

Closing Carbon Cycles with Renewable Amines (3CRA)

Publieke samenvatting / Public summary

Aanleiding

The production of sustainable and circular bulk and platform chemicals has in recent years mainly focused on oxygen containing renewable carbon. Examples from the Netherlands are the synthesis of HMF/FDCA from lignocellulose (Avantium) and lactic acid/PLA (Corbion) by fermentation of carbohydrates. The sustainable synthesis of so-called nitrogen-containing platform chemicals such as amines, on the other hand, is still in its infancy. Amines are important building blocks for the chemical industry and are used, for example, for the synthesis of polyamides (PA, market \$30-35 billion) and polyurethanes (PU, market \$70-75 billion). The vast majority of industrially available amines are of fossil origin and the use of circular/biobased sources for their production such as plastic recyclate and biomass would not only be a sustainable alternative but also diminish the dependency on petrochemicals.

Doelstelling

In this proposal, a consortium of knowledge institutes (wo, hbo) and industry aims to carry out the synthesis of platform amines from biomass and end-of-life plastics. Furthermore, it will investigate the chemical re/upcycling of polyamides and polyurethanes by means of an ammonolysis, a depolymerisation reaction using ammonia (NH₃). The products obtained are then purified from impurities and by-products, and in the case of polyurethanes, the amines obtained are used for repolymerization. In the depolymerisation of

Projectinformatie / Project information

Projectnummer / Project number
MOOI422007

Subsidiebedrag / Grant amount
€ 3.193.418,00

Algemene informatie / General information

Penvoerder / Secretariat
Stichting Hanzehogeschool Groningen

Publicaties en materialen / Publications and attachments

- 08.05.2024

MOOI422007
Voortgangsrapportage 1

- 10.06.2025

MOOI422007
Voortgangsrapportage 2

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polyamides the amides are first hydrolysed towards the corresponding carboxylic acids and used in the repolymerisation towards polyamides. The above cycles are particularly suitable for end-of-life plastic streams from sorting installations that are not suitable for mechanical/chemical recycling. Any loss of material is compensated for by synthesis of amines from (mixtures of) end-of-life plastics and biomass (organic waste streams). The ammonia required for depolymerisation can be synthesised from green hydrogen (Haber-Bosch process).

Korte omschrijving

- Synthesis of (di)amines from biomass (including aniline, aromatic and aliphatic diamines) - Synthesis of (di)amines from end-of-life plastics (from PP/PE & polyesters) - Polymerisation of renewable diamines towards polyamides and polyurethanes - Molecular recycling (including Twaron, nylon, MDI based foams and elastane)) - Evaluation (LCA/TEA) and process design - Development of new circular business models - Installation of Innovation communities (fasten acceptance)

Resultaat

Closing carbon cycles (high carbon efficiency) and supplementing the amines needed for the chain from biomass and end-of-life plastics results in a significant CO₂ saving, a reduction in material input and waste. Our project focuses on a number of specific industrially relevant cases/chains and should/will result in economically, ecologically (including safety) and socially acceptable routes for recycling polyamides and polyurethanes. Commercialisation of the results obtained are foreseen by the companies involved. Furthermore, as our project will result in a wide variety of new and drop-in (di)amines from sustainable sources, it will increase the attractiveness to use these sustainable monomers for currently prepared and new polyamides and polyurethanes. Also other market applications (pharma, fine chemicals, coatings, electronics, etc.) are foreseen for the sustainable amines synthesized within our proposition.

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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