purification of the pyrolysis products by hydrogenation and the associated loss of the olefins, as well as cracking in a steam cracker furnace, can thus be dispensed with.

The "pool-in-loop" test facility: a rotary kiln reactor.

The "pool-in-loop" researchers are using laboratory-scale tests to calculate the yield of valuable products from this process. They estimate that a significant increase in yield of 46 percent is possible. Greenhouse gas emissions could also be reduced by 44 percent.
A further reduction in greenhouse gas emissions can be achieved by so-called load-flexible operation. Depending on the supply of renewable energy, the "pool-in-loop" test facility: a rotary kiln reactor. Depending on the amount of energy available from renewable sources, the corresponding sorting fractions can be converted into products with different compositions by adjusting the operating mode.

Social added value

Catalytic cracking has the potential to become established as a sustainable and energy-efficient method of chemical recycling for polyolefin-rich plastic fractions. It targets residual material (post-consumer) fractions that previously had to be thermally utilized and provides feedstock materials for the chemical and plastics industries.

The process promoted by "pool-in-loop" thus complements mechanical recycling and enables material cycles to be closed efficiently. By recycling plastic waste that was previously only thermally utilized, previously lost material flows are included in the plastics cycle. The priority objectives of the "KuRT" funding measure – improved recycling of plastics and the associated increase in economic efficiency – are thus directly addressed and pursued with this project. The planned collaborative project aims to transfer the innovative catalytic cracking technology to an industrial scale, involving partners along the entire value chain.

Agglomerated film residues are used in laboratory operations.

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

Project title
pool-in-loop: Development of an energy-efficient depolymerisation process for polyolefin-containing plastic waste using catalysts for the direct production of polymers for new plastics.

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