Catalytic Low-temp Efficiency for Advanced decontaminatioN

Publieke samenvatting / Public summary

Aanleiding

The environmental impact of chemical recycling of plastics can be minimized by maximizing the process's energy efficiency and enhancing the output's selectivity and product quality. The widely used pyrolysis processes - currently explored for plastics recycling - operate at temperatures up to 800°C in an oxygen-free environment. They result in a mixture of oils, gases and char. Thermal pyrolysis process suffers from a lack of selectivity for the desired products, low energy efficiency and prolonged reaction times. In contrast, catalytic pyrolysis of plastic waste could improve conventional pyrolysis processes by enhancing process and energy efficiency as well as product quality. It also contributes to reducing the adverse environmental impacts of pyrolysis processes by reducing their CO2 footprint. However, catalytic pyrolysis comes with added complexity and related cost, which stems from the need to design and develop cost-efficient, highly active, selective, and stable catalysts. This necessitates research to advance the catalytic pyrolysis of plastics and to bring them forward for potential industrial applications.

Doelstelling

This aim of the CLEAN project is to design, develop and test novel low-temperature catalysts and related adsorption and conversion processes for plastic waste conversion, with a specific focus on polyolefin films to be further used for chemicals production via thermal pyrolysis. This is done by

Projectinformatie / Project information

Projectnummer / Project number
CPNL251010
Subsidiebedrag / Grant amount
€ 1.500.000,00

Algemene informatie / General information

Penvoerder / Secretariat
Universiteit Utrecht

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spanning the entire value chain from plastic waste collection and sorting, the subsequent making of pyrolysis oil up to the use of this pyrolysis oil to produce chemicals. To realize this value chain, CLEAN brings together the expertise of (a) polyolefins films separation, sorting and densification (Renewi), (b) plastic waste thermal pyrolysis technology (BlueAlp), (c) pyrolysis oil conversion into chemicals (Shell) Pagina 3 van 27 and (d) materials development for adsorption and catalysis (Utrecht University). Special emphasis will be on energy optimization and specification integration as each of these steps are interlinked. As a result, CLEAN will create the optimal plastic waste-to-end product chain to make the envisaged plastic oil process not only technically feasible and scalable, but also economically viable and more sustainable.

Korte omschrijving

Within CLEAN, Utrecht University will work on the development and testing of adsorbents and catalysts, capable of dewatering and decontaminating real-life plastic waste, as sorted with state-of-the-art collecting/sorting technologies by Renewi. These adsorbents and catalysts as well as the related processes have to be scalable and their output should meet the industrial process requirements for thermal pyrolysis, which will be done in close cooperation with BlueAlp. Finally, the newly obtained pyrolysis oil should meet the specifications, as desired by the downstream end users. This activity will be done together with Shell. To successfully reach these targets, a PhD student and technician, employed at Utrecht University, focus on novel adsorbent and catalyst formulations, and their individual components will be tested in their powdered form on model plastic compounds, and the outcomes will be compared with the current thermal pyrolysis oil properties. Based on these findings, a postdoctoral researcher will be working at Renewi, BlueAlp and Shell thereby focusing on real-life plastic waste conversion in the form of shaped bodies, which are industrially scalable and implementable.

Resultaat

CLEAN has two outcomes: (a) Active and durable adsorbents and catalysts for the dewatering, decontamination and partial depolymerization of polyolefins film waste. The materials development will bring new insights into the breakdown mechanism of polyolefins and the phenomena that alter the process selectivity and stability thereby focusing on various inorganic and organic contaminants. (b) A highly integrated plastic waste-pyrolysis oil-chemicals production process with optimized energy consumption and an integration of the specifications of plastic waste and pyrolysis oil to ensure the best quality and yield for the chemicals produced from polyolefins films waste. The materials, reactor and processes developed will – where possible and needed – be protected via intellectual property rights. Furthermore, the obtained scientific insights, after filing patent applications, will be published in peer-reviewed journals as well as presented at major conferences and social media to disseminate the findings to ensure maximizing the project impact. The patent applications will form the basis for potential implementation by Renewi, BlueAlp and Shell in follow-up projects based on CLEAN.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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